A RANDOMISED FIELD EXPERIMENT TO EVALUATE THE IMPACT OF A BEHAVIOURAL INTERVENTION ON THE WATER STORAGE PRACTICES OF HOUSEHOLDS IN GRABOUW, WESTERN CAPE

Report
to the Water Research Commission

by

Marisa von Fintel[1], Wesaal Khan[2,3], Tinta Morris[2], Caroline Poole[1], Martine Visser[4], Ronelle Burger[1]

[1] Department of Economics, Stellenbosch University
[2] Department of Microbiology, Stellenbosch University
[3] Stellenbosch University Water Institute
[4] School of Economics, University of Cape Town

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EXECUTIVE SUMMARY

BACKGROUND

Despite substantial progress in expanding access to improved water sources in South Africa, many households in informal settlements continue to face unreliable water supply and depend on storing water for domestic use. In these settings, unsafe water storage and inadequate hygiene practices remain important contributors to waterborne disease, particularly diarrhoeal illness. While infrastructure investments are essential, there is growing interest in whether low-cost behavioural interventions can complement supply-side improvements and reduce health risks where infrastructure constraints persist.

This project responds to these challenges by evaluating a locally co-designed behavioural intervention aimed at improving household hygiene and water storage practices in two informal settlements – Siyanyanzela and Khotsong – located near Grabouw in the Western Cape.

AIMS

The aims of the project were to:

1. Co-design a behavioural intervention with members of the participating communities.
2. Implement the intervention using a randomised roll-out.
3. Measure the impact of the intervention on the microbiological quality of stored drinking water.
4. Assess changes in household knowledge and behaviour related to safe water storage and hygiene.
5. Measure the impact of the intervention on self-reported diarrhoeal outcomes.
6. Examine spill-over effects on neighbouring households.
7. Conduct an indicative assessment of the cost-effectiveness of the intervention.

METHODOLOGY

The study was implemented as a household-level randomised controlled trial. Baseline data were collected from 627 households in April–May 2024 and included a household survey and microbiological testing of stored drinking water. The intervention – a short informational video accompanied by a visual reminder – was developed in collaboration with community members and delivered through in-home visits to households randomly assigned to the treatment group in October 2025. Endline data collection took place in November 2025 and repeated the household survey and water testing.

RESULTS AND DISCUSSION

The intervention did not lead to measurable improvements in the microbiological quality of stored drinking water. The intervention was, however, associated with significant improvements in hygiene-related behaviours, including increased soap availability and the presence of dedicated handwashing spaces. Importantly, households exposed to the intervention reported substantially lower diarrhoeal incidence compared to households in the control group. This suggests that hygiene-focused behavioural changes can interrupt faecal-oral transmission pathways even in the absence of improvements in water quality.

Spill-over effects were observed among some control households who were inadvertently exposed to the intervention, although these effects were limited and context-dependent and are interpreted descriptively rather than causally.

CONCLUSIONS

The findings indicate that while behavioural interventions alone are unlikely to improve household water quality without accompanying infrastructure improvements, they can play a meaningful role in improving hygiene

practices and reducing diarrhoeal disease. The results highlight the importance of multi-barrier approaches to waterborne disease prevention, in which behavioural interventions complement supply-side investments.

RECOMMENDATIONS

- Behavioural interventions should be implemented alongside improvements in water infrastructure, where the objective is to improve stored water quality.
- Low-cost, targeted hygiene messaging should be integrated into municipal and public health communication strategies, particularly in informal settlements.
- Hygiene-focused behavioural interventions should be considered a viable short- to medium-term strategy for reducing diarrhoeal disease in infrastructure-constrained settings.
- Indicative cost assessments suggest that low-cost behavioural interventions can be feasibly scaled, particularly where digital delivery mechanisms and existing community health systems can be leveraged.

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Reference Group	**Affiliation**
Dr Eunice Ubomba-Jaswa	Water Research Commission (Research Manager)
Ms Penny Jaca	Water Research Commission (Project Administrator)
Prof Alf Botha	Stellenbosch University
Dr Ilse Elgelaar-Meets	Stellenbosch University
Dr Solomon Taonameso	University of Venda
Dr Wilma ten Ham-Baloyi	Nelson Mandela University
Dr Amber Abrams	University of Cape Town
Mr Cornelis van der Waal	Grabouw Development Agency
Ms Vuyiseka Twala	Theewaterskloof Municipality
Mr Landile Litholi	Theewaterskloof Municipality
Mr Buyelwa Mbalo-Tshungwana	Theewaterskloof Municipality
Ms Joanna Marzec-Visagie	Theewaterskloof Municipality

Fieldworkers		
Okuhle Zongo	Tembi Muakalisa	Zwelenkosi Siziba
Nobubele Qetsu	Samantha Basson	Nolwazi Zuma
Ilse Sam	Lincoln Mohambi	Namhla Nompehle
Rethabile Ramotsamai	Sue Nique Louw	Sinovuyo Phoswayo
Mamello Tsele	Andiswa Mhlongo	Liyema Mhlongo
Siziphiwe Nyathela	Masonele Zweni	

CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION AND MOTIVATION

This is the final report describing the motivation, design, implementation and impact of the randomised roll-out of a behavioural intervention in two informal communities in South Africa. The report evaluates the impact of this intervention on the quality of stored water, self-reported gastrointestinal health, as well as households' knowledge and water storage behaviour. The study contributes to the literature on safe domestic water storage in South Africa, and more broadly to the goal of ensuring universal access to safe water and sanitation as set out in the Constitution of the Republic of South Africa, as well as the United Nations' Sustainable Development Goals (SDGs). Despite access to clean water being recognised as a basic human right, South Africa is unlikely to reach the goal of providing universal access to all by 2030, as envisioned by the SDGs. Although substantial progress has been made in expanding access to improved water sources, large inequalities in access still exist between poor and wealthy households, and between households residing in urban areas and those in rural areas.

The most recent General Household Survey (GHS) of South Africa, conducted in 2024, indicates that approximately 77% of households have access to a tap on site, whereas approximately 88% of households have access to improved water sources (including municipal public taps) (StatsSA, 2024). However, a large proportion of households report interruptions in the supply of municipal water that lasted at least two days. In such instances, approximately 45% of households report reliance on stored water (StatsSA, 2024). As a result, access to safe drinking water remains a concern, even among households that have nominal access to improved water sources. Recent reports on the progress of granting access to safely managed water have consequently highlighted countries in Sub-Saharan Africa, including South Africa, as being unlikely to meet the 2030 goal for universal access to safely managed water (UNICEF and WHO, 2022). Across the continent, only approximately 39% of the population uses safely managed water. In order to reach the SDG by 2030, many African countries would require a 12-fold increase in the speed at which access to safely managed water is currently being granted (UNICEF and WHO, 2022).

This issue is especially pertinent given the well-established link between access to water, sanitation, and hygiene services (WASH) on the curtailment of gastrointestinal diseases (Curtis and Cairncross, 2003; Wolf et al., 2022). Given this background, the current study examines household-level water treatment and safe storage (HWTS), specifically among South African households with unreliable access to improved water sources.

Through the implementation of a randomised field experiment, we evaluate whether a behavioural intervention can induce changes in how low-income householders store water intended for drinking, and whether these behavioural changes have a significant impact on the quality of the stored water and the prevalence of waterborne disease among household members. The behavioural intervention took the form of an informational video. The video was developed collaboratively between the research team and community members, and filmed on site with a local nurse, the ward councillor of the study community and community members who appeared in the video and delivered the information. The explicit aim of the project was to develop the intervention as a light-touch demand-side behavioural nudge that can be scaled nationally. The intervention is not framed as a stand-alone solution but rather as an approach that amplifies the effectiveness and health impacts of existing supply-side interventions, such as communal taps in informal settlements and in-house taps inside subsidised (RDP) housing.

Since 1994, the South African government has allocated significant public resources to improve water, sanitation and housing for low-income families in South Africa. Through one of the largest subsidised housing projects in the world, over 4.4 million South Africans have gained access to in-house, or at least in-the-yard water supply and sanitation services (DHS, 2016). Despite these substantial investments, quality challenges and cumulative service backlogs persist, particularly in informal settlements and rural areas. While improved access to clean water and adequate sanitation has reduced the share of deaths of children under five attributable to diarrhoeal disease, it still accounts for 16% of all deaths of under-fives in South Africa and thus remains a cause for concern (Hendricks et al., 2022). Emerging research on Environmental Enteric Dysfunction (EED) further suggests that chronic exposure to unsafe water and poor sanitation may contribute to the persistently high rates of stunting in the country, where one in five children are stunted, a rate far higher than in countries of comparable socio-economic status (Budge et al., 2019; NDoH, 2019). The long-term impacts of stunting include impaired cognitive development that affects labour market prospects and earnings (Almond et al., 2018; McGovern et al., 2017; NDoH, 2019). Inadequate access to clean and safe water may play a significant role in intergenerational poverty traps.

This study was implemented in the form of a randomised field experiment in the Siyanyanzela and Khotsong communities located near Grabouw in the Western Cape Province. These are low-income communities consisting primarily of informal housing structures constructed from corrugated iron or wood, and are characterised by high levels of economic vulnerability. Given the geographically narrow focus, the study is best viewed as a scoping exercise that provides proof of concept for further analysis and potentially scaling up the intervention. To inform any discussions around the scaling up of the intervention, this report not only presents evidence of the impact of the behavioural intervention but also includes an assessment of spill-over effects and a consideration of the cost-effectiveness of the intervention.

The rationale for this study is as follows. First, within the South African context, fiscal and geographic constraints imply that universal provision of tap water in each dwelling is unlikely to be achieved in the near future. As a result, many households, especially those residing in informal settlements, will continue to rely on communal water infrastructure and stored water as the primary source of water for drinking purposes. Second, there is an established literature linking HWTS practices with the contamination of stored water and gastrointestinal illnesses. Third, international evidence suggests that behavioural nudges aimed at improving the HWTS practices of households are effective. Each of these strands of evidence is discussed in greater detail in the literature review appearing later in the report.

Previous work commissioned by the Water Research Commission (WRC) has highlighted the need for targeted education and awareness campaigns aimed at improving health and hygiene behaviour in informal settlements (Naidoo and Chidley, 2008). These studies emphasised that information-based interventions can be as important as infrastructure provision in improving health outcomes, particularly when such interventions are co-designed with communities, sustained over time and rigorously evaluated. Lessons from earlier WRC-funded projects, which found once-off education campaigns to be largely ineffective in changing behaviour in the long term, directly informed the conceptualisation and design of the intervention evaluated in this study (Naidoo and Chidley, 2008; van Wyk, 2006; Nala et al., 2003; Burt and Berold, 2012).

1.2 PROJECT AIMS

In the table below, we set out the project aims as well as an indication of where in this report each of the aims are discussed:

Table 1: Project aims

Aim number	Description of aim	Section in final report where project aim is discussed
1	Co-designing the intervention with members of the participating communities through focus groups	5
2	Enrolling potential participants into the study and setting up and implementing the intervention	5
3	Measuring the impact of the intervention on water quality using microbiological analysis	5 and 6
4	Measuring the impact of the intervention on households' knowledge regarding safe water storage	6
5	Measuring the impact of the intervention on the self-reported diarrhoea of households residing in the study sites	6
6	Measuring the spill-over effects of the interventions mentioned in aim 1 above on neighbouring households	7
7	Conducting an analysis of the cost-effectiveness of the proposed interventions for scaling	7

1.3 SCOPE AND LIMITATIONS

The study took the form of a baseline and an endline survey, conducted before and after the implementation of the behavioural intervention. In both instances, data were collected from households using a household survey, as well as microbiological water tests conducted on water samples collected from households' stored drinking water. The analysis therefore focuses on short- to medium-term changes in household behaviour, water quality, and self-reported health outcomes, rather than longer-term health or developmental impacts.

Since the study was only implemented in two informal settlements in the Western Cape Province, the findings should therefore be interpreted within the specific geographic and socio-economic context. It should be highlighted that the randomised design allows for the credible estimation of the causal impact of the intervention on households' behaviour, water quality, and health; the limited geographic scope implies that the results should be viewed as providing proof of concept rather than providing results that may be generalised to the national level. The intervention was intentionally designed as a low-cost and scalable behavioural intervention, and the analysis includes an indicative assessment of cost-effectiveness and spill-over effects, rather than a full health-economic evaluation.

The timeline for the study is set out below. The remainder of the report is structured as follows. Chapter 2 provides a brief discussion of the relevant literature. Chapter 3 presents an overview of the study context and baseline characteristics of the two communities in which the study was undertaken. Chapter 4 discusses findings from modelling the baseline relationship between household behaviour, water quality, and health outcomes. Chapter 5 describes the development, design, and implementation of the behavioural intervention. Chapter 6 presents the results from the endline survey evaluating the impact of the intervention. Chapter 7 discusses spill-over effects and provides an indicative assessment of cost-effectiveness. Chapter 8 discusses the policy implications of the findings, and Chapter 9 concludes.

The timeline of the project is set out below. Initial community engagement, in the form of focus group discussions, took place in October 2023, during which households in the study communities were asked about their water use behaviours and their knowledge of safe water storage. Baseline fieldwork and microbiological water testing were conducted in April and May 2024. In August and September 2024, the research team conducted additional microbiological analyses on a sub-sample of households' stored water.

The video intervention was developed, filmed, and produced between March and September 2025, and the endline survey and microbiological water tests were conducted in November 2025. Although the endline fieldwork was not conducted in the same months as the baseline fieldwork (as originally planned, i.e. April 2025), the study team considered historical data on average temperature and precipitation in Grabouw during March/April and October/November over the past ten years. The differences in these averages across the two periods are small and statistically insignificant. It is therefore unlikely that the change in timing materially affected the study outcomes.

Feedback to Theewaterskloof Municipality was provided in the first week of December 2025 at a workshop hosted by the municipality in Grabouw. It should be noted that not all components of the project are reported on in detail in this final report, as findings from several activities were documented in earlier deliverables submitted to the WRC. Instead, the focus of this report is to provide a narrative overview of the main components of the project as they relate to the video intervention's motivation, development, roll-out and evaluation.

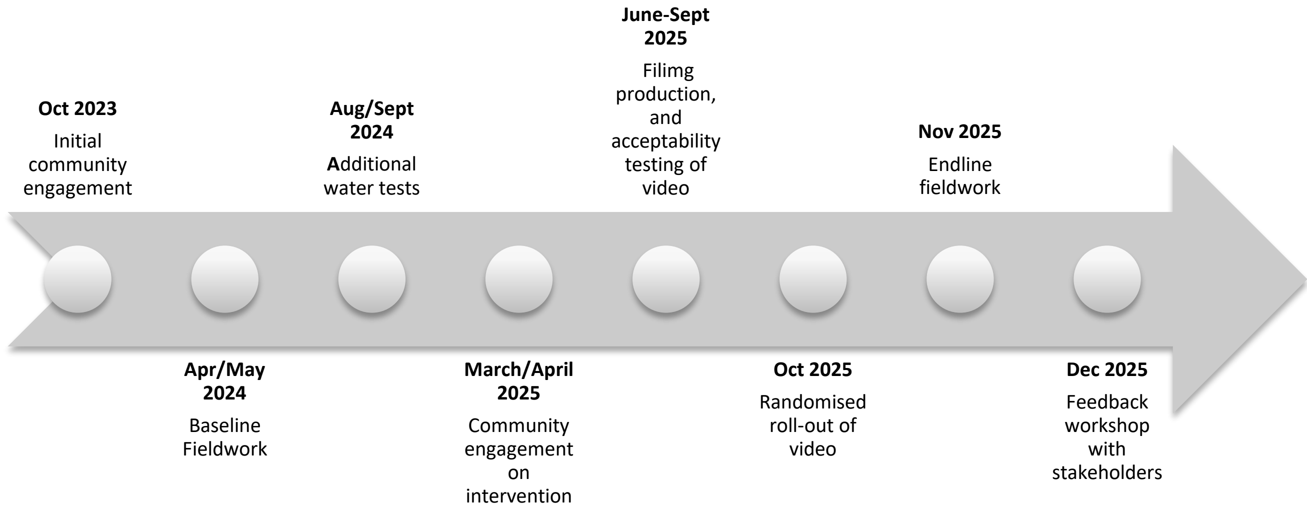

Figure 1: Timeline of project activities

CHAPTER 2: OVERVIEW OF THE LITERATURE

2.1 INTRODUCTION

This chapter provides an overview of the most relevant literature that informed the development and roll-out of the behavioural intervention. First, it considers the literature discussing the link between human behaviour and stored water contamination. Second, it provides an overview of the literature linking household behaviour and characteristics to diarrhoea. Finally, it considers the literature on the effectiveness of behavioural interventions in changing health-related household behaviours.

2.2 THE RELATIONSHIP BETWEEN HOUSEHOLD BEHAVIOUR AND STORED DRINKING WATER CONTAMINATION

Evidence from the literature indicates that, in instances where households store drinking water, water quality is often lower at the point of use compared to where it was drawn (Wright et al., 2004; WHO, 1997). This indicates contamination during storage and at the point of use, which potentially erodes health gains associated with improvements in water quality at source (Rufener et al., 2010). As such, the provision of clean water at source is necessary but insufficient to guarantee the consumption of water that is free from disease-causing pathogens (McGuinness et al., 2021). The WHO (1997) attributes much of the recontamination of clean water to user behavioural patterns, and identifies changes in these behaviours as the means to eliminate the associated health risks. The factors that determine point-of-use contamination, notably the human behaviours and practices related to water storage and retrieval, are the focus of the first part of this literature review.

Water handling practices describe how people store water in their homes once they have acquired it (from whatever source). These practices include whether different containers are used to collect water from source areas and those used to store water in the home, retention times, the (constrained) choices about which type(s) of container to store water in, the manner in which water handlers retrieve water from their containers, how containers are cleaned, and whether water is treated at the point of use.

(Choice of) water storage containers

The containers used to collect water from external supply sources to the home and those used to store water after collection and before use affect the microbial quality of the water (Manga et al., 2021; Jensen et al., 2002). Although many transmission mechanisms operate through user behaviours (such as container cleansing and placement practices as well as water retrieval practices, each discussed in subsections that follow) the container itself, comprising various attributes (the material, the shape and the lid) has an effect on stored water quality regardless of water-related behaviours and practices (Manga et al., 2021).

Differences in water quality associated with container materials may result from differences in thermal conductivity – with some materials such as clay creating a cooling effect and others, such as steel and dark coloured plastics, absorbing more heat (Schafer and Mihelcic, 2012). Similarly, different materials' propensities for accumulating biofilm (which contain a concentration of bacteria) on the inner sides of the container may account for stored water quality differences. Al-Ghanim et al. (2014) found that plastic tanks have elevated rates of biofilm accumulation. Manga et al. (2021) note in their systematic literature review that further investigations are required due to inconsistent and often conflicting findings in the literature.

In a laboratory study comparing microbial contamination in clay, plastic, glass, stainless steel and ceramic water storage containers, Obianyo (2020) found no differences in faecal coliform content after 28 days. All vessels showed zero counts, a result consistent with the limited survival of coliforms outside the host gastrointestinal tract. However, substantial variation was observed in the rate of decline of coliform counts across materials during earlier measurement intervals, with clay pots retaining the highest counts after seven days (10.67 coliforms per 100 ml; SD = 1.53), more than double those recorded in plastic containers (4.33 coliforms per 100 ml; SD = 1.15).

Evidence from real-world settings rarely contains longitudinal insights; however, they benefit from better representation of the interaction between technologies and user behaviours. In their systematic review, Manga et al. (2021) note that while plastic containers are more widely used than containers made from other materials, the reasons underlying households' selection of specific container types remain under-researched. Consequently, relatively little is known about the roles of container cost (relative to household income), availability, durability, convenience, or climatic conditions in shaping household choices.

Surface area of the opening, presence or absence of a lid

The size of the opening of the container – and whether the container can be covered – influences stored water recontamination (Mintz et al., 1995; Meiehofer et al., 2019). Jensen et al. (2002) found that reducing the size of the neck from 10.5cm to 5.5cm resulted in reductions in coliform counts. Mellor et al. (2013) similarly found that containers with wide openings recorded higher levels of coliform contamination compared to those with narrow necks. However, Levy et al. (2014) found no significant differences between containers with openings smaller than and larger than 8 cm. Gärtner et al (2021) point out that the inconvenience of cleaning containers with narrow openings, such as jerrycans, can be associated with increased coliform presence as households struggle to clean inside the container.

Mixed evidence is also reported for the effects of container coverings on stored water quality. Although widely accepted as one of the key determinants of 'keeping clean water clean' (Meiehofer et al., 2019; Mintz et al., 1995), Holt (2005) found, in a study with by far the largest sample size (Manga et al., 2021), that the protective effect of lids may be undermined if lids are frequently removed and replaced.

Container cleansing practices

Meierhofer et al. (2019) examined how household recontamination of disinfected water collected from a kiosk in a Kenyan informal settlement was affected by container type, container cleaning practices, point-of-use water purification, and other household hygiene behaviours. Among these factors, only container cleansing practices were found to have a statistically significant effect on stored water quality. This effect varied with container material, though not at conventional levels of significance, with the typically used jerry cans accumulating coliforms at faster rates than an improved plastics vessel.

Based on these findings, the authors recommend more frequent cleaning of household water storage containers, with mechanical cleaning preferred over the use of chlorine or sand. These latter methods are thought to abrade inner container surfaces over time, increasing the risk of contamination. Meierhofer et al. (2019) note a tension between the recommendation for narrow-necked containers (to prevent hand contamination) and the difficulty such designs pose for mechanical cleaning. They propose modified containers that maintain narrow openings for filling and extraction (preferably via a tap), while including a secondary opening large enough to allow for effective scrubbing.

Water retrieval from the storage container

Modes of water retrieval from stored water containers vary widely but can be categorised as either (i) pouring from the container, (ii) scooping water using an implement such as a cup or ladle, or (iii) dispensing water using the container's tap. Contamination can occur during retrieval if an implement (cup, jug, ladle) that is used to scoop water from the container is contaminated. Equally, contamination of treated water can occur through contact with the water handler's hands if the hands are contaminated and not washed prior to handling.

In a study of 13 villages in Sierra Leone, Clasen and Bastable (2003) collected water samples at both the point of collection and point of use and found that water drawn from safe sources frequently became re-contaminated during household storage. Although no significant associations were found between stored water quality and characteristics such as the age, education, or hygiene awareness of the female household head, or household sanitation conditions, the authors identified strong associations with water retrieval practices. Stored water accessed by scooping contained more than 2.5 times the number of coliforms compared to water accessed by pouring or via a tap.

In a study of 146 households in Vietnam, Anh et al. (2010) similarly identified scooping water with a ladle or cup as the strongest predictor of faecal contamination. VanDerslice and Briscoe (1993) reported faecal coliform concentrations nearly one-third higher in water retrieved by dipping compared to pouring in the Philippines. Rufener et al. (2010) observed that in 35% of households in Bolivia, water that was uncontaminated at the point of collection was re-contaminated by the time it reached drinking cups, although the authors could not distinguish whether contamination originated from hands or drinking vessels.

Handwashing behaviour

Unwashed hands may lead to contamination of clean water during collection or transportation from the point of collection, or when water storage containers are handled and when water is retrieved, particularly if the retrieval involves dipping or scooping (Rufener at al., 2010). Hand contamination, in turn, is determined by the frequency of handwashing, the timing of handwashing in relation to other activities, whether or not soap is used, and the general sanitary conditions of the living environment.

Meierhofer et al. (2019) assessed the effects of various hygiene practices on stored water quality but did not detect statistically significant impacts associated with the cleanliness of handwashing stations, toilet type, or reported handwashing frequency. As in other studies, accurately measuring handwashing behaviour poses significant challenges (Burns et al., 2018), and difficulties in detecting marginal effects may partly reflect measurement error.

Container exposure to children and animals

Granting young children unsupervised access to the water container has been specifically highlighted in the literature as a behaviour that increases the risk of contamination, as children may be less able or willing to comply with strict hygiene practices (Elala et al., 2011). The presence of domestic livestock in close proximity to the dwelling has also been highlighted as a potential source of water contamination (da Silva et al., 2020).

Environment

Storage of water in warm temperatures (which could lead to bacterial regrowth in the container) has also been shown to increase the likelihood of contamination (Jensen et al., 2002).

2.3 THE RELATIONSHIP BETWEEN HOUSEHOLD CHARACTERISTICS AND DIARRHOEA

While the previous section provided a clear case for the link between household behaviour and the quality of stored drinking water, household characteristics (including but not limited to behaviour) can also have a direct impact on the diarrhoeal prevalence in the household.

Stored drinking water quality

The direct link between drinking contaminated water and diarrhoea, especially among children, is well-established in the literature (Mattioli et al., 2014 and Parvin et al., 2021). Many of the pathways through which household behaviours affect stored water quality, discussed above, also have direct implications for diarrhoeal risk. For example, poor handwashing practices may contaminate drinking water and may also directly increase exposure to pathogens through other routes (Mattioli et al., 2014).

Sanitation and handwashing

A large body of evidence links access to improved sanitation (typically defined as pit latrines with slabs or any other facilities that aim to remove faeces from the environment) to reduced prevalence of diarrhoeal diseases, specifically in children under the age of 5 years (Freeman et al., 2017). Improved sanitation facilitates the correct disposal of stools, which is an important component of reducing diarrhoea. The unsafe disposal of stools (measured at both the household and neighbourhood level), specifically of children who are too young to use toilet facilities, increases the risk of diarrhoea (Bawankule et al., 2017). The practice of open defecation is a significant problem in informal settlements in Sub-Saharan Africa, often attributed to a lack of private sanitation facilities and inadequate access to communal toilets (Colombo et al., 2023).

Handwashing practices have a direct impact on the prevalence of diarrhoea, independent of their role in contaminating drinking water. At a minimum, handwashing requires access to sufficient quantities of clean water. Water insecurity, whether due to limited supply or long distances to the nearest clean water source, has been associated with higher diarrhoeal prevalence (Aydamo et al., 2024). While handwashing with water alone can reduce diarrhoeal risk, the use of soap provides additional protective benefits (Noguchi et al., 2021). Additionally, attitudes towards handwashing and knowledge of its benefits further influence behaviour and are associated with lower diarrhoeal prevalence (Aydamo et al., 2024).

Housing type

Housing quality has been shown to influence diarrhoeal risk, particularly among children. Unimproved floors such as dirt or earthen have been associated with higher diarrhoeal prevalence in Zimbabwe (Koyuncu et al., 2020). Evidence regarding the role of wall and roof materials is more mixed (Yaya et al., 2018; Juvakoski et al., 2023). Not having access to electricity at the household level has been shown to be associated with higher levels of household diarrhoea (Yaya et al., 2018).

Waste disposal

A growing body of evidence links improper domestic solid waste management with the increased prevalence of diarrhoea (Juvakoski et al., 2023). The increased risk of having diarrhoea for households with solid waste (garbage) on the premises compared to those who dispose of solid waste off-site has been estimated to be significantly larger than the association between any of the traditional WASH factors (Randremanana et al., 2016).

2.4 BEHAVIOURAL NUDGES WHICH INFLUENCE WATER STORAGE BEHAVIOUR

Research drawing on behavioural economics has shown that information (such as education and awareness campaigns) can be packaged and delivered to recipients in a way that effectively induces behavioural changes (Smith and Visser, 2014). In the South African study by Smith and Visser (2014), it was demonstrated that a behavioural nudge presenting households with information regarding their own water use relative to their neighbours reduces water consumption significantly.

International evidence on the topic corroborates these findings. Although point-of-use water treatment technologies have been shown to improve health outcomes of households and communities, systematic reviews highlight unwillingness to pay (Ahuja et al., 2010) and low take-up (Wolf et al, 2022) of these technologies amongst households. Encouraging households to make use of these technologies is no easy task. Ahuja et al. (2010) identify various behavioural biases hindering households from consistently adopting safe water storage and point-of-use treatment practices. It is here that the knowledge from behavioural economics can have an impact.

Although there is not much evidence of the impact of behavioural nudges on safe water storage practices, there is a body of evidence illustrating that behavioural nudges can be effective in influencing households' behaviour around water consumption (see, for example, Smith and Visser, 2014 in South Africa, Nayar and Kanaka, 2017 in India, and Miranda et al., 2020 in Costa Rica). However, information interventions delivered without complementary psychological interventions are typically not successful in changing behaviour. For example, Davis et al (2011) find no evidence that an information intervention in Tanzania (including a health message with test results from the household's water and hands) leads to changes in actual behaviour (although reported behaviour of treated households does change significantly) Similarly there is evidence that low-cost behavioural nudges in the form of SMSes has limited effects on behaviour in a setting with low mobile phone penetration (Ritter et al., 2020).

The literature also includes examples of the effectiveness of marketing and psychological interventions in influencing HWTS practices. Luoto et al. (2014) provide evidence of the success that marketing nudges can have in encouraging participating households to take up various freely available point-of-use water treatment products. However, a review by Evans et al. (2014) concludes that the evidence on the effectiveness of social marketing campaigns in changing water-related behaviour remains mixed.

More recently, a study by John and Orkin (2021) evaluated the effectiveness of providing light-touch psychological interventions in order to encourage women in Kenya to chlorinate their drinking water. The study found significant impacts. The interventions included sessions with the women to assist them with the visualisation of alternative realisations of the future and planning exercises aimed at strengthening commitment to health-promoting behaviours.

2.5 CONCLUSION

The design, development, and implementation of the behavioural intervention reported in this study were informed by the synthesis of these three strands of literature. The evidence on household behaviours associated with stored water contamination and diarrhoeal risk guided the selection of target behaviours, while the behavioural economics literature informed the choice of a light-touch, co-designed intervention. In the sections that follow, the report outlines the process of developing and implementing the intervention and provides evidence on its effectiveness in influencing household behaviour, water quality and health outcomes.

CHAPTER 3: STUDY CONTEXT AND BASELINE CHARACTERISTICS

3.1 STUDY AREA AND COMMUNITIES

The study population was identified as all households in the communities of Siyanyanzela and Khotsong (sometimes spelled Khutsong), which are the two largest informal settlements in Grabouw, in the Theewaterskloof Municipality. The settlements have developed on the slopes of the Hottentots Holland mountains in the area directly North of the N2 highway and to the West of the Ou Kaapse Weg Road (GPS coordinates 34°09'31.3"S 18°59'09.0"E). A satellite map of the area is attached to this report as Appendix A.

Siyanyanzela is the older settlement of the two, is more densely populated and has better road access and access to public services generally. Data from a 2023 census conducted in the area by Eigelaar-Meets (2024) approximates the total population of the two areas to be around 3 000 households, with approximately 90% of these households residing in Siyanyanzela.[1]

The Theewaterskloof Municipality has grown substantially since the early 2000’s, with a 50% growth in the municipal population between 2001 and 2022 (Theewaterskloof Municipality, 2026). The growth in population has placed pressure on infrastructure and municipal-provided services. In addition, a significant proportion of the population growth is classified as indigent households, which amplifies demand for subsidised services.

Grabouw has experienced substantial in-migration in recent years, which has been primarily driven by seasonal agricultural employment (Matisa, 2025). Migrants, often from poorer rural areas (particularly the Eastern Cape) often relocate to Grabouw for temporary work but often remain behind in the area (Matisa, 2025). A substantial number of these seasonal migrants reside in informal structures that are located in areas (such as Siyanyanzela and Khotsong) with very tenuous access to publicly provided services such as water, electricity, and sanitation (often as a result of the location of these informal structures on the slopes of mountains on the outskirts of the original, more established informal settlements). This places sustained pressure on service delivery systems. The Theewaterskloof Municipality is under increased strain to deliver services with a limited revenue base and restricted ability to generate its own income (Theewaterskloof Municipality, 2026).

The service most directly relevant to this project is the provision of clean tap water. For residents of Siyanyanzela and Khotsong, access to municipal water is primarily through publicly provided standpipes. An illustration of the capacity and resource constraints faced by the Theewaterskloof Municipality is the limited number of functioning public standpipes available in these communities. At the time of the study, only eight municipal standpipes were operational across Siyanyanzela and Khotsong. As part of the project, data were collected on the precise geographic location of each functioning standpipe. In total, eight standpipes were identified and mapped, six of which are located in Siyanyanzela and two in Khotsong. A map showing the locations of these standpipes is included in Appendix B. Photographs of two of the public standpipes in Siyanyanzela are presented below.

This chapter provides an overview of the methodology for and results from the baseline data collection in the form of household surveys and microbiological water tests.

[1] Although in informal discussions with the Theewaterskloof Municipality the number of households in these areas has grown substantially in the past two years, mostly driven by in-migration.

3.2 BASELINE DATA COLLECTION AND FIELDWORK OVERVIEW

Baseline fieldwork was conducted in April and May 2024, with 10 fieldworkers recruited through the municipality who were all unemployed or part-time employed individuals who reside in the study area and had passed the Grade 12 National Senior Certificate exam. Training took place for four days prior to the official commencement of the fieldwork. The training was provided by Caroline Poole from Soreaso[2], an organisation specialising in data collection, and Khanya Mama, a master's student on the project. The training offered fieldworkers exposure to topics such as the steps in social research, the types of sampling and data collection, the guidelines when conducting face-to-face interviews (including discussions on how to establish rapport, confidentiality and ethical considerations during the interview, respect towards the participants, and a specific focus on getting to know the specific questionnaire).

Figure 2: Photos of three municipal public taps in Siyanyanzela

Water samples had to be taken as part of the administration of the survey. As discussed in the next section, the sample size exceeded 600 households and it was therefore decided that the fieldworkers themselves would be trained as co-researchers in collecting the water samples. Cross-validation analysis was conducted to ensure that the collection protocol was adequately followed. Further detail on this process is provided in the next section.

Ethical approval for the project was obtained from the Research Ethics Committee for Research for Human Research (Humanities) with reference number 28757. A copy of the survey questionnaire and the informed consent are included as Appendices C and D at the end of this report.

3.3 SAMPLING STRATEGY AND BASELINE SAMPLE

Because of the paucity of evidence on interventions on the quality of stored drinking water in the South African context, power calculations to determine sample size were conducted based on the impact of similar interventions in Kenya and Bangladesh (Luoto et al., 2014), and Burkina Faso (Anderson et al., 2021). A sample size of 600 households was found to be powered to detect effect sizes of 10 percentage points if the outcome variable is treated as binary with a mean of 0.5 and power is assumed to be 80%. The assumption

[2] https://soreaso.co.za/

of a binary outcome variable is based on the variable capturing the presence/absence of coliforms and *E-coli* in the water, although other health-related and attitudinal variables would also be of interest as outcome variables.

Based on the power calculations and the population size, a 20% random sample was drawn using systematic sampling of every 5th dwelling structure. This amounted to 600 households in total. Because of the distribution of the population between the two sites, approximately 17% (100 households) were sampled from Khotsong and the remaining 83% (500 households) were sampled from Siyanyanzela. Khotsong was over-represented in the final sample because of its relative deprivation in terms of access to infrastructure and public services generally. The research team also included additional households in the sample to account for attrition in the endline. The final sample consisted of 625 households in total for the survey (representing 1 854 individual residents) and 627 households for the microbiological water tests (of this sample, 100 households were from Khotsong and the remainder were from Siyanyanzela). The discrepancy in sample size resulted from two households where consent was obtained for the water sample but not for the household survey.

Screening of eligibility was conducted first to establish that the household routinely stored water in a container for drinking purposes. In addition, households with no adult member aged 18 years or older were not interviewed due to ethical considerations. Based on these criteria, there were five households that had to be replaced. In addition, there were three households that were sampled but refused to participate in the study and also had to be replaced. Replacement was done by selecting the dwelling to the right of the no-longer-eligible dwelling. The questionnaire was administered to the oldest woman in the household, or another household member who was knowledgeable about the household members and water-related behaviour of the household.

Within the area, there are three municipal reservoirs that are part of the municipal water distribution. Treated water is pumped from the reservoirs to the communities below. During fieldwork, it was clear that many households were reliant on self-installed makeshift taps that were illegally connected to the municipal water system. A photo of such a makeshift tap is provided in the figure below. During fieldwork and from discussions with the municipal officers, it became clear that the number of municipal-provided standpipes in these communities is not sufficient, and therefore residents often accessed the formal water network to install their own illegal water connections. This practice, as well as other HWTS behaviours in the community, are discussed in the sections below.

Figure 3: Photo of a makeshift tap in Siyanyanzela

3.4 SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

Selected descriptive statistics of the demographic and socio-economic characteristics of the baseline sample are provided in Table 2 below. The statistics illustrate the level of economic vulnerability of the sample and are, to a large degree, what one would expect from informal settlements in the Western Cape Province. However, there are some exceptions. The sample is younger, with smaller household sizes (283 households, or 45.76% of the sample consists of only one or two members). These households also have fewer dependents than what is usually the case for households residing in informal settlements in the Western Cape Province (435 households or approximately 70% of the sample, have no child under the age of five in the household and 611 households or approximately 98% of the sample have no adult aged 65 years or older). In addition, the households in the sample have better access to the formal labour market than would typically be expected from such an area. Approximately 70% of the sample has at least one person employed in formal employment. Access to employment and lack of dependence also translate into lower rates of grant receipt for the sample, and this can be seen from the fact that only 55.2% of the households in the sample receive at least one type of grant, even though the households are all economically vulnerable. It is clear from these statistics that households often settle in the areas in search of economic opportunities, and that households are formed around employment.

Table 2: Descriptive statistics on the demographic and socio-economic characteristics at baseline

Variable name	**Siyanyanzela**	**Khotsong**	**Statistically significantly different means (K – S)** [#]	**Total Sample**
	Mean (standard deviation)	Mean (standard deviation)	t-statistic	Mean (standard deviation)
Individual-level variables (n=1 854)				
Age in years	24.837 (14.982)	23.994 (14.505)	-0.921	24.692 (14.900)
Completed years of education (sample > 18 years)	9.747 (2.750)	8.698 (3.393)	-4.742*	9.571 (2.893)
Black African	0.984 (0.127)	0.963 (0.189)	-2.423*	0.980 (0.140)
Female	0.532 (0.499)	0.543 (0.499)	0.364	0.534 (0.500)
Number of individuals	**1530**	**324**		**1 854**
Household-level variables (n=625)				
Household size	2.914 (1.627)	3.240 (1.694)	1.823	2.970 (1.641)
At least one person in household has access to labour market (formal employment) Yes/No	0.712 (0.453)	0.680 (0.469)	-0.651	0.707 (0.455)
Number of children younger than 5 in household	0.366 (0.621)	0.390 (0.602)	0.360	0.370 (0.617)
Number of adults older than 65 in household	0.023 (0.150)	0.050 (0.411)	1.164	0.027 (0.214)
Household includes at least one grant recipient Yes/No	0.541 (0.499)	0.610 (0.490)	1.269	0.552 (0.498)
Number of grants received in the household	1.003 (1.276)	1.180 (1.175)	1.281	1.032 (1.261)
Asset Index of household[##]	0.000 (0.977)	-0.000 (1.092)	-0.002	0.000 (1.000)

Access to electricity even if currently disconnected	0.901 (0.299)	1.000 (0.000)	3.314*	0.917 (0.277)
Floor of the dwelling mainly earth (sand) or vinyl on earth (sand)	0.180 (0.384)	0.220 (0.416)	0.947	0.186 (0.390)
Number of households	**525**	**100**		**625**

Notes: #Statistical significance: * denotes $p \leq 0.05$. ##The asset index was calculated with multiple correspondent analysis using a list of assets as set out in question 1.30 in the household questionnaire in Appendix D. The index was standardised with a mean of 0 and a standard deviation of 1

Some statistically significant differences between the two areas are clear from the descriptive statistics reported in Table 2. The fourth column reports the t-statistic for the difference in the means between the two areas.

Households in Khotsong are generally larger and younger and have fewer years of completed education. These households also have more dependents (although these differences are not statistically significantly different from zero at conventional levels of statistical significance). These differences are informative in describing the differences in water quality and HWTS behaviour, as discussed in the next section.

3.5 BASELINE WATER SOURCES, STORAGE PRACTICES, WASH BEHAVIOUR AND HEALTH OUTCOMES

The main aim of the household questionnaire was to measure the HWTS behaviour, WASH behaviour, and health outcomes of individuals in the sample. The summary statistics of the responses to some of these questions are set out in Table 3 below.

Approximately 76% of households in the sample source their water mainly from one of the informal makeshift taps in their yard or elsewhere close to their dwelling. This proportion is significantly greater in Siyanyanzela (78.2%) compared to Khotsong (67%), which can be explained by the fact that Siyanyanzela is an older and more established settlement. The water source is typically close to the dwelling, as almost 92% of the households in the sample reported that their water source was within 100 metres of their dwelling.

Table 3: Summary statistics of water storage behaviour and health outcomes at baseline

Variable name	Siyanyanzela	Khotsong	Statistically significantly different means (K – S) #	Total Sample
	Mean (standard deviation)	Mean (standard deviation)	t-statistic	Mean (standard deviation)
Number of days that water was in container before sampled	0.586 (1.769)	0.394 (0.652)	-1.068	0.555 (1.642)
Water collected from makeshift tap	0.782 (0.414)	0.670 (0.473)	-2.414*	0.764 (0.425)
Tap within 100m from household dwelling	0.920 (0.275)	0.900 (0.302)	-0.589	0.915 (0.279)
Size of storage container 5 litres	0.033 (0.178)	0.071 (0.258)	1.812	0.039 (0.193)
Size of storage container 10 litres	0.101 (0.302)	0.172 (0.379)	2.035*	0.113 (0.316)
Size of storage container 20 litres	0.866	0.758	-2.779*	0.849

	(0.341)	(0.431)		(0.358)
Water container made of plastic	0.968 (0.177)	1.000 (0.000)	1.828	0.973 (0.163)
Water container kept inside	0.994 (0.076)	1.000 (0.000)	0.763	0.995 (0.070)
Water container fully covered with a lid	0.887 (0.316)	0.860 (0.349)	-0.781	0.883 (0.322)
Does household routinely purify stored water before drinking? Yes/No	0.054 (0.226)	0.110 (0.314)	2.134*	0.063 (0.243)
Dedicated jug/cup to scoop water	0.613 (0.488)	0.720 (0.451)	2.034*	0.630 (0.483)
Prevalence of diarrhoea in household in last month	0.196 (0.397)	0.297 (0.459)	2.285*	0.212 (0.409)
Prevalence of highly credible gastrointestinal illness (diarrhoea, vomiting, stomach cramps) in household in last month	0.134 (0.341)	0.221 (0.417)	1.984*	0.147 (0.354)
Place to wash hands inside the dwelling Yes No	0.612 (0.488)	0.560 (0.499)	-0.978	0.604 (0.489)
Reporting soap Yes/No	0.528 (0.500)	0.657 (0.477)	2.366*	0.548 (0.498)
Household access to flush toilet (includes chemical toilet)	0.567 (0.496)	0.616 (0.489)	0.910	0.575 (0.495)
Household uses bin with lid	0.076 (0.266)	0.070 (0.256)	-0.220	0.074 (0.264)
Household uses refuse bag or bin without lid	0.731 (0.444)	0.770 (0.423)	0.813	0.737 (0.441)
Household disposes of waste on open ground (at formal or informal dump site)	0.193 (0.395)	0.160 (0.368)	-0.768	0.188 (0.391)
Household disposes of wastewater on open ground	0.980 (0.145)	1.000 (0.000)	0.715	0.980 (0.139)
Number of households	**100**	**525**		**625**

Notes: #Statistical significance: * denotes $p \leq 0.05$

A variable was constructed to measure the number of days that the water was stored in the container before sampling took place (as the difference between the date on which water was reportedly collected and the interview date). On average, respondent households refill their containers at least once a day, and therefore the average storage time was half a day. A more accurate measure of this could be generated by considering the time when water was collected vs when the interview took place. This will allow for a more accurate and fine-grained measure.

The vast majority of respondent households store their water in 20-litre containers (85%) that are made of plastic (97.3%) and have a lid that fully covers the top of the container (88.3%). These containers are almost always kept inside the dwelling (99.5%). Water purification is not common. Only 5.4% of households in Siyanyanzela and approximately 11% of households in Khotsong reported that they routinely purify their water before drinking it. This difference is statistically significant. In addition, approximately 61.3% of households in Siyanyanzela and 72% of households in Khotsong indicated that they use a dedicated cup or jug when scooping the water from the container (this difference is also statistically significant). Not reported in the table, however, also interesting, is the answer of respondents to the follow-up question asking about whether household members also sometimes drank from the same jug or cup after scooping the water. Approximately

87.1% of the respondents who indicated a dedicated cup/jug was used indicated that household members also drank from this cup (at almost 87.6% in Siyanyanzela and 86.1% in Khotsong).

In order to measure the health outcomes of the individuals in the sample, the household prevalence of diarrhoea in the last month is reported. This variable is constructed from the household roster where the respondent was asked about the occurrence of diarrhoea for each individual household member during the last month. A similar variable capturing the household prevalence of highly credible gastrointestinal illness (HCGI) is constructed using the answers to questions in the household roster, including diarrhoea, vomiting and stomach cramps. The prevalence is statistically significantly higher in Khotsong compared to Siyanyanzela as measured by both these variables.

The survey also collected information on sanitation and hand-washing. No questions were asked about hand-washing directly, but questions were included about whether the household had a dedicated basin or other container which they used for hand-washing after visiting the toilet. Approximately 61.2% of households in Siyanyanzela and 56% of households in Khotsong reported having such a facility (not statistically significantly different). When asked about the availability of soap to wash hands, only 52.8% of respondent households in Siyanyanzela and 65.7% of respondent households in Khotsong reported that soap was present. The fieldworkers also observed whether this report was indeed factually correct. This data has not yet been analysed, but could potentially be useful to get accurate statistics of the actual presence of soap.

Approximately 57.5% of the households in the sample had access to a flush toilet as their main toilet facility. This includes approximately 9.6% of households that have access to a chemical toilet. Approximately 31.4% of households in the sample report that they practise open defecation “in the bush”. Last, the table also includes statistics about the disposal of solid waste and wastewater, both of which are potential sources of pathogens that could cause illnesses. Approximately 41.1% of the sample dispose of their solid waste in a refuse bag or bin without a lid, with approximately 18.8% of the sample disposing of solid waste away from the dwelling, at the formal or informal dump site. Given the informal nature of the settlement, it is not surprising that the vast majority of households in the sample (98%) dispose of wastewater from cooking, cleaning or washing on the open ground and not in a drain or sink.

3.5.1 Water reliability, trust and risk attitudes

The survey included various questions aimed at gauging the attitudes of respondents and their households toward the municipality and water provision and quality generally. During various discussions with the Theewaterskloof municipality, the research team was informed that water outages and intermittent water supply were not a regular occurrence after the improvements on the water network during 2023. However, 65% of the sample answered “yes” to the question “*Do you have problems with reliable access to drinking water? In other words, is the water supply sometimes interrupted, i.e. no water coming out of the tap?”.* When asked about how often they experience interruptions in their water supply, 41.25% of the 65% answered “*most of the time*”. Another 4% of the 65% reported that they “*never have enough water*”.

When asked about the water quality, respondents generally reported that they approve of the taste (70.83%), smell (76.28%) and colour (60.58%) of the water coming out of the tap. The lower score for colour is most likely as a result of the discolouration of the water as a result of the natural vegetation in the area, which colours the water reddish-brown. Trust in the municipality regarding the provision of water is low, with the average score reported as 4 out of 10.

Table 4 below provides some summary statistics on the responses around questions of water availability, trust toward the municipality and risk-taking. Approximately 83% of respondents reported never interacting with the municipality (including a ward member) in the preceding 12 months prior to the survey regarding water access or quality. However, as indicated above, 65% of the sample reported that their household had problems with reliable access to water. The breakdown in the relationship between residents and the municipality in terms of water provision is clear when one considers the low score (4 out of 10) for the question asking about level of trust that the municipality will ensure quality water access. When comparing the two areas with each other, there are no noticeable statistically significant differences except for the proportion of households reporting problems with reliable drinking water access (higher in Siyanyanzela than in Khotsong) and a lower score for the taste of the water in Siyanyanzela compared to Khotsong (significant at the 10% level).

Table 4: Summary statistics from baseline data regarding water availability, municipal trust and risk-taking

Variable name	**Siyanyanzela (S)**	**Khotsong (K)**	**Statistically significantly different means (K – S)#**	**Total Sample**
	Mean (standard deviation)	**Mean (standard deviation)**	**t-statistic**	**Mean (standard deviation)**
Proportion of households who never interacted with municipality (including ward councillor) about water in last 12 months	0.834 (0.373)	0.820 (0.386)	-0.342	0.832 (0.374)
Proportion of households reporting problems with reliable access to drinking water	0.671 (0.470)	0.540 (0.500)	-2.525*	0.650 (0.477)
How would you rate the taste of the water at the source? (score from 1=good to 3=bad)	1.345 (0.607)	1.470 (0.658)	1.856	1.365 (0.616)
How would you rate the smell of the water at the source? (score from 1=good to 3=bad)	1.265 (0.521)	1.320 (0.530)	0.960	1.274 (0.523)
How would you rate the colour of the water at the source? (score from 1=good to 3=bad)	1.534 (0.737)	1.590 (0.753)	0.689	1.543 (0.740)
How much do you trust the municipality to make sure that you have good quality water available at all times? (score from 1 = no trust to 10 = full trust)	4.034 (2.981)	4.20 (2.954)	0.509	4.061 (2.975)
Would you describe yourself as someone who has a lot of trust in others? (score from 1=strongly agree to 5=strongly disagree)	2.610 (1.191)	2.680 (1.197)	0.539	2.621 (1.191)
Would you describe yourself as someone who often takes risks? (score from 1=strongly agree to 5=strongly disagree)	2.764 (1.408)	2.680 (1.370)	-0.549	2.750 (1.401)
Number of households	**524**	**100**		**624**

Notes: #Statistical significance: * denotes $p \leq 0.05$

3.6 BASELINE WATER QUALITY

3.6.1 Materials and methods

3.6.1.1 Training of Co-researchers

As 627 water samples had to be collected from the same consortium of houses used for the baseline survey, the concept of citizen science was employed in the current study, where the co-researchers/field workers were trained to collect the samples. Thus, to ensure that the water samples were collected using the correct procedure for accurate microbial analysis of the stored water, researchers from the Water Resources Laboratory (Department of Microbiology, SU) presented a training session to the co-researchers in Grabouw on 10 April 2024. All co-researchers were provided with cooler boxes containing the materials required for sampling, i.e., 50 mL sterile plastic conical tubes (Labcon, California, United States), paper towels, nitrile gloves (Lasec, South Africa), permanent marker, sampling instruction diagram (English and Afrikaans) (Figure 4) and biohazard waste bags (storage of the collected samples).

Researchers from the Water Resources Laboratory then demonstrated the step-by-step water collection procedure to the co-researchers (Figure 5), highlighting the need to ensure that the inside and top of the 50 mL plastic conical tubes should remain untouched, and the tubes should be tightly sealed. Additionally, the co-researchers were requested to enquire from the study participant whether they regularly used another smaller container to remove the water from the primary storage container. Based on the study participant response, the co-researchers were requested to use this smaller container to collect the water samples and then transfer the water to the conical tubes. Furthermore, the co-researchers were requested to ask the study participants if they would prefer to personally collect the water sample from the primary storage container using the conical tube, rather than having the co-researcher do it. By giving the study participants the option to collect the water sample or use their smaller container for water sample collection, it acknowledges their comfort levels and ensures that participants have control over the process, which can help in building trust and make them feel valued in the study.

The co-researchers' training also included information on the correct storage of the collected water samples. The co-researchers were provided with brief information on why the samples had to be stored at 4°C (refrigeration temperature – to inhibit microbial growth) until collection by researchers from the Water Resources Laboratory. Arrangements were then made with one of the primary survey co-ordinators to store all the collected samples at 4 °C, and a researcher from the Water Resources Laboratory would collect the samples twice a week, whereafter the samples were processed in the Department of Microbiology. Below are two images illustrating two ways in which the samples were collected.

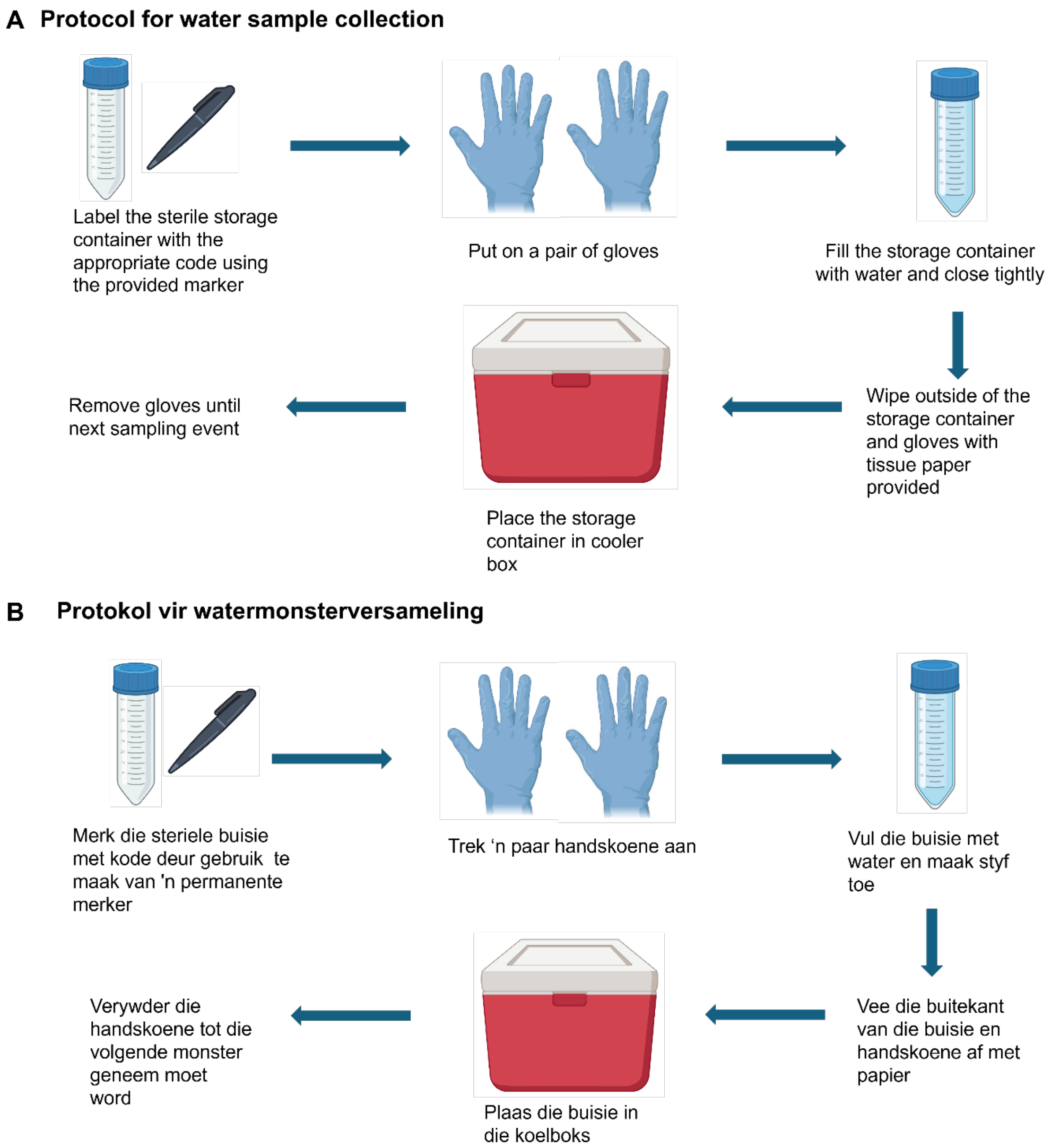

Figure 4: Sampling protocol diagram provided to each co-researcher in A) English and B) Afrikaans

Figure 5: Fieldworkers taking a water sample from a storage container (left) and a participant providing a sample from a storage container (right)

3.6.1.2 Sample Collection

Water collection from the storage containers was conducted over a one-month period from 11 April 2024 to 7 May 2024 by the trained co-researchers. A 50 mL water sample was collected from each baseline survey participating household located in the informal settlement areas of Siyanyanzela and Khotsong. Each participating house was assigned a number or code by the co-researchers and the GPS co-ordinates were recorded. The GPS information will assist the Microbiology researchers in locating the houses for the endline. A total of 637 water samples were then collected from the Grabouw informal settlement communities, of which 627 water samples were collected from the primary storage containers in participating baseline survey houses. An additional ten samples were collected by the Water Resources Laboratory researchers along with the co-researchers in order to validate the sampling methods employed for water collection.

3.6.1.3 Sample Processing

Following sample collection, the quality of the stored water was assessed by determining the presence of *Escherichia coli* (*E. coli*) and coliforms. This was conducted using the Petrifilm™ *E. coli*/ Coliform (EC) Count Plates (3M™, South Africa) (Figure 6A). Briefly, the water samples were vortexed thoroughly, whereafter 1 mL of the water sample was placed onto the Petrifilm™ EC Plates as per the manufacture's instruction. The samples were then incubated at 37°C for 24 hours, whereafter the colony forming units (CFU)/100 mL were determined. As per the manufacturer guidelines, colonies with a blue pigment associated with gas were identified as *E. coli*, while red colonies within one colony diameter of entrapped gas were recorded as coliforms (Figure 6B). The total coliform count was then determined as the number of the red and blue colonies present at 24 hours.

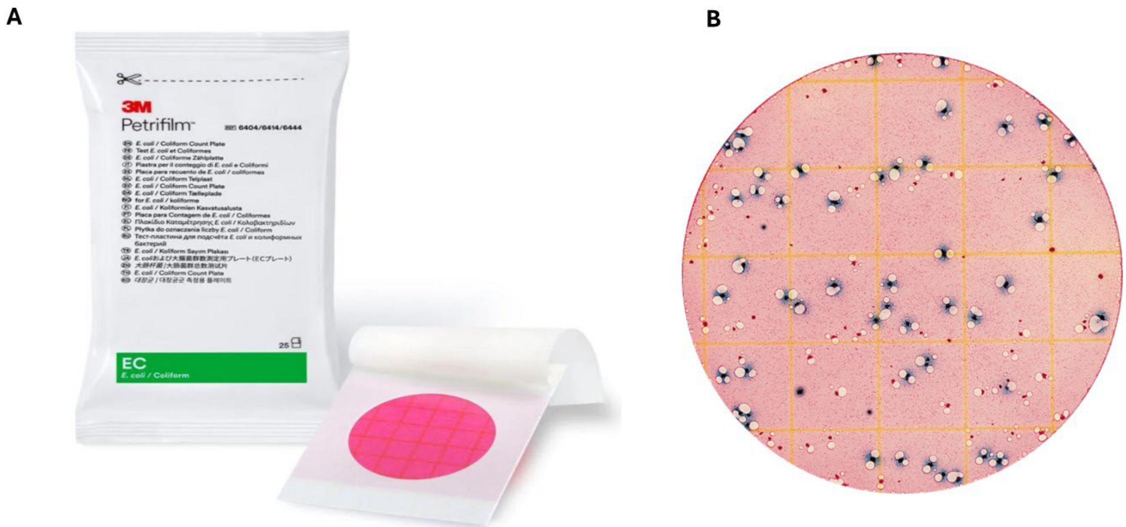

Figure 6:A) Petrifilm™ EC Count Plates (3M™) and B) Positive result depicting blue colonies with a blue pigment identified as E. coli, while red colonies were identified as coliforms

3.6.1.4 Validation of Petrifilm™ Analysis

While it is recognised that the results generated from the Petrifilm™ EC Plate Counts (3M™) can only be used as an indication of the presence/absence of coliforms and *E. coli*, a validation step was included for all water samples with a CFU/100 mL greater than 1. Accordingly, 100 µL of the collected water samples selected for validation were spread plated in duplicate onto HiCrome™ Coliform Agar [Sigma-Aldrich, St. Louis, United States of America (USA)] and incubated at 37°C for 24 hours. However, samples identified as too numerous to count (TNTC; > 250 CFU/100 µL) using the Petrifilm™ EC Plate Counts (3M™), were serially diluted (10^{-1} to 10^{-3}) in 0.85% (w/v) saline solution (NaCl; Kimix, South Africa), with 100 µL spread plated onto HiCrome™ Coliform Agar (Sigma-Aldrich) in duplicate. For the HiCrome™ Coliform Agar (Sigma-Aldrich) plates, colonies with a blue to violet pigment were identified as *E. coli*, while salmon to red colonies were identified as coliforms. The total coliform count (total coliforms) was determined as the number of *E. coli* and coliform colonies present at 24 hours and the CFU/100 mL was calculated.

3.6.2 Results and discussion

1.3.2.1 Sample Processing and Validation of Petrifilm™ Analysis

For the ten samples collected by the Water Resources Laboratory researchers with the co-researchers, in order to validate the water collection sampling methods employed, all the Petrifilm™ EC Plate Counts corresponded with a count of 0 CFU/100 mL recorded for eight of the stored water samples (results not shown). For two of the stored water samples, counts ranging from 1 × 10^3 CFU/100 mL to 3.2 × 10^3 CFU/100 mL were then recorded in the water samples collected by the Water Resources Laboratory researcher and the co-researcher. This simple validation step demonstrated that the co-researchers were working aseptically and the correct procedure for storage container water sample collection was being applied.

A total of 627 water samples were then collected from the household water storage containers located in the informal settlement areas of Siyanyanzela and Khotsong and were subjected to Petrifilm™ EC Plate Counts analysis. Based on the Petrifilm™ EC Plate Counts, 76/627 (12.1%) were found to contain *E. coli*/coliforms (total coliforms) with results ranging from 1.00 × 10^2 to TNTC (> 250 CFU/100 mL) (Figure 7 and Appendix E). In order to graphically represent the results for the number of houses that tested positive using the Petrifilm™

EC Plate Counts method, a hypothetical value of 2.5×10^5 CFU/100 mL was assigned to the counts recorded as TNTC.

Of the 76 water samples found to contain *E. coli*/coliforms (total coliforms) using the Petrifilm™ EC Plate Count assay, 64.5% (49/76) were found to contain *E. coli*/coliforms (total coliforms) at a range of 1.00×10^2 to 9.00×10^2 CFU/100 mL, 26.3% (20/76) at a range of 1.00×10^3 to 9.00×10^3 CFU/100 mL, 2.6% (2/76) at a range of 1.00×10^4 to 9.00×10^4 CFU/100 mL, while 6.6% (5/76) exceeded the count of 2.5×10^5 CFU/100 mL (TNTC) (Figure 7 and Appendix E). The *E. coli*/coliform counts in 76/627 water samples collected from the primary storage containers in the informal settlement communities of Siyanyanzela and Khotsong were thus above the recommended standard limit of the South African National Standards (SANS) 241 guidelines for drinking water (total coliforms/100 mL ≤ 10). Of these samples, 18 were from households in Khotsong (representing 18% of the sampled households) and 58 were from households in Siyanyanzela (representing 11% of the sampled households). This raises a public health concern for the residents, necessitating the identification of contamination sources such as inadequate water storage (South African Bureau of Standards, 2015). To address the issues, regular and more detailed monitoring of the water quality, improved storage methods, and community education on hygiene practices should be implemented.

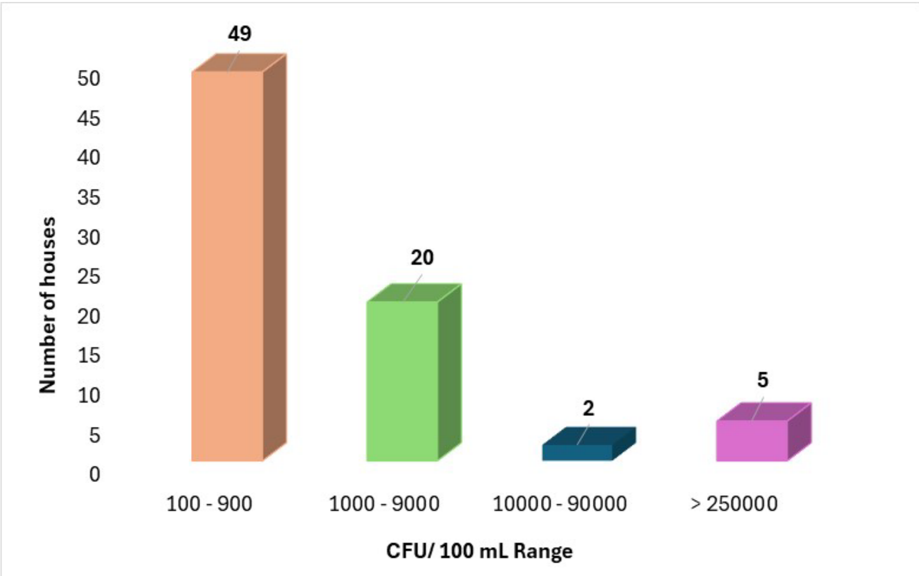

Figure 7: The range of the CFU/100 mL detected in the houses in the Grabouw informal settlement areas that tested positive using the Petrifilm™ EC Count assay

Based on the HiCrome™ Coliform Agar validation, *E. coli*/coliform (total coliforms) counts ranging from 0 to 1.58×10^8 CFU/100 mL were detected in the water samples analysed. In contrast to the Petrifilm™ EC Plate Counts, 56/76 (73.7%) water samples did not contain *E. coli*/coliforms (total coliforms) (Appendix E), with the highest *E. coli*/coliform count (total coliforms) detected in the water sample collected from House 72. It should, however, be noted, that based on the Petrifilm™ EC Plate Count results, this plate count validation step was only incorporated approximately two weeks after the primary sampling session had ended, which implied that the water samples had been stored at 4°C for that time period. The samples were not all analysed using plate counts on the same day – this analysis was completed over a period of two weeks. The discrepancies detected between the Petrifilm™ EC Plate Count and the HiCrome™ Coliform Agar validation results could thus potentially be attributed to the *E. coli*/coliforms (total coliforms) entering a viable but non-culturable (VBNC) state under the low temperature storage conditions. Several studies have demonstrated that environmental conditions including acidity or alkalinity, starvation, antimicrobials, low or high temperatures could result in the induction of a VBNC state, resulting in discrepancies in plate-based or culture-based detection methods (Zhang et al. 2024).

In addition, discrepancies between the two detection methods (Petrifilm™ EC Plate Counts and HiCrome™ Coliform Agar) highlight the varying sensitivity and specificity of the media employed in the two assays. For example, each medium contains two indicators: 5-bromo-4-chloro-3-indolyl-D-glucuronide and tetrazolium (Petrifilm™ EC Plate Counts) or Salmon-GAL and X-glucuronide (HiCrome™ Coliform Agar). These indicators show glucuronidase activity and facilitate colony enumeration, respectively. The detection of *E. coli*/coliforms is thus dependent on the presence of enzymes specific to each medium. However, the detection of *E. coli*/coliforms is based on typical phenotypes, which is a major limitation as some pathogenic *E. coli* do not produce beta-glucuronidase, while non-*E. coli* species have also been reported to produce beta-glucuronidase (Bird et al., 2020). This is problematic as it may interfere with the detection sensitivity and specificity of media, including Petrifilm™ EC Plate Counts and HiCrome™ Coliform Agar, which depend on the activity of glucuronidase (Bird et al., 2020). Thus, to circumvent this limitation, two media were used in the current research to validate the results.

3.7 CONCLUSION

The results from the household survey and microbiological tests reported in this chapter provide an overview of the two study communities and indicate that households are generally smaller than the average household in informal communities in South Africa and are composed primarily of working-age adults, with relatively fewer children and elderly individuals. This demographic profile is consistent with the migrant nature of the areas, where many adults relocate for employment-related reasons. In addition, the household survey reveals a high prevalence of makeshift taps, which is likely related to the limited availability of municipally provided public taps in the communities. Participants also report low levels of trust in the municipality. Diarrhoeal prevalence at baseline is moderate, at approximately 30%.

With respect to the microbiological analysis of stored water samples, the baseline results indicate relatively low levels of contamination, with 76 out of 627 samples testing positive. While these descriptive statistics are useful in characterising baseline behaviours, attitudes and water quality in the study communities, they are limited in their ability to inform decisions regarding the design of the intervention. To address this, the next chapter examines the relationships between household behaviour, household characteristics, water quality, and health outcomes in greater detail.

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CHAPTER 4: BASELINE RELATIONSHIPS BETWEEN HOUSEHOLD BEHAVIOUR, WATER QUALITY, AND HEALTH

4.1 CONCEPTUAL FRAMEWORK

This chapter considers the relationships between household behaviour, health outcomes (as recorded in the household survey) and water quality (as measured with the microbiological water tests) at baseline. The literature review in Chapter 2 and the empirical results from this chapter feed into and are combined with the focus group discussions reported in the next chapter in order to develop the behaviour intervention.

The conceptual framework by Trevett et al. (2005) and Trevett and Carter (2008) is adopted to provide a roadmap outlining the primary determinants of pathogen loads in household drinking water and the consequent risk of disease. The framework, replicated below, is useful to segment the evidence about how human behaviour leads to contamination of stored water. In this framework disease risk, resulting from the contamination of water after collection and before use, is mediated by the health and immunity status of the individual. The pathogen load of stored drinking water, defined by the presence/absence or concentrations of certain types of disease-causing pathogens, is determined by primary factors including water handling practices of household members, hygiene behaviours, and living conditions or environment and secondary factors grouped into anthropological, socio-economic and pathogen influences.

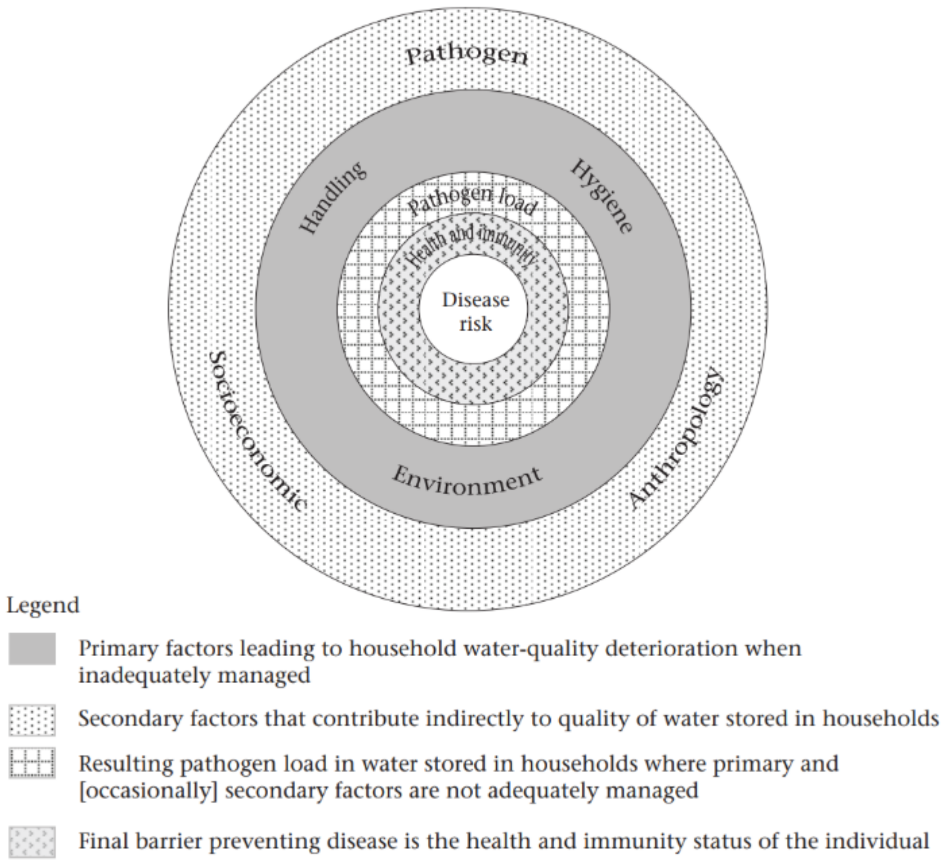

Figure 8: Conceptual model of disease risk related to contamination of stored household drinking water (Trevett and Carter, 2008: 127)

Applying this conceptual framework to the data collected at baseline provides the following outcome variables of interest (pathogen load, health and disease risk in the conceptual framework):

Pathogen load

- A binary variable capturing the presence/absence of E. Coli in the sample water using the Colilert screening test ("**E. Coli**")

Health

- The self-reported prevalence of diarrhoea (measured as a binary variable taking the value of 1 if anyone in the household reported having diarrhoea in the last 30 days ("**Diarrhoea**")
- The prevalence of highly credible gastrointestinal illness ("**HGCI"**), measured as a binary variable taking the value of 1 if anyone in the household displayed the following symptoms in the past 30 days:
    - Vomiting
    - Diarrhoea
    - Nausea and abdominal cramps

information on the following primary contributing factors:

Environment

- The number of government grants (cash transfers) received by the household ("**Grants**")
- The number of children under five years old residing in the household ("**Children under 5**")
- An asset index score of the household that was calculated with multiple correspondent analysis using a list of assets as set out in question 1.30 in the household questionnaire in Appendix D. The index was standardised with a mean of 0 and a standard deviation of 1 ("**Assets**")
- A binary variable capturing whether the household resides in Siyanyanzela or Khotsong ("**Siyanyanzela**")
- A binary variable indicating that the household disposed of their household solid waste at the communal dumping site rather than keeping their waste in a rubbish container or bag either inside or outside the house ("**No bin**")

Handling

- The number of days that the water was stored in the container before the water sample was collected (i.e. the difference between the day on which water was collected for storage and the day on which the fieldworkers collected the water sample for testing ("**Days in container**").
- A binary variable capturing whether the household's primary source of drinking water is a makeshift tap installed by the household themselves ("**Makeshift tap**")
- A binary variable capturing whether the household retrieves water from a cup and then drinks from the same cup ("**Scoop and drink**")
- A binary variable indicating that the container was closed with a lid (which was observed and confirmed by the fieldworker) ("**Container closed**")
- A binary variable indicating that the household washes their water storage container at least twice a week ("**Wash often**")

Hygiene

- A binary variable indicating that soap was present at the point where the household washes their hands (which was observed and confirmed by the fieldworker) ("**Soap**")
- A binary variable indicating that the household had a dedicated space/vessel for washing their hands on the plot (which was observed and confirmed by the fieldworker) ("**Handwashing**")

Pairwise correlations were obtained between all variables of interest and the significance of the associations were considered, based on the Pearson correlation coefficients. These variables and their correlations with each other are reported as a correlation matrix with Pearson correlation coefficients and significance levels in Table 5 below.

The correlation matrix does not speak to causation; however, it is sufficient to make some tentative preliminary conclusions about the relationship between water storage, health outcomes and water quality.

- The absence/presence of *E. Coli* in the water samples is strongly positively associated with a higher household prevalence of diarrhoea and HCGI. This association is significant at the 1% level of significance.
- The absence/presence of *E. Coli* in the water sample is positively associated with the number of days that the water was in the container prior to extraction (at the 10% level of significance). It is also correlated with the number of grants received by the household as an indicator of socio-economic status (at the 1% level of significance).
- The variables capturing the prevalence of diarrhoea and HCGI are strongly correlated with each other and also strongly correlated with the number of children under five in the household (at the 1% level of significance). This correlation is most likely a feature of the fact that children are more susceptible to water-borne diseases. Keeping a lid on the storage container and washing the storage container at least twice a week are behaviours that prevent diarrhoea and HCGI, as there is a negative correlation with these variables and the prevalence of diarrhoea and HCGI.
- Where the household disposes of its solid waste is correlated with both the prevalence of diarrhoea and HCGI. Households that dispose of their solid waste away from the house are less likely to report diarrhoea and HGCI (significant at the 1% level of significance), although these households are seemingly poorer than the rest of the sample (negative correlation between this variable and the asset index). This speaks to the influence of household waste on site and how this increases gastrointestinal disease.
- Whether the household has a makeshift tap or not is not statistically significantly correlated with the presence of *E. Coli* in the water sample. However, it is correlated (albeit negatively) with HCGI symptoms. This correlation is tenuous as it is only significant at the 10% significance level. In addition, households that reported a makeshift tap are also more likely to have soap in the house or plot. They are, however, less likely to report having a dedicated container in which they wash their hands (this might be because these households make use of the makeshift tap and a dedicated container is not necessary).
- Households residing in Siyanyanzela have lower levels of contaminated water and also a lower prevalence of diarrhoea.

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Table 5: Person correlation coefficients and statistical significance

	E. coli	Diarrhoea	HCGI	Grants	Children under 5	Assets	Siyanyanzela	No bin	Days in container	Makeshift tap	Scoop and drink	Container closed	Wash often	Soap	Handwashing
E. Coli	**1.0000**														
Diarrhoea	0.0898	**1.0000**													
HCGI	0.0974	0.9447	**1.0000**												
Grants	0.0906	0.2012	0.1782	**1.0000**											
Children under 5	0.0266	0.0867	0.1380	0.3527	**1.0000**										
Assets	0.0370	-0.0163	0.0428	0.0579	0.0551	**1.0000**									
Siyanyanzela	-0.0646	-0.0658	-0.0536	-0.0408	-0.0240	0.0161	**1.0000**								
No bin	0.0015	-0.1186	-0.1093	-0.0474	-0.0531	-0.0940	-0.0049	**1.0000**							
Days in Container	0.0759	0.0427	0.0248	0.0085	0.0200	0.0418	0.0431	0.0091	**1.0000**						
Makeshift tap	-0.0049	-0.0129	-0.0717	-0.0144	0.0339	0.0578	0.0950	0.1023	0.0275	**1.0000**					
Scoop and drink	-0.0064	0.0360	0.0149	0.0169	0.0184	-0.0466	0.0127	0.0293	0.0078	0.0611	**1.0000**				
Container closed	0.0562	-0.0909	-0.0729	-0.0067	-0.0737	0.0528	0.0315	0.0085	0.0187	0.0194	-0.0690	**1.0000**			
Wash often	-0.0300	-0.1533	-0.1741	0.0045	0.0252	0.0401	0.0351	-0.0719	-0.0092	-0.0700	-0.0489	0.1244	**1.0000**		
Soap	0.0031	-0.0624	-0.0418	-0.0055	0.0391	0.0502	-0.0089	0.1642	-0.0302	0.0928	0.0608	0.0785	0.0349	**1.0000**	
Handwashing	-0.0614	0.0306	0.0188	0.0071	0.0103	-0.0027	0.0384	-0.2315	-0.0148	-0.0811	-0.0254	0.0350	0.1264	0.0080	**1.0000**

Note: Statistical significance is indicated by colour: Red indicates significance at the 10% level, yellow indicates significance at the 5% level and green indicates significance at the 1% level.

*Highly Credible gastrointestinal illness (HCGI) includes symptoms of diarrhoea, vomiting, and stomach cramps

4.2 THE RELATIONSHIPS BETWEEN HOUSEHOLD BEHAVIOUR, WATER QUALITY, AND HEALTH

Although pairwise correlations are useful in analysing the relationship between variables, this does not impose any structure on the possible pathways and directions of correlation. In addition to the pairwise correlations reported above, a structural equation model (SEM) is therefore also applied to understand the interplay between household behaviours indicated by the measures discussed above and both water quality and diarrhoea. A SEM is a technique that is used to test and examine the direct and indirect hypothesized relationships among variables (Gefen et al., 2000). Using this technique enables us to understand the direct and indirect pathways linking household behaviour and the presence of *E. coli* in stored water and diarrhoea prevalence. From the literature review, we conceptually model the channels linking household behaviours and water contamination at the household point of use, and how this is related to diarrhoeal illnesses and water quality. Figure 9 captures the SEM path diagram with estimated coefficients from the estimated model of relationships between variables capturing household behaviour, water quality and diarrhoeal prevalence.

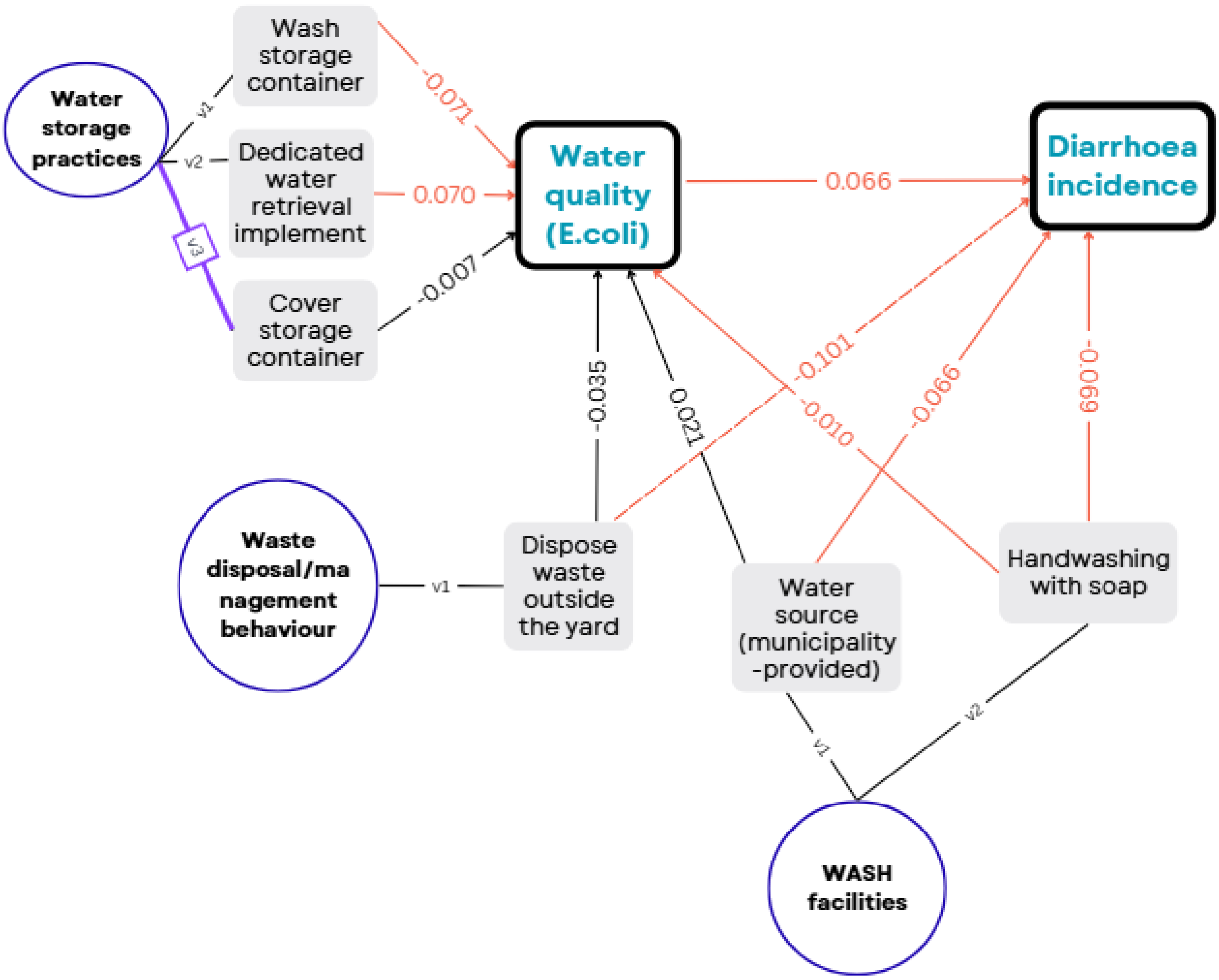

Figure 9: SEM path diagram

Notes: SEM path diagram modelling household behaviours, water quality and diarrhoea with estimated coefficients. Solid arrows indicate direct pathways, while dashed ones indicate indirect pathways. The arrows highlighted in orange indicate the statistically significant pathways at a 5% level of significance. The outcomes of interest are household stored water quality, as shown by the presence of *E. coli*, and diarrhoeal illness in the household.

4.2.1 Discussion

The results from the SEM analysis indicate that household water storage behaviours in Siyanyanzela and Khotsong are important routes for faecal contamination of water at the point of use. The results show that poor hygiene of water storage containers and water retrieval implements are significant exposure pathways for *E. coli* presence in household stored water. Households that wash their water storage containers at least twice a week have a significantly lower risk of water contamination. These findings conform to existing evidence documenting that frequently washing or disinfecting water storage containers lowers faecal contamination of stored drinking water (Staddon and Brewis, 2024; Berihun et al., 2023). While proper washing and disinfection of containers lowers contamination, Gärtner et al. (2021) and Meierhofer (2019) point out that the commonly used practice of cleaning containers with a mixture of water and sand potentially leads to further contamination by reintroducing bacteria due to abrasion.

The results from the SEM reveal that the implement (cup or jug) used to retrieve water is a significant pathway for stored water contamination. There is less risk of water contamination among households with proper water retrieval practices (i.e., having a dedicated water retrieval implement that is used only for accessing water from the storage container). This could be because households: dip cups or jugs to access water from the containers that may get contaminated from unclean hands (Kirby et al., 2016), use vessels without handles (Harris et al., 2013) and interchangeably use the implements for multiple purposes within the household.

The findings from the SEM reveal that proper household waste management behaviour, although decreasing the risk of contamination, is not a significant pathway for water microbial contamination. These findings are contrary to previous evidence that shows that improper waste management provides an unsanitary environment for pathogen-carrying vectors that may come into contact with stored water or water retrieval vessels (Kirby et al., 2016). However, the analysis indicates that improper waste management is a significant transmission mechanism for diarrhoea, consistent with previous studies (Usman et al, 2018; Juvakoski et al., 2023; Raphela et al., 2024).

The model reveals that the quality of drinking water is a significant transmission pathway for diarrhoea in these communities. The finding that drinking contaminated stored water is associated with diarrhoeal illnesses among households is supported by existing literature documenting that faecal-contaminated water is an effective pathway for transmitting diarrhoea pathogens (Parvin et al., 2021; Khan et al., 2021).

Handwashing and water provision facilities are also significant pathways for the transmission of diarrhoea-causing pathogens among these households, findings that have been shown in other studies. Proper handwashing with soap lowers the risk of diarrhoea by eliminating pathogens often detected on dirty hands, particularly when children put their hands directly in their mouths or indirectly contaminate objects and food that they ingest (Hashi et al., 2017; Luby et al., 2011). In addition, washing hands with soap lowers diarrhoea among young children by preventing food contamination by mothers or caregivers (Bisimwa et al., 2022).

The analysis also shows that the household source of drinking water is an efficient diarrhoea-pathogen transmission mechanism. Although primarily relying on improved water sources, households in these communities that obtain water from self-made or makeshift taps (not installed by the municipality) are associated with a higher risk of diarrhoea. This speaks to the risk of the recontamination of the treated municipal water when households illegally connect these self-made taps to the existing formal water infrastructure, which may expose the water to pathogens coming from the ground around the water pipes. It also speaks to the lack of water access in the communities. Although standpipes have been erected in Siyanyanzela and Khotsong, they are insufficient to meet the growing water needs in the community. This has arguably contributed to the installation of self-made taps. These results provide the background for the development of the behavioural intervention discussed in the next chapter.

CHAPTER 5: DESIGN AND ROLL-OUT OF VIDEO INTERVENTION

5.1 INTRODUCTION

The aim of this chapter is to describe the process of designing the video in collaboration with the communities of Siyanyanzela and Khotsong, making use of the conclusions from both the literature review and the baseline data analysis – specifically the results from the SEM reported in the previous chapter. The chapter also describes the randomised roll-out of the video and reports on the balance of the treatment and control samples at baseline.

5.2 DESIGN OF VIDEO

A core component of the project was the understanding that there would have to be buy-in about the intervention from the communities, which would culminate in a co-designed intervention as a collaborative output between the researchers and the communities. On 29 April 2025, discussions with two focus groups were facilitated by Caroline Poole and Nobubele Qetsu in Siyanyanzela. The first group consisted of eight women from Siyanyanzela and the second of eight women from Khotsong. The women were aged between 18 and 60 years. The focus group guidelines have been provided as Appendix F at the end of the report.

The focus group discussions touched on: the current household drinking water collection and storage practices; the individuals in the communities who are seen as authority figures within the community and from whom the community would be open to accept a message about water safety; what framing and tone of the video intervention would be best suited and best accepted by the individuals in the communities; and assessing the acceptability of such a video.

The discussions confirmed some of the prior assumptions about the nature of the video but also revealed additional considerations that had not previously been understood. A summary of the main conclusions from the focus group discussions is provided below:

5.2.1 Existing water collection and storage practices

- The main source of water for households in these two areas is the illegal (makeshift) taps that are erected by household members themselves in their yards. This practice is very widespread in the two areas and only a minority of inhabitants walk to the municipal standpipes and collect water from there.
- There is also a geographic component to this since households closer to the municipal standpipes are more likely to collect their water from there instead of erecting their own makeshift taps.
- Households use plastic buckets (5, 10, or 25 litres) to collect and store their water in.
- Household members do not wash their hands before collecting water or scooping water from the bucket
- Household members do not use a dedicated cup and would repeatedly scoop and drink from the same cup

- Participants are worried about the quality and safety of the municipal water. Many are concerned about the discolouration of the water, which is naturally brown/red as a result of the vegetation and soil in the area.
- There are low levels of trust in the municipality

5.2.2 Community authority figures

- The younger focus group from Khotsong preferred a clinic sister in uniform or someone from the university who is fluent in isiXhosa. The older group from Siyanyanzela preferred a ward councillor or ward committee member, or even a pastor or teacher. They were distrusting of people from the outside and preferred someone who was from their own community. They were also open to the idea us the clinic sister in her uniform. Both groups indicated that they would not take cartoons seriously, it had to be real people.

5.2.3 Framing and tone of video

- Because it was very difficult to convey these abstract concepts to the groups, Caroline facilitated this discussion using examples. For the older group from Siyanyanzela, there was a preference for the video to be shared in a public place such as the community hall. They indicated that they did not typically have data on their phones to watch videos, but they did have data bundles for WhatsApp. They also suggested having pictures that could be viewed on WhatsApp to support the video.
- The older group indicated that they wanted to be told what NOT to do. They liked the idea of getting the community together and screening the video and communicating to the community what behaviour they needed to change.
- The younger group from Khotsong also agreed that it would be beneficial to get the community behind the idea by having public posters in shops and creating a “buzz” about the information that the video contained. However, they did not like the idea of any prescriptive type of messaging. They would rather be told WHY they should avoid certain behaviours and how this would benefit them.

5.2.4 Assessing the potential impact of the video

- Both groups were very positive when asked about the potential impact of the video on their behaviour. They indicated that had they known about how to keep their water safe, they would have changed their behaviour because any outbreak of diarrhoea negatively impacts their children and them.

A video script was developed after taking the focus group discussions and the findings from the structural equation model into consideration. The process was informed by consulting various community leaders, including the ward councillor for the area, the sister from the local clinic and residents in the communities who had been fieldworkers in the baseline household survey.

The main conclusions from the model set out above and the focus group discussions with the community resulted in the following points being identified as the main messages that the video would have to convey as well as who the most appropriate person would be to convey the message. The film script was developed around these messages:

- A message about the importance of drinking clean water to avoid getting ill (sister from the local clinic)

- A message about the safety of the municipal water provided by the Theewaterskloof Municipality, and safety of this water even when it is discoloured (ward councillor)
- A message about the importance of obtaining water from the municipal standpipe and not a self-made/makeshift tap (ward councillor)
- A message about the correct way to collect and store water to avoid contamination (fieldworker/narrator)
- A message about what to do if you are unsure whether your water is clean or not, along with water treatment that is safe and affordable for the community (fieldworker/narrator)
- A message about the importance of keeping your household waste away from the water and your plot (fieldworker/narrator)

After a final video script had been settled on, it was translated into spoken isiXhosa, since this was the predominant language spoken in the two communities. The English version of the final video script has been attached to the report as Appendix G.

It was decided that the video would have English subtitles for the rare instances where individuals were not able to understand isiXhosa. The video was filmed on 30 June 2025 in Siyanyanzela. Both the sister from the local clinic as well as the ward councillor agreed to appear on the video. One of the fieldworkers who had assisted with fieldwork on the project agreed to participate as the narrator.

Feedback on the acceptability and clarity of the video was obtained in the first week of September 2025. In this focus group session, 16 women (eight from Siyanyanzela and eight from Khotsong) were asked to watch the video, and then recall the messages that they remembered from the video. They were also asked about the accuracy of the translation, the sequence and the sound quality. Feedback from these women lead to a shortening of the video and a change in the sequence of the messages to improve recall. The video was finalised at the end of September. A selection of screenshots from the final video have been included below. The final version of the video is available at this link:

https://www.dropbox.com/scl/fi/3oqd4ak3f2c5dylczy2i8/BEAM_FINAL_1080p.mp4?rlkey=e8d62uagyvf9nlq8e478y70hi&dl=0

Figure 10: Filming if the video on water safety in Siyanyanzela during June 2025

Figure 11: Filming of the video on water safety in Siyanyanzela during June 2025

Figure 12: Screenshot of community nurse from video on water safety

Figure 13: Screenshot of ward councillor from video on water safety

Figure 14: Screenshot of narrator, Okuhle Zongo, from video on water safety

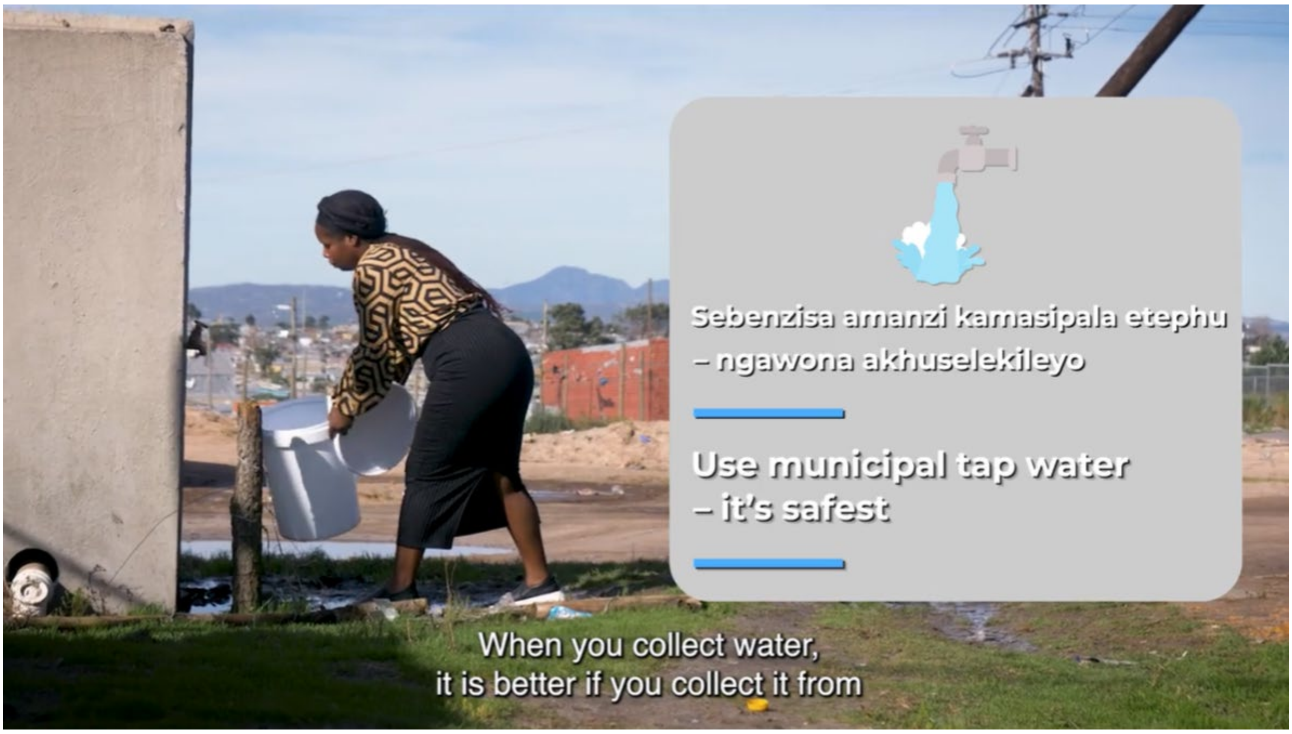

Figure 15: Screenshot from video on water safety

In addition to the video intervention, it was also decided to leave behind a visual reminder of the five most important steps to ensure that water is stored safely. After considering the feedback from the focus group discussions it was decided that the visual reminder should take the form of a high-quality vinyl sticker that the household could stick to either their water container or to a flat surface in their home. The sticker has been reproduced below.

5.3 ROLL-OUT OF THE INTERVENTION

5.3.1 Randomisation strategy

The randomisation of the video was implemented as a two-arm, household-level randomised controlled trial. The unit of randomisation, intervention and analysis is the household. Households were randomly assigned to one of two study arms – treatment (n=312) or control (n=315). Households assigned to the treatment group received a single in-home visit during which fieldworkers screened a water-safety video of approximately eight minutes on a tablet to available household members. In addition, a small visual reminder in the form of a sticker with simple icons was placed on the household's primary drinking-water container or another flat surface, depending on the stated preference of the household. Households in the control group did not receive an in-home visit during the study period.

Randomisation was conducted using computer-generated assignment lists. To ensure balance across key characteristics, randomisation was stratified by settlement (Siyanyanzela versus Khotsong) and by baseline stored-water contamination status (presence versus absence of *E. coli*). Within each stratum, households were allocated using permuted blocks of varying sizes. Allocation lists were generated centrally by the principal investigator, and fieldworkers received information on treatment assignment only for the purposes of intervention delivery.

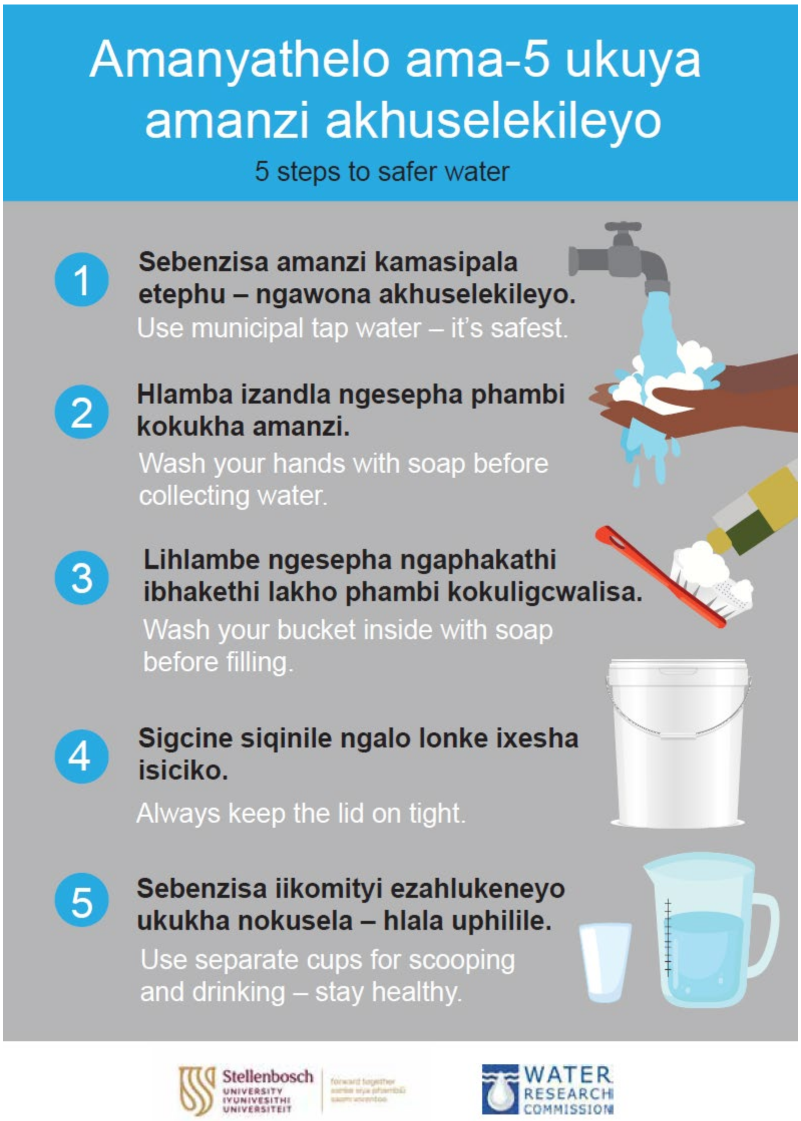

Figure 16: A copy of the vinyl sticker that was given to each treated household

To minimise bias, the fieldworkers delivering the intervention were not the same as the fieldworkers conducting the endline survey. Intervention exposure occurred exclusively through in-home visits; no public or group screenings of the video were conducted.

During treatment visits, fieldworkers recorded basic implementation details, including start and end times. During the visit, household members viewed the video, there was a brief recall check and then confirmation of sticker placement. These measures were collected for monitoring purposes only; all impact analyses follow an intention-to-treat approach.

Potential spillover effects were addressed in two ways. First, all households were asked at endline whether they had been exposed to the video or visual reminder, regardless of treatment assignment. Second, GPS coordinates were used to calculate distances between households in order to explore spatial spillovers in later analyses.

Based on baseline data, the mean prevalence of *E. coli* contamination in stored water was 0.12 (standard deviation 0.33), and the proportion of households reporting at least one diarrhoeal case in the past 30 days was 0.21 (standard deviation 0.41). Assuming a two-sided test with a significance level of 5% and 80% power, the minimum detectable effect size is approximately 7 percentage points for stored-water contamination and 9 percentage points for diarrhoeal outcomes. The low explanatory power of baseline covariates ($R^2 \approx 0.02$) suggests that additional covariate adjustment is unlikely to materially affect statistical power.

The trial was pre-registered on the American Economic Association's registry for randomised controlled trials (AEARCTR-0016551) and is available at https://doi.org/10.1257/rct.16551-1.0.

5.3.2 Balance at baseline

In order to be able to attribute any differences in the outcome variables at endline to the intervention, it is essential that treatment and control households are comparable (in terms of observable characteristics related to the storage of water) at baseline. Balance checks were therefore conducted on key household, water, and health characteristics prior to the intervention. The table below reports the baseline means for treatment and control households and the results from t-tests of statistical differences.

Table 6: Balance of sample at baseline

Variable	Control group mean (standard deviation)	Treatment group mean (standard deviation)	Differences in means (C-T) t-statistic
Proportion of sample where *E. coli* was present in water sample	0.117 (0.322)	0.125 (0.331)	-0.289
Proportion of sample which reported that any household member had diarrhoea in past 30 days	0.225 (0.419)	0.199 (0.400)	0.816
Proportion of sample residing in Siyanyanzela	0.838 (0.369)	0.840 (0.367)	-0.056
Proportion of sample that had soap present at hand-washing area	0.368 (0.027)	0.299 (0.458)	1.822
Proportion of sample that had designated space for handwashing in the house or yard	0.594 (0.492)	0.614 (0.488)	-0.509
Proportion of households with at least one child under the age of 5 years	0.311 (0.464)	0.301 (0.460)	0.267
Proportion of households where container had a lid on	0.870 (0.337)	0.897 (0.304)	-1.062
Proportion of sample who make use of a makeshift tap as their main source of drinking water	0.771 (0.421)	0.758 (0.429)	0.371
Frequency of washing storage container (per week)	1.468 (0.808)	1.521 (0.915)	-0.764
Proportion of sample reporting that they retrieve water from the storage container using a dedicated cup which they do not drink from	0.087 (0.282)	0.072 (0.258)	0.696
Sample size	315	312	

Note: #Statistical significance: * denotes $p \leq 0.05$

The results indicate that treatment and control groups were well balanced at baseline, with no statistically significant differences across the main outcome or control variables at conventional levels of significance. This provides support for the fact that randomisation was successful in ensuring two comparable groups.

Chapter 6 describes the endline sample and attrition patterns in more detail. Although overall attrition between baseline and endline was approximately 29%, balance was maintained in the analytical sample used to estimate intervention impacts. Full balance results for the endline sample are reported in Appendix G.

5.3.3 Conclusion

This chapter has described the design, randomisation, and implementation of the behavioural intervention, as well as the procedures adopted to ensure comparability between treatment and control households. The analysis now turns to the evaluation of its effects. Chapter 6 presents the endline results, examining differences between treatment and control households' behaviour related to water storage, as well as stored water quality and self-reported diarrhoeal outcomes.

CHAPTER 6: ENDLINE EVALUATION AND IMPACT OF THE INTERVENTION

6.1 INTRODUCTION

This chapter presents the results from the endline survey and water tests and estimates the impact of the video intervention on the outcome variables discussed in the previous chapters.

6.2 EVALUATION DESIGN AND ENDLINE DATA

As set out in Chapter 5, the video intervention was implemented as a randomised controlled trial, with 315 households randomly assigned to the control group and 312 households assigned to the treatment group. Randomisation was stratified by area (Siyanyanzela and Khotsong) as well as by baseline water contamination status (whether *E. coli* was detected in the stored water sample at baseline). Prior to the roll-out of the intervention, balance was ensured between treatment and control groups on key observable characteristics, as reported in Table 6 in the previous chapter. Balance was also achieved in the estimation sample after accounting for attrition at endline; these results are presented in Appendix H.

The intervention was rolled out between 7 October and 1 November 2025. During this period, fieldworkers delivered the video intervention and accompanying visual reminder in person to households assigned to the treatment group. No visits were made to control households during this time. Endline data collection took place between 7 November and 1 December 2025.

Both Siyanyanzela and Khotsong experience high levels of population mobility due to the fact that their residents are often migrant workers, many of whom migrate to these settlements for seasonal employment. As a result, tracing households across survey waves was challenging, particularly due to out-migration from the area. Enumerators were instructed to trace households by first visiting the last recorded address from the baseline survey. They then administered a screening questionnaire to establish whether the baseline respondent was still resident in the household. If the original respondent was no longer a resident, enumerators asked whether any other adult (18 years or older) who had been present at baseline was still living in the household. If either the original respondent or another adult baseline household member was still resident, the household was included in the endline survey. If none of the adults who had resided in the household at baseline were still living in the structure, the household was excluded from the endline survey.

In a small number of cases, the original household (defined as the same adult members present at baseline) had relocated to another structure within Siyanyanzela or Khotsong. These households were also included in the endline sample, as long as at least one adult household member who had been resident at baseline was still present. The aim was therefore to trace the household members themselves, rather than the physical dwelling alone.

6.3 ENDLINE SAMPLE AND ATTRITION

Endline interviews were conducted approximately three to four weeks after the intervention was delivered to each household. Attrition between baseline and endline is discussed in this subsection. Overall, the attrition rate in the treatment group was 28.53%, with 223 of the 312 baseline households successfully traced and interviewed at endline. In the control group, attrition was slightly lower at 25.08%, with 236 of the 315 baseline households re-interviewed. The difference in attrition rates between treatment and control groups is not statistically significant (t-statistic for the difference in means = −0.973). In addition, there were four households who refused to participate in the study, either completely or partially (one household refused to participate in the survey and water tests and three households refused to participate in the survey, but consented to water samples being collected).

To better understand the characteristics of households that attrited from the study, Table 7 compares baseline characteristics of households that remained in the sample with those that were not re-interviewed at endline and reports tests of differences in means. The results indicate statistically significant differences in attrition across the two study sites, with households in Siyanyanzela more likely to attrit than those in Khotsong. In addition, households that attrited had significantly lower baseline asset index scores than households that remained in the sample, suggesting that poorer households were more likely to migrate out of the area between survey waves, potentially in search of employment.

While these differences point to selective attrition regarding the area where the households resided and their socioeconomic status, the rates of attrition are not different between treatment and control groups. In future analysis of the data for academic publication, such differences could be addressed through regression analysis.

Table 7: Differences in characteristics of attrited sample and estimation sample at baseline

Variable	Mean (standard deviation) of estimation sample observed at baseline and endline	Mean (standard deviation) of attrited sample only observed at baseline	t-statistic of differences in means[#]
Proportion of sample where *E. coli* was present in water sample	0.129 (0.335)	0.101 (0.023)	0.929
Proportion of sample which reported that any household member had diarrhoea in past 30 days	0.222 (0.019)	0.185 (0.030)	1.022
Proportion of sample residing in Siyanyanzela	0.863 (0.344)	0.774 (0.420)	2.694*
Proportion of households with at least one child under the age of 5 years	0.314 (0.465)	0.286 (0.035)	0.673
Average number of government grants received by household	1.063 (1.188)	0.976 (1.472)	0.762
Mean asset index score[##]	0.061 (1.084)	-0.164 (0.679)	2.518*
Sample size	168	459	

Notes: [#]Statistical significance: * denotes $p \leq 0.05$ [##]The asset index was calculated with multiple correspondent analysis using a list of assets as set out in question 1.30 in the household questionnaire in Appendix D. The index was standardised with a mean of 0 and standard deviation of 1.

6.4 KNOWLEDGE RETENTION IMMEDIATELY AFTER VIEWING VIDEO

At the endline, the same household questionnaire administered at baseline was used. The only additional questions were those designed to assess respondents' recall of the messages conveyed in the video intervention. Knowledge recall questions were administered at two points: first, immediately after the video was shown to respondents during the intervention phase in October 2025, and second, at the start of the endline interview, prior to the administration of the remaining survey questions during November 2025.

Knowledge recall questions were asked to all respondents in the treatment group, as well as to respondents in the control group who answered "yes" to either of the following questions: "*Have you seen any video about steps you must follow to keep your stored water clean and safe?*" or "*Have you seen any stickers setting out steps to keep your stored water clean and safe?*". Recall was tested using the open-ended question: "*What key messages from the video can you remember? Please tell me as many as you can.*" Enumerators recorded each recalled message that corresponded to one of the ten key messages conveyed in the video, listed below:

1	Use municipal water rather than a self-made tap
2	Use the right type of water storage container
3	Wash hands before collecting water
4	Wash the container inside before collecting water
5	Keep the container's lid on tight
6	Store the water inside in a cool place away from animals and children
7	Use a separate cup for scooping and drinking water
8	If unsure whether water is clean, rather boil before drinking
9	Keep your drinking water in a separate container from water for other uses
10	Keep rubbish away from the house

The distribution of knowledge recall scores measured immediately after viewing the video is compared with recall scores measured at endline in Figure 17 below. If anything, the endline distribution appears to be shifted to the right relative to the distribution observed immediately after the intervention. This suggests that respondents internalised the messages conveyed in the video during the period between the intervention and the endline interview (approximately three to four weeks), potentially reinforced by the presence of the visual reminder left in the household.

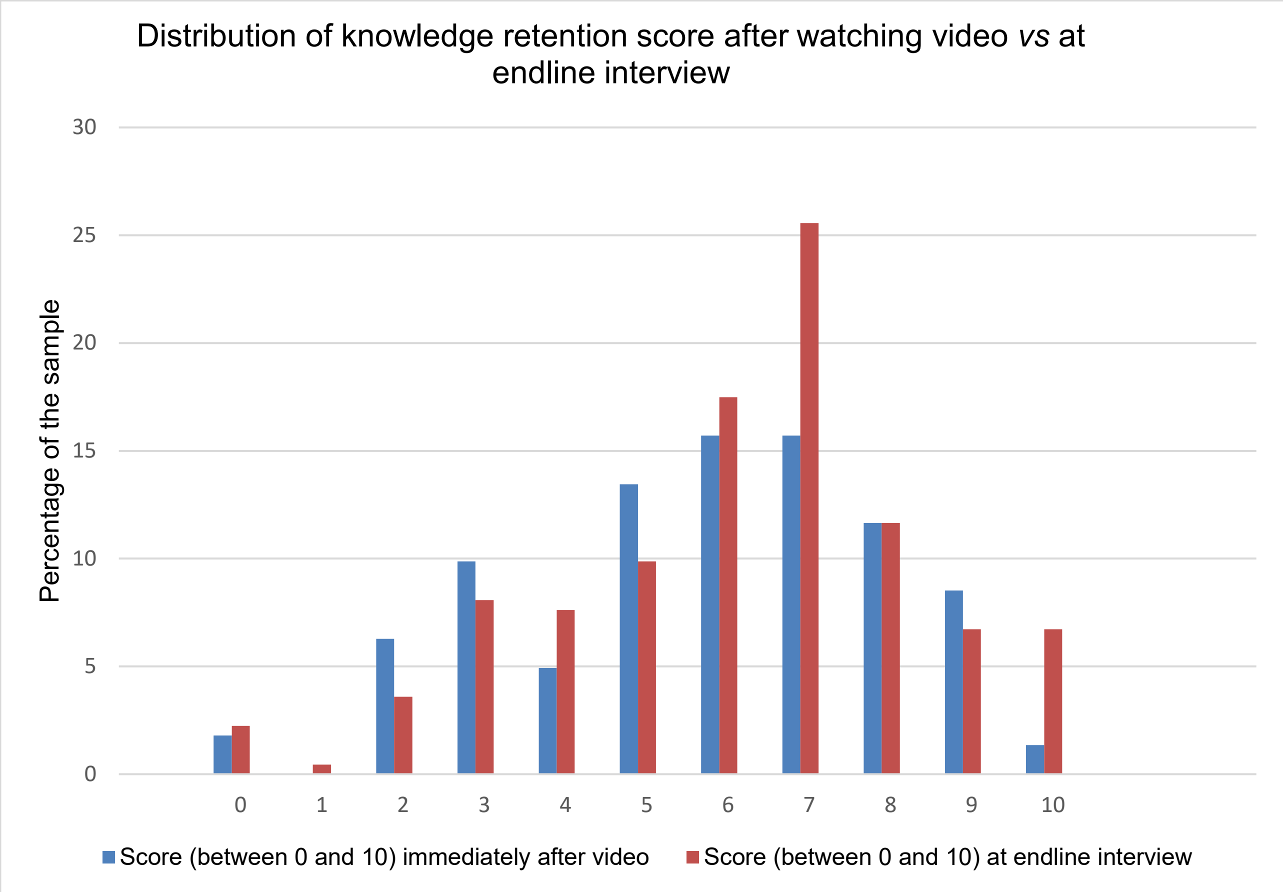

Figure 17: Distribution of knowledge recall

6.5 ENDLINE WATER SAMPLE COLLECTION AND MICROBIOLOGICAL WATER ANALYSIS

Endline water collection followed the identical protocol at baseline and will therefore not be repeated here, as it has already been reported in detail in Chapter 3. As a summary, a 50 mL water sample was collected from each baseline survey participating household located in the informal settlement areas of Siyanyanzela and Khotsong. A total of 462 water samples were then collected from the informal communities, of which 462 were houses where water samples were collected from the primary storage containers. The discrepancy between the total sample of water tests (462) and the survey sample size (459) results from the fact that there were three households who gave informed consent for the water tests but not the interview (i.e. partial refusals).

Following sample collection, the quality of the stored water was assessed by determining the presence of *Escherichia coli* (*E. coli*) and coliforms. This was conducted using the Petrifilm™ *E. coli*/ Coliform (EC) Count Plates (3M™, South Africa). Briefly, the water samples were vortexed thoroughly, whereafter 1 mL of the water sample was placed onto the Petrifilm™ EC Plates as per the manufacturer's instructions. The samples were then incubated at 37°C for 24 hours, after which the colony forming units (CFU)/100 mL was determined. Colonies with a blue pigment associated with gas were identified as *E. coli*, while red colonies within one colony diameter of entrapped gas were recorded as coliforms. The total coliform count was then determined as the number of red and blue colonies present at 24 hours.

6.5.1 Sample Processing and Petrifilm™ Analysis

A total of 462 water samples, collected from household water storage containers located in the informal settlement areas of Siyanyanzela and Khotsong, Grabouw (rural settlement in the Western Cape, South Africa GPS co-ordinates: 34°09'31.3"S 18°59'09.0"E) were then subjected to Petrifilm™ EC Plate Counts analysis. Based on the Petrifilm™ EC Plate Counts, 22.9% (106/462) were found to contain *E. coli/*coliforms (total coliforms) with results ranging from 1.00 × 10^2 to 9.6 × 10^4 CFU/100 mL (Figure 3 and Table 1, Appendix).

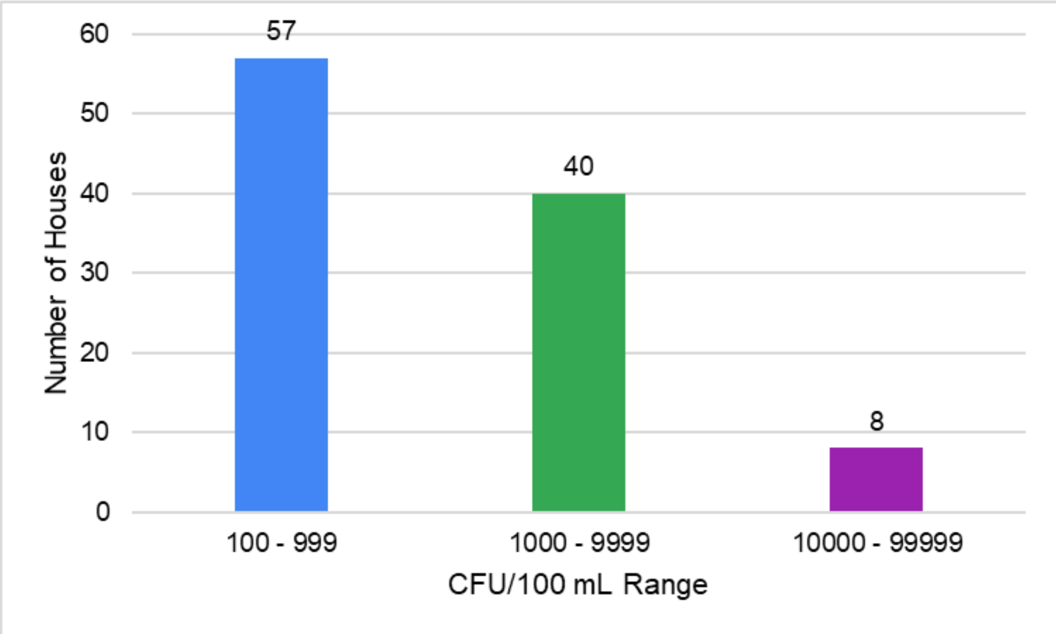

Figure 3. The range of the CFU/100 mL for the number of houses in the Grabouw informal settlement areas that tested positive using the Petrifilm™ EC Count Plates

Of the 106 samples found to contain *E. coli*/ coliforms (total coliforms) using the Petrifilm™ EC Plate Count assay, 53.8% (57/106) were found to contain *E. coli/*coliforms (total coliforms) at a range of 1.00 × 10^2 to 9.00 × 10^2 CFU/100 mL, 37.7% (40/106) at a range of 1.00 × 10^3 to 9.00 × 10^3 CFU/100 mL and 7.5% (8/106) at a range of 1.00 × 10^4 to 9.00 × 10^4 CFU/100 mL (Figure 3). In conclusion, the *E. coli*/total coliform levels detected – using the Petrifilm™ EC Plate Count assay – exceeded the South African National Standards (SANS) 241 guideline limit (≤ 10 total coliforms/100 mL) in 22.9% (106/462) of water samples collected from household storage containers in the informal settlement communities. These findings raise significant public health concerns and underscore the need to identify potential sources of contamination, including inadequate sanitation infrastructure and suboptimal water storage practices (South African Bureau of Standards, 2015).

The levels of contamination are much higher at endline (106/462=22.94%) compared with baseline levels (76/627=12.12%). The higher prevalence of contaminated water observed at the end compared with baseline may also be attributed to several factors – such as seasonal variation, container hygiene, storage duration, and household handling practices. Although some of these practices were targeted by the intervention, as reported in the next section, the impact of the intervention on these practices was not significant.

6.6 IMPACT OF THE INTERVENTION

In this section, the impact of the intervention on household behaviour, health outcomes, and water quality is reported. Table 8 provides a summary of the mean values of the targeted variables for treatment and control households at endline. These variables include final outcomes, such as diarrhoeal prevalence and stored water quality, as well as intermediate behavioural pathways related to water storage, handling and retrieval practices. The table also reports t-statistics for differences in means between treatment and control groups in order to assess statistical significance. While this analysis is descriptive in nature, it relies on the randomised design of the intervention and the fact that balance was achieved between treatment and control groups at baseline and maintained after attrition.

Table 8: Impact of the intervention on behaviour, health and water quality

Variable	Mean (standard deviation) of control group at endline survey	Mean (standard deviation) of treatment group at endline survey	t-statistic of differences in means (C-T)#
Outcome			
Proportion of households where presence of *E. coli* in water sample was detected	0.237 (0.426)	0.211 (0.409)	0.680
Proportion of households reporting at least one person with diarrhoea in the last 30 days	0.136 (0.343)	0.045 (0.207)	3.405*
WASH behaviour/knowledge			
Proportion of households with soap present (as confirmed by fieldworker)	0.449 (0.498)	0.572 (0.496)	-2.644*
Proportion of households with dedicated space for handwashing in the yard	0.873 (0.334)	0.928 (0.259)	-1.978*
Water collection, storage and retrieval behaviour/knowledge			
Proportion of households where container has a lid on	0.932 (0.252)	0.964 (0.186)	-1.536
Proportion of households whose primary source of drinking water is a makeshift tap	0.898 (0.303)	0.892 (0.311)	0.207
Proportion of households who wash their storage containers at least twice a week	0.805 (0.397)	0.848 (0.360)	-1.197
Proportion of households who reported having a dedicated cup to scoop and drink water from the storage container	0.204 (0.404)	0.130 (0.337)	2.129*
Proportion of households reporting that they routinely purify their water before drinking it (including boiling the water)	0.068 (0.253)	0.056 (0.230)	0.534
Sample size	236	223	

Notes: #Statistical significance: * denotes $p \leq 0.05$

6.6.1 Impact on water quality

There is no statistically significant difference in the proportion of households whose stored water samples tested positive for the presence of *E. coli* between treatment and control groups at endline. This suggests that the intervention did not have a measurable impact on stored water quality.

6.6.2 Impact on diarrhoea

The proportion of households reporting that at least one household member experienced diarrhoea in the past 30 days is statistically significantly higher in the control group (approximately 13.6%) than in the treatment group (approximately 4.5%). This points to a substantial reduction in diarrhoeal prevalence among households exposed to the informational intervention compared with households that did not receive the intervention.

6.6.3 Impact on behaviour/knowledge

Although knowledge of safe water practices was not assessed directly through a dedicated knowledge test, the survey included a range of questions on self-reported water- and hygiene-related behaviours. Responses to these questions also serve as indirect measures of household knowledge regarding safe practices. It is well established that households may not always report their behaviour accurately and may instead report what they perceive to be socially desirable. As such, reported behaviour is likely to capture a combination of actual practices and knowledge of recommended behaviours.

With respect to WASH-related behaviours, fieldworkers verified that households in the treatment group were significantly more likely to have soap present in the household compared to households in the control group (57.2% versus 44.9%). In addition, treatment households reported statistically significantly higher rates of having a dedicated handwashing space in their yards (92.8%) relative to control households (87.3%). These findings suggest that the video intervention increased awareness of the importance of handwashing with soap and provides a plausible behavioural pathway through which reductions in diarrhoeal prevalence may have occurred in the treatment group.

In contrast, the results relating to water collection, storage, and retrieval behaviours are less encouraging. None of the variables capturing these practices show statistically significant differences between treatment and control groups. Notably, the proportion of households reporting the use of a dedicated cup for scooping and drinking water from the storage container is significantly higher in the control group than in the treatment group. Overall, the absence of significant changes in reported water storage and handling behaviours provides a likely explanation for the lack of observed impact on stored water quality.

6.7 CONCLUSION

In conclusion, the behavioural intervention appears to have been effective in changing household behaviour related to hand hygiene, but not in influencing practices associated with water collection, storage and retrieval. This pattern is likely explained by the fact that water-related behaviours are more difficult to change in the absence of corresponding improvements in underlying infrastructure. The next chapter examines potential spill-over effects of the intervention and presents an indicative assessment of its cost-effectiveness.

CHAPTER 7: SPILL-OVER EFFECTS AND INDICATIVE COST-EFFECTIVENESS

7.1 INTRODUCTION

This chapter provides additional analysis of the effectiveness of the intervention. Specifically, it examines potential spill-over effects by assessing whether households in the control group were inadvertently exposed to the intervention and whether such exposure influenced their outcomes. As a second objective, the chapter provides an indication of the costs related to the implementation of the intervention and situates the findings of this study within the broader literature by comparing the observed impacts of the intervention to those reported for similar behavioural interventions. It also relates these impacts to the relatively low cost of the intervention to provide an indicative assessment of cost-effectiveness and scalability.

7.2 SPILL-OVER EFFECTS

The spill-over effects of the intervention are assessed by comparing households in the control group that were exposed to the intervention with households in the control group that were not exposed. It should be emphasised that spill-over effects were not explicitly targeted in the study. However, households in these communities live in close proximity to one another, and neighbours may have been exposed to the video or the visual reminder through households in the treatment group.

It is also important to note that baseline sampling was conducted randomly by selecting one out of every five households, using a geographically ordered approach based on streets. Replacement took place if a selected household was unwilling to participate. As a result, treatment and control households were unlikely to be located immediately adjacent to one another. Nevertheless, spill-over could still have occurred, as households in these communities are likely to come into contact through shared resources and because limited dwelling space means that residents spend a substantial amount of time outdoors, where information is often shared informally.

Of the 236 households in the control group, 63 households (26.69%) reported exposure to the intervention through either viewing the video or seeing the visual reminder.

To assess potential spill-over effects, Table 9 reports differences in outcome and behavioural variables among households in the control group, comparing those who were exposed to the intervention through spill-over with those who were not. Because exposure among control households was not randomly assigned, the comparisons presented are descriptive and are not interpreted as causal estimates of spill-over effects.

The results indicate that both diarrhoeal prevalence and levels of *E. coli* contamination were lower among households with exposure to the intervention, although only the difference in *E. coli* contamination is statistically significant. In addition, households that were exposed to the intervention were substantially more likely to have soap present in the household (82.5%) compared to households with no exposure (31.2%). In contrast, the pattern is reversed for the variable capturing the presence of a dedicated handwashing space, with households without exposure being more likely to report such a space than exposed households (94.2% compared to 68.3%).

None of the variables related to water collection, storage, and retrieval differ significantly between the two groups, with the exception of the use of a dedicated cup for scooping and drinking water from the storage container. Among households exposed to the intervention, 31.7% reported engaging in this practice, compared to 16.3% among households with no exposure.

Overall, these findings can be interpreted as indicative of possible spill-over effects of the intervention. However, they should be treated with caution, as spill-over exposure was not part of the randomisation design and balance in baseline characteristics between exposed and unexposed control households was not ensured.

Table 9: Differences in means for the control group to assess spill-over effects

Variable	Mean (standard deviation) of the control group with no exposure to intervention at the endline survey	Mean (standard deviation) of the control group with exposure to the intervention at the endline survey	t-statistic of differences in means #
Outcome			
Proportion of households where the presence of *E. coli* in the water sample was detected	0.272 (0.446)	0.143 (0.353)	2.068*
Proportion of households reporting at least one person with diarrhoea in the last 30 days	0.145 (0.353)	0.111 (0.317)	0.661
WASH behaviour/knowledge			
Proportion of households with soap present (as confirmed by fieldworker)	0.312 (0.465)	0.825 (0.383)	-7.847*
Proportion of households with dedicated space for handwashing in the yard	0.942 (0.234)	0.683 (0.469)	5.620*
Water collection, storage and retrieval behaviour/knowledge			
Proportion of households where container has a lid on	0.919 (0.273)	0.968 (0.177)	-1.329
Proportion of households whose primary source of drinking water is a makeshift tap	0.902 (0.300)	0.889 (0.317)	0.288
Proportion of households who wash their storage containers at least twice a week	0.798 (0.403)	0.825 (0.383)	-1.197
Proportion of households who reported having a dedicated cup to scoop and drink water from the storage container	0.163 (0.370)	0.317 (0.469)	-2.632*
Proportion of households reporting that they routinely purify their water before drinking it (including boiling the water)	0.075 (0.265)	0.049 (0.218)	0.690
Sample size	173	63	

Notes: #Statistical significance: * denotes $p \leq 0.05$

While the evidence on spill-over effects is necessarily descriptive and should be interpreted with caution, the findings suggest that some elements of the intervention – particularly those related to hygiene awareness – may have extended beyond directly treated households. These potential spill-over effects are relevant when considering the broader reach and scalability of low-cost behavioural interventions. The following section therefore turns to an indicative assessment of the cost-effectiveness of the intervention by relating its observed impacts to the resources required for implementation and comparing these to similar interventions documented in the literature

7.3 INDICATIVE COST-EFFECTIVENESS

This section provides an indicative assessment of the cost-effectiveness of the intervention in order to provide context to discussions around scalability. Rather than conducting a full economic evaluation, the analysis documents the key cost components of developing and delivering the video intervention and thereafter it relates these costs to the main impacts observed at endline as reported in the previous chapter. The purpose is to provide a comparison of the resources required for implementation relative to the magnitude and nature of the impact of the intervention. Furthermore, the discussion situates these within the broader literature on similar low-cost behavioural interventions.

Table 10 summarises the costs associated with developing and delivering the behavioural intervention. Costs are reported on an intention-to-treat (ITT) basis, calculated using the full number of households assigned to the treatment group (312 households), which is the appropriate denominator for comparison with the impact estimates presented in Chapter 6. This approach reflects the real-world costs of implementing the intervention, including the fact that not all households assigned to treatment could be successfully reached at endline. It should also be pointed out that the costs for the tablets used for the intervention were not included, as these tablets were university assets that had already been acquired in previous projects. If the intervention were to be scaled, tablets or alternative delivery devices would represent an additional capital cost; however, these costs are likely to be modest relative to infrastructure-based interventions and may be further reduced through the use of existing municipal or clinic-owned devices.

Taking the total cost into account, the cost of the intervention is calculated at approximately R791. Excluding once-off development and capital costs, the estimated cost of delivering the intervention was approximately R263 per household on an intention-to-treat basis. This figure reflects the resources required to implement the intervention under realistic field conditions, including unsuccessful tracing of some households assigned to treatment. At this relatively low per-household cost, the intervention was associated with a sizeable reduction in reported diarrhoeal prevalence and improvements in hygiene-related behaviours. While this analysis does not constitute a formal cost-effectiveness evaluation and does not estimate cost per case averted or health-adjusted life years, the magnitude of the observed health impact relative to the modest delivery cost suggests that the intervention represents a potentially cost-effective demand-side complement to existing water and sanitation services.

It should also be noted that future scale-up of the intervention would not necessarily require the use of tablets or in-home visits. As digital infrastructure, including fibre connectivity, continues to expand into informal communities across South Africa, the video component of the intervention could be delivered directly to households via mobile phones. In such a model, follow-up visits could be conducted by trained community healthcare workers, primarily to reinforce key messages and distribute the visual reminder. This delivery approach would substantially reduce the marginal cost per household. Under a scenario in which the video is disseminated digitally and community healthcare workers are responsible only for distributing the visual reminders, the primary remaining cost would be the printing of the visual materials (approximately R6 000), implying a marginal cost of roughly R19 per household.

Table 10: Cost of intervention

Cost component	Description	Cost (Rands)	Cost Type
Video development	Script development, filming, production, editing, translation,	R150 000	Once-off
Tablets	Tablets used for in-home delivery of intervention (owned by University of Stellenbosch)	In-kind (not costed)	Capital
Visual reminder development	Development of the message and designing graphics, translation	R15 000	Once-off
Printing of visual reminders	Printing costs	R6 000	Recurrent
Fieldworker time	Time spent delivering the intervention (including meals and airtime)	R76 000	Recurrent
Total intervention cost		**R247 000**	
Cost per household assigned to treatment (intention to treat)		**R247 000/312=R791**	
Total recurrent cost (excluding once-off development costs)		**R82 000**	
Cost per household assigned to treatment (excluding once-off development costs)		**R82 000/312=R263**	

7.4 CONCLUSION

While the evidence on spill-over effects is descriptive and should be interpreted with caution, the findings suggest that some elements of the intervention – particularly those related to hygiene awareness – may have extended beyond directly treated households. Taken together, the findings on spill-over effects and the indicative cost assessment suggest that the intervention has the potential to impact the behaviour of households around hygiene and result in health benefits at relatively low cost, particularly when considered as an intervention to be incorporated into the existing public health system. These results highlight the value of low-cost behavioural interventions in settings where structural constraints limit the expansion of infrastructure. The final chapter summarises the main conclusions of the study and sets out recommendations for policy and future research.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 EMPLOYMENT AND CAPACITY BUILDING THROUGH FIELDWORK

Fieldwork for both the baseline and endline surveys was conducted using fieldworkers recruited from the study communities. These fieldworkers were provided with National Qualifications Framework (NQF) Level 5 training through a short course in survey enumeration and fieldwork offered by Stellenbosch University. In addition, reference letters were provided to support their future employment prospects.

By the time of the endline survey, only four of the original ten fieldworkers remained fully unemployed and available to work on the project. This outcome suggests that participation in the project contributed to improved employability and access to subsequent employment opportunities, highlighting an additional capacity-building benefit of the research beyond its primary objectives.

8.2 SUMMARY OF KEY CONCLUSIONS

There are several conclusions from the study. First, access to municipal water infrastructure in Siyanyanzela and Khotsong remains severely constrained, especially in light of the population growth driven by in-migration. The very limited number of functioning public standpipes has resulted in households constructing informal, self-made connections, which may increase the risk of contamination within the water infrastructure system.[3]

Second, the video intervention impacted hygiene-related behaviours, particularly handwashing practices and the availability of soap in households. These behavioural changes support the finding that the intervention reduced the prevalence of diarrhoea in households who were exposed to the intervention compared to households who were not. However, the intervention did not result in substantial changes in water storage, handling, or retrieval practices, nor did it lead to a reduction in microbiological contamination of stored drinking water.

Third, these differences in the findings – the improvements in health outcomes and the absence of improvements in stored water quality – highlight the limitations of behavioural interventions in contexts where the underlying water infrastructure remains unchanged. While improved hand-hygiene behaviour may interrupt faecal-oral transmission pathways, households continued to rely on water that was microbiologically contaminated, as evidenced by the fact that higher levels of water contamination were observed at the endline compared with the baseline.

Finally, the findings highlight the importance of multi-barrier approaches in approaches to diarrhoeal disease prevention. It is possible for improvements in hygiene behaviour to lead to lower levels of diarrhoea, even in constrained service-delivery environments. However, sustained reductions in exposure to waterborne pathogens are unlikely without there being complementary investments in water infrastructure and reliable access to clean water

[3] It should be noted that the Theewaterskloof municipality is aware of this problem and is planning to expand the water infrastructure in these areas.

8.3 RECOMMENDATIONS

The recommendations set out below are directly linked to the original project aims. Each recommendation reflects the extent to which the corresponding aim was achieved and draws on the evidence generated during the design, implementation and evaluation of the intervention.

- **Aim 1: Co-designing the intervention with community members**

The co-design process ensured that the intervention was locally credible and was well received by households. The empirical evidence reported here indicates that it was also effective in influencing hygiene-related behaviours and lowering the prevalence of diarrhoea.

- **Recommendation:**

The results from this study provide additional support for the current consensus that behavioural interventions aimed at changing human behaviour should be co-designed with community members and delivered using members of the community who are trusted and known, as this approach enhances acceptability and uptake.

- **Aim 2: Enrolling households and implementing the intervention**

Since mobile coverage at the time of the intervention was not universal, and access to data was expensive and therefore limited, household-level, in-home delivery of the intervention was the most feasible option to ensured high exposure.

- **Recommendation:**

Future WASH interventions in informal settlements should consider methods of delivery that are not reliant on mobile infrastructure. These could be home-delivery by community health workers and public screenings at clinics or community centres. The roll out of cheap fibre (which is currently taking place in Siyanyanzela and Khotsong as of January 2026) provides an opportunity for these messages to be sent to mobile devices making use of the fibre infrastructure.

- **Aim 3: Measuring the impact on water quality**

The intervention did not lead to improvements in the microbiological quality of stored drinking water This appears to reflect the persistence of upstream infrastructure constraints, continued reliance on contaminated water sources, and the absence of significant changes in household water storage and retrieval practices.

- **Recommendation:**

Behavioural interventions aimed at improving household water quality should be implemented alongside measures that address upstream water infrastructure and contamination at the water source. Implemented on their own, behavioural nudges are unlikely to result in long-term improvements in stored water quality where households are necessitated to rely on unsafe or unreliable water sources

- **Aim 4: Measuring the impact on knowledge**

Knowledge related to water safety and hygiene was assessed indirectly through self-reported and observed household behaviours, including the presence of soap, the availability of a dedicated handwashing space, and reported hygiene practices. The results indicate that households exposed to the intervention had improved behaviour (and by implication, knowledge) regarding specifically handwashing.

- **Recommendation:**

Targeted, low-cost informational interventions can be effective in improving household knowledge on hygiene behaviour and should be integrated into broader municipal and public health communication strategies.

- **Aim 5: Measuring the impact on diarrhoeal outcomes**

Reductions in reported diarrhoeal prevalence were observed among households exposed to the intervention, despite limited changes in stored water quality. This suggests that improvements in hygiene-related behaviours – particularly handwashing with soap – can interrupt faecal-oral transmission pathways even when water quality remains constrained.

- **Recommendation:**

In contexts where infrastructure expansion or upgrade is not feasible, hygiene-focused behavioural interventions should be considered as an efficient short- to medium-term strategy for reducing diarrhoeal disease.

- **Aim 6: Measuring spill-over effects**

Spill-over effects were observed among a subset of control households; however the effects were not observed for all outcome variables of interest. It should be noted that exposure outside the treatment group was not assigned as part of the treatment assignment and awareness of the intervention amongst the control group appears to have been created by informal interactions among community members.

- **Recommendation:**

Although a full spatial analysis of the spill-over effects was not conducted as part of this report, future analysis of the data would be able to take into consideration the spatial exposure of households relative to their position vis-à-vis treated neighbours.

- **Aim 7: Cost-effectiveness and scalability**

The intervention was low-cost and therefore feasible to scale up. However, its cost-effectiveness is in part determined by the availability of public health and municipal systems as well as infrastructure such as fibre networks.

- **Recommendation:**

Low-cost behavioural interventions should be viewed as complementary components of multi-barrier WASH strategies rather than stand-alone solutions. When considering scaling-up, cost-effectiveness assessments should take into account not only direct impacts but also opportunities to reduce marginal costs through digital roll-out and integration with existing public health systems.

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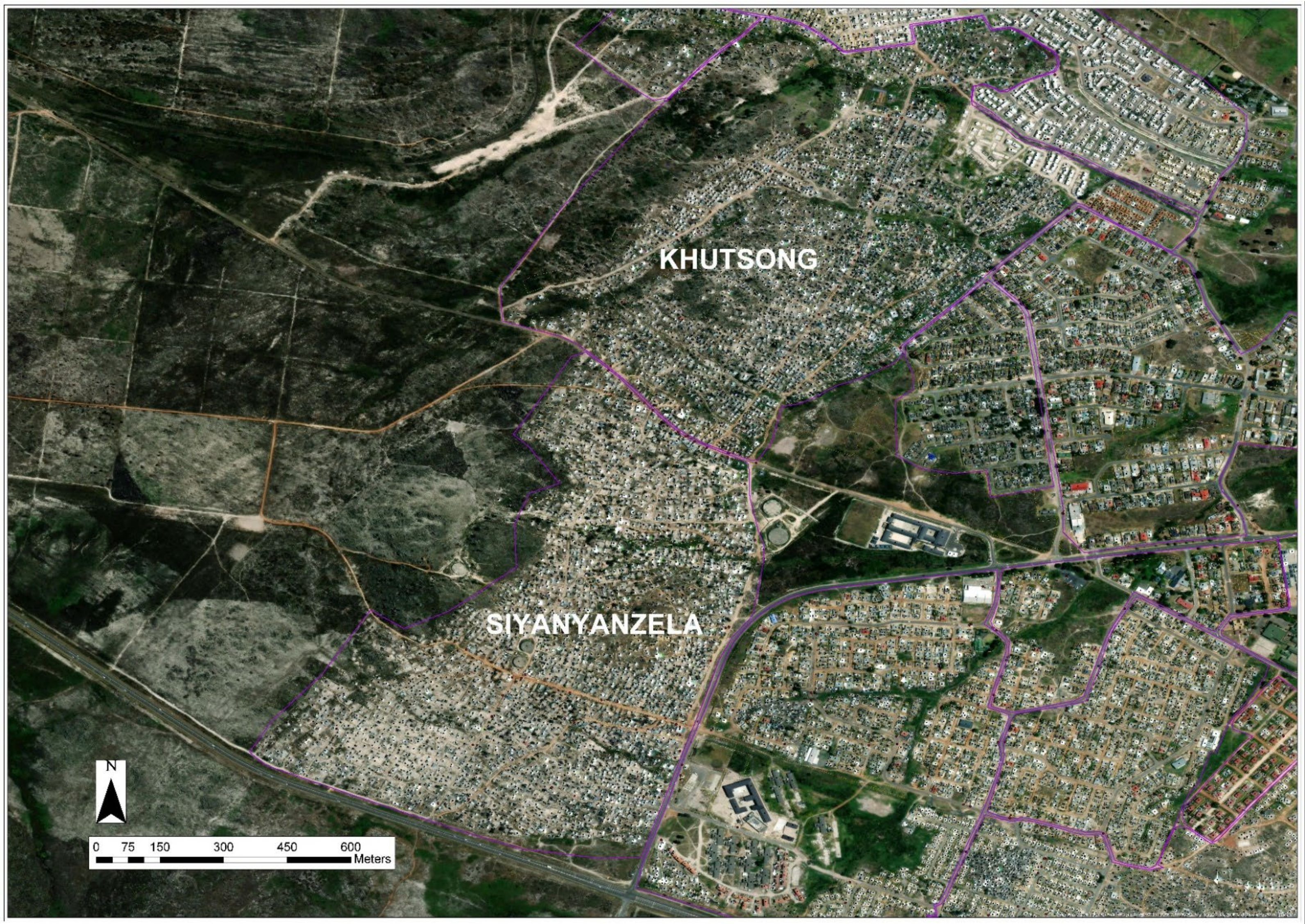
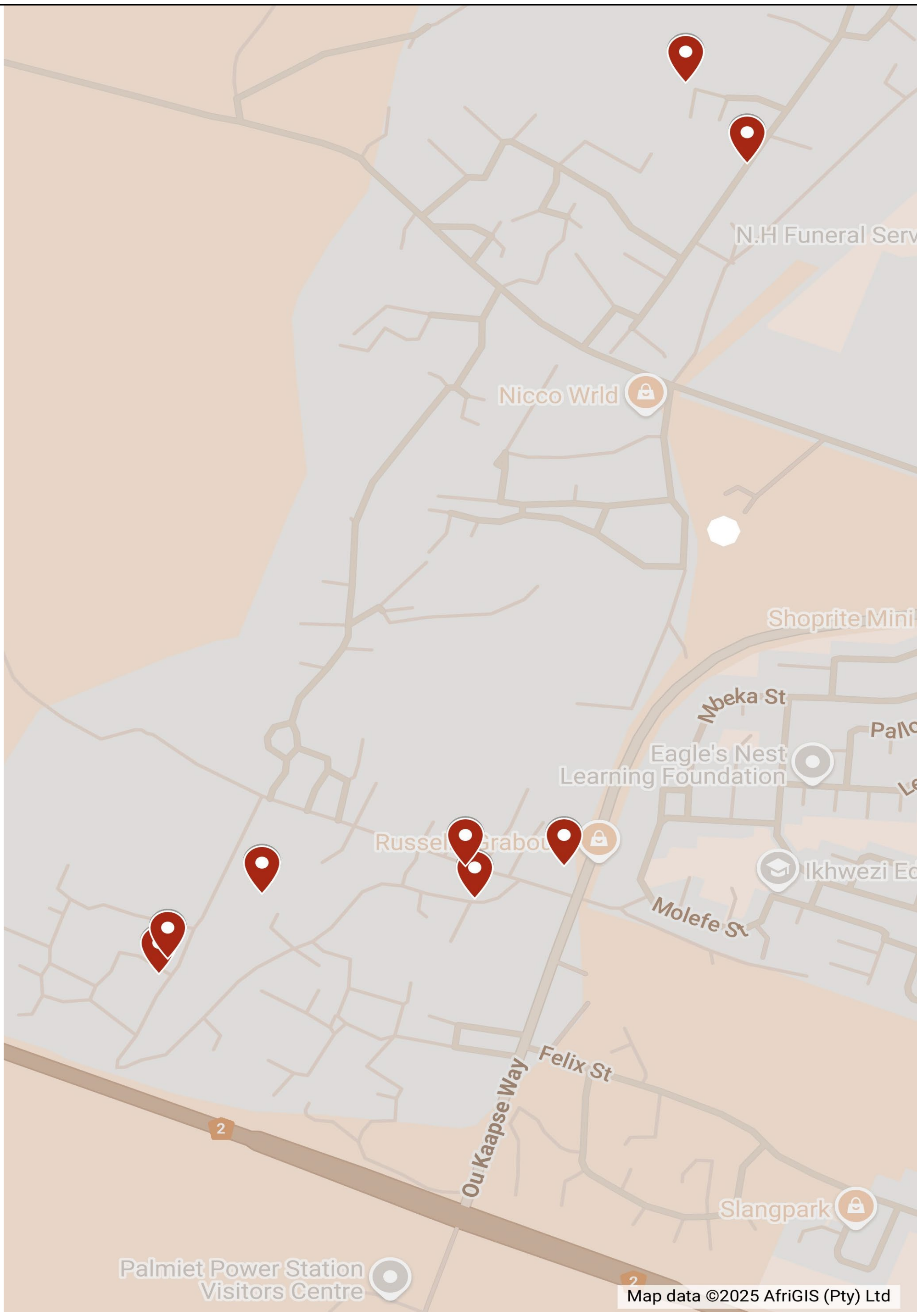
APPENDIX A: MAP OF GRABOUW WITH LABELLED STUDY AREAS



APPENDIX B: MAP INDICATING LOCATION OF MUNICIPAL STANDPIPES IN SIYANYANZELA AND KHOTSONG



APPENDIX C: INFORMED CONSENT FOR BASELINE SURVEY

STUDY ON WATER STORAGE IN GRABOUW

CONSENT TO PARTICIPATE IN RESEARCH

Hello!

I am working for Stellenbosch University and would like to ask you to help me with a study we are doing for the Water Research Commission.

We want to find out more about households in Siyanyanzela and Khotsong in Grabouw. We would like to know more about the people living in the areas, what services the houses have, and also how the families living there collect water and store drinking water in their houses.

I would like to ask you to take part in the study. This will mean that you agree that:

- I can ask you some questions about your household and how you store and drink water. This will take around 30-40 minutes. I will write down your answers on this form.
- I can collect 500 ml of water from your stored water now for the researchers to do some tests in a science laboratory in Stellenbosch.
- I or someone else from the study team can come back later, if necessary, to collect some more water (2 litres) from your stored water for the researchers to do some more detailed tests in the laboratory in Stellenbosch.
- I or someone else from the study team can come back to your household later this year to share some information around drinking water and how best to store drinking water.
- I or someone else from the study team can come back next year around April to ask these same questions to you again.

The information you give me will not be used to tell Stellenbosch University or The Water Research Commission about what you do in your house. I will have to write down your name, telephone number and address, but this is only so that we can find your house again later. I will not share any of your contact details or your name with the University or the Water Research Commission. When we use the information, we will replace your name with a number that can not be tracked back to you.

You can choose if you want to be in this study or not. If you choose to talk to me, but feel unhappy in any way, or do not like the questions I ask you, please tell me. You do not have to answer any questions that you don't want to answer, and we can stop at any time.

I am going to leave a copy of a document that gives more information about the study. If you have any questions or are unhappy about what we talked about, please contact Marisa von Fintel at Stellenbosch University at 021 808 2481.

Before we begin, please answer the following questions by ticking “Yes” or “No”`:

Do you understand what I explained to you?	Yes	No
Do you understand that we can stop at any time?	Yes	No
Do you understand that I will not share your answers with anyone outside the study, and your answers will not be linked back to you.	Yes	No
Do you have any questions that you want to ask me before we start?	Yes	No
Can I start asking you the questions on the form?	Yes	No

Signature of Respondent ______________________________ Date: ___________________

I have explained the project and the implications of being interviewed to the respondent in a language in which the respondent is fluent. I believe that the consent is informed and that he/she understands the implications of participation.

Name of interviewer: ______________________________

Signature of interviewer:____________________________ Date: __________________________

STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

You are invited to take part in a research project. Please take some time to read the information below which will explain the details of this research project.

Please feel free to contact the researchers about any part of this project that you do not fully understand. It is very important that you are completely satisfied that you clearly understand what this research is about and how you could be involved.

Your participation is completely voluntary, and you are free to decline to participate. In other words, you may choose to take part, or not. Saying no will not affect you negatively in any way whatsoever.

You are also free to withdraw from the study at any point, even if you do agree to take part initially. You may also choose not to answer certain questions by selecting the "refuse to answer" option. This will not affect you negatively in any way whatsoever.

The Research Ethics Committee: Social, Behavioural and Education Research at Stellenbosch University has approved this study (Project ID #: 28757). We commit to conduct the study according to the ethical guidelines and principles of the South African Department of Health Ethics in Health Research: Principles, Processes and Studies (2015).

1. WHO IS CONDUCTING THIS STUDY?

This research study is conducted by Marisa von Fintel, Ronelle Burger, Wesaal Khan and Martine Visser.

The researchers are from the department of Economics and Microbiology at Stellenbosch University, and from the department of Economics at University of Cape Town.

2. WHY DO WE INVITE YOU TO PARTICIPATE?

You have been selected as a participant because you live in one of the areas chosen for the study, Siyanyanzela and Khotsong, and you store drinking water in your house.

3. WHAT IS THIS RESEARCH PROJECT ABOUT?

In this project, we would like to find out more about how people like yourself collect, store and use water. Also, we would like to see if people like yourself will change their behaviour when it comes to collecting and storing water in their household in order to make the collection and storage of water safer. This will help so that they and their households do not consume water that is not clean. Consuming water that is not clean leads to many illnesses and is dangerous, especially for young children.

4. WHAT WILL BE ASKED OF ME?

I would like to ask you to take part in the study. This will mean that you agree that:

- I can ask you some questions about your household and how you store and drink water. This will take around 30-40 minutes. I will write down your answers on this form.
- I can collect 500 ml of water from your stored water now for the researchers to do some tests in a science laboratory in Stellenbosch.
- I or someone else from the study team can come back later, if necessary, to collect some more water (2 litres) from your stored water for the researchers to do some more detailed tests in the laboratory in Stellenbosch.
- I or someone else from the study team can come back to your household later this year to share some information around drinking water and how best to store drinking water.
- I or someone else from the study team can come back next year around April to ask these same questions to you again.

5. ARE THERE ANY RISKS IN MY TAKING PART IN THIS RESEARCH?

No, there are no risks.

6. WILL I BENEFIT FROM TAKING PART IN THIS RESEARCH?

The study will collect evidence about what can be done to help people to collect and store water in a safer way. This will have a positive effect on their family's health. We will present the results of this study to policy makers to change the way in which water policies are made.

7. ARE THERE ANY COSTS INVOLVED?

You will be required to answer the questions in the household questionnaire. This will take approximately 30 – 40 minutes of your time. You will also be asked to allow us to take a little bit of water from your stored water to test it in a laboratory at Stellenbosch University.

8. WHO WILL HAVE ACCESS TO MY INFORMATION?

We must record your name and contact details so that we are able to make contact with you again later this year and next year. However, we will not be linking your answers to these questions to your name or any characteristic which will allow people to identify you. The data which we collect will be saved in a location which is password protected. When we analyse the data, all answers will be anonymised so that the researchers will not even be able to see who provided what answer. Also, as a fieldworker, I am bound by confidentiality. By signing the form below, I promise that I will not disclose your answers to anyone.

9. HOW DO I MAKE CONTACT WITH THE RESEARCHERS?

If you have any questions or concerns about this study, please feel free to contact the researcher, Marisa von Fintel at marisavonfintel@sun.ac.za or 0218082481.

10. RIGHTS OF RESEARCH PARTICIPANTS

If you have questions, concerns, or a complaint regarding your rights as a research participant in this research project, please contact Mrs Clarissa Robertson [cgraham@sun.ac.za; (+27) 021 808 9183] at the Division for Research Development.

****

DECLARATION BY THE RESEARCHER

As the **researcher,** I hereby declare that the information contained in this document has been thoroughly explained to the participant. I also declare that the participant has been encouraged (and has been given ample time) to ask any questions. In addition, I would like to select the following option:

x	The conversation with the participant was conducted in a language in which the participant is fluent.
	I did/did not use an interpreter.

MFintel.

_______________________________________ __April 2024_____________

Signature of Principal Investigator **Date**

APPENDIX D: BASELINE SURVEY

Study on water storage in Grabouw

Household Questionnaire Cover

This questionnaire is to be administered to the oldest woman in the household or another household member who is knowledgeable about the living arrangements and spending patterns of the household. ONLY HOUSEHOLDS WHO ROUTINELY (USUALLY) STORE WATER FOR DRINKING PURPOSES ARE TO BE INCLUDED IN THE STUDY. IF THE HOUSEHOLD DOES NOT STORE WATER AT ALL, THEN THIS IS TO BE RECORDED IN THE SCREENIGN SHEET BEFORE STARTING THE INTERVIEW.

INSTRUCTION TO INTERVIEWER	**Record the answers by SELECTING the correct response and/or by writing the answer in the space provided.** Please note that **only one response is allowed per question** unless another instruction is given. Please note that **categories should NOT be read to the participant** unless another instruction is given

FOR OFFICE USE ONLY

A1 *qual_con*	**Quality controlled by (name and surname)**	
A2 *corrections*	**Corrections made to acceptable standard?**	
A3 *qual_date*	**Date accepted**	

Household ID

A4 *hhid*	**Household ID**											
A5 *address*	**Household street address**											

Interviewer details

A6 *intvr_name*	**Interviewer name and surname**				
A7 *intvr_date_hh*	**Date of interview (dd/mm/yyyy)**	_____/_____/2024	**A8** *intvr_time_hh*	**Interview start time**	— —:— —
			A9 *intvr_time_hh*	**Interview end time**	— —:— —

INTRODUCTION AND SCREENING

INTERVIEWER: **First do brief introduction and screening of whether the household stores drinking water** ***INTERVIEWER READ OUT:*** **Since you have confirmed that your household stores water for drinking, I would like to please confirm that I am speaking to the correct person in the household.**				
				SKIPS
A10 *respondent_confirm*	**Are you the oldest woman living in the household OR the person most knowledgeable of what goes on in the household?**	Yes	1	**A12**
		No	2	
A11 *respondent_confirm*	**When will the oldest women Or the person who is most knowledgeable about what goes on in the household be available?**	Record time		**END**
A12 *consent*	**Are you willing to help us with this research by answering our questions?**	Yes	1	**Administer consent, then A16**
		No	2	

Refusals (if applicable)

				SKIPS
A13 *why_not_willing*	**Why are you not willing to answer these questions?**	Not convenient now. Come back later	1	
		Do not want to participate in survey	2	**A15**
A14 *convenient_time*	**When would be a convenient time?**	Date and time		**END**
A15 *refusal_explain*	**Why do you not want to participate in this survey?**	Too busy	1	**END**
		Not interested/waste of time	2	**END**
		Questionnaire too personal/too intrusive	3	**END**
		Don't trust surveys	4	**END**
		Never do surveys	5	**END**
		Too old	6	**END**
		Sickness/ Recent Death/ Recent childbirth	7	**END**
		Other (specify) *refusal_explain_other*	97	**END**

		Don't know	98	**END**

Respondent details

A16 *respo_name*	**Name**	
A17 *respo_surname*	**Surname**	
A18 *repo_aka*	**Any other names by which this person is known?**	
A19 *cell1*	**Telephone number (1)**	
A20 *cell2*	**Telephone number (2)**	

SECTION 1: HOUSEHOLD

INTERVIEWER READ OUT: We would like to ask you about the households on this plot.				**SKIPS**	
1.1 *nr_hhs*	**How many households live on this plot, i.e. within the boundaries of this yard? By household we mean a person living alone, or a group of people who share kitchen facilities and a communal area such as a lounge or dining room and who eat together.**	Number		**1.2 if >1** **1.4 if =1**	
		Don't know	98		**1.4**
		Refused to answer	99		**1.4**
1.2 *hhs_study_*	**Will the other household on this plot also likely be participating in this study (i.e. do they also store water in a container for drinking)?**	Yes	1		
		No	2		**1.4**
		Don't know	98		
		Refused to answer	99		
1.3 *hhs_hhid*	**INTERVIEWER: Write down the unique hhid assigned to the other household(s) on this plot?**	Number(s)			

INTERVIEWER READ OUT: We would like to ask you questions about people who are part of YOUR household (not including the other households on the plot). A household is a group of individuals who live together and eat together. They share resources. Remember to include babies!

List all members in the household starting with yourself, and then list the rest of the members from oldest to youngest.

INTERVIEWER: If refusal or don't know, record don't know =98, refused = 99

1.4	1.5	1.6	1.7	1.8	1.8.1	1.9	1.10	1.11	1.12	1.13
pcode	*name*	*surname*	*relation_head*	*race*	*race*	*gender*	*age*	*educ*	*marital*	*main_activity*
	Name	**Surname**	**Relationship to respondent?** **INTERVIEWER: See code sheet # for relationship code.**	**Population group.**	**Specify population group** **(only if selected option 5 in previous question)**	**Gender**	**Age in years**	**Highest education qualification completed** **INTERVIEWER: See code sheet # for education code.**	**Marital status?** **INTERVIEWER: See code sheet # for marital status code.**	**Main activity or work status:** **1 Paid employee** **2 Self-employed** **3 Employer** **4. Unemployed (looking for work)** **5. Unemployed (not looking for work)** **6 Unpaid family work including housewife** **7 Retired** **8 Learner at school or preschool/creche** **9. Studying not in school** **10 Other (specify)**
	Name	**Surname**	**Relationship code**	**Black African =1** **Coloured = 2** **Asian/Indian = 3** **White = 4** **Other = 5**	**Specify race**	**Male = 1** **Female = 2** **Other = 3**	**Years**	**Education code**	**Marital status code**	**Activity code**

	1.14 *diarrhoea* **Has this person had diarrhoea (loose and watery stools) in their stools in the past month?**	**1.15** *blood* **Has this person had blood in their urine or blood in their stools in the past month?**	**1.16** *cough* **Has this person had an illness with a cough at any time in the past month?**	**1.17** *vomiting* **Has this person had an illness where they vomited a lot during the past month?**	**1.18** *breathing* **Has this person had trouble breathing during the past month? Specify population group**	**1.19** *fever* **Has this person had a high fever during the past month?**	**1.20** *cramps* **Has this person had stomach cramps during the past month?**	**1.21** *rash* **Has this person had a rash on their skin during the past month?**	**1.22** *Consult_health* **Has this person been to consult someone about these conditions in the past month?**	**1.23** *consult_health_where* **Where did this consultation take place?** **<u>INTERVIEWER</u>: Read out options.**	**1.24** *consult_health_name* **What is the name of the hospital/doctor /clinic and where is it (address)?**
	Yes, once=1 **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse =99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse =99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Yes, once=1** **Yes, more than once=2** **No=3** **Don't know=98** **Refuse=99**	**Public Hospital =1** **Private Hospital =2** **Public Health Clinic = 3** **Private clinic = 4** **Private doctor = 5** **Nurse or pharmacist = 6** **Traditional healer = 7** **Don't know (don't**	

										remember) = 98 Refuse =99	
1											

INTERVIEWER READ OUT: I am now going to ask some more questions about your household.				SKIPS
1.25 *hh_language*	**What is the main language spoken in your household?**	Afrikaans	1	
		English	2	
		Ndebele	3	
		Sepedi	4	
		Sesotho	5	
		Setswana	6	
		Swati	7	
		Tsonga	8	
		Venda	9	
		Xhosa	10	
		Zulu	11	
		Other (specify) *hh_language_other*	97	
		Don't know	98	
		Refused	99	
1.26 *hh_dwelling_type*	**In what type of dwelling does your household live?**	Formal house built by a contractor	1	
		Formal house that was self-built	2	
		Formal house that was built via a government subsidy (RDP house)	3	
		Informal dwelling	4	
		Backyard dwelling-formal	5	
		Backyard dwelling-informal	6	
		Flat or apartment	7	
		Traditional dwelling	8	
		Other (specify) *hh_dwelling_type_other*	97	
		Don't know	98	
		Refused	99	
1.27 *dwelling_roof*	**What is the main material used for the roof of the main dwelling?**	Bricks	1	
		Cement block / concrete	2	
		Corrugated iron / zinc	3	
		Wood	4	
		Plastic	5	
		Cardboard	6	
		Mixture of mud and cement	7	
		Wattle and daub	8	
		Tile	9	
		Mud bricks	10	
		Thatching	11	
		Asbestos	12	
		Cement roof sheeting	13	
		Stone and rock	14	

		Other (specify) *dwelling_roof_other*		97		
		Don't know		98		
		Refused		99		
1.28 *dwelling_floor*	**What is the <u>main</u> material used for the floor of the dwelling?**	Earth/ sand		1		
		Dung		2		
		Wood/ planks		3		
		Parquet/ polished wood		4		
		Vinyl on earth/ dirt		5		
		Vinyl on cement		6		
		Cement		7		
		Ceramic tiles		8		
		Carpet		9		
		Other (specify) *dwelling_floor_other*		97		
		Don't know		98		
		Refused		99		
1.29 *dwelling_wall*	**What is the <u>main</u> material used for the walls of the dwelling?**	Bricks		1		
		Cement block / concrete		2		
		Corrugated iron / zinc		3		
		Wood		4		
		Plastic		5		
		Cardboard		6		
		Mixture of mud and cement		7		
		Wattle and daub		8		
		Tile		9		
		Mud bricks		10		
		Thatching		11		
		Asbestos		12		
		Cement roof sheeting		13		
		Stone and rock		14		
		Don't know		98		
		Refuse		99		
					Yes	**No**
1.30	**Does this household OWN the following items in working order?** **<u>INTERVIEWER:</u> Read out and selected "yes" or "no: for each asset**	1	Swimming pool *own_pool*		1	2
		2	Computer/ desktop PC/ laptop *own_computer*		1	2
		3	Vacuum cleaner/ floor polisher *own_vacuum_polisher*		1	2
		4	Dishwashing machine *own_dishwasher*		1	2
		5	Washing machine *own_washing_machine*		1	2
		6	Tumble dryer *own_tumble_dryer*		1	2
		7	Deep freezer – freestanding *own_deep_freezer*		1	2

		8	Refrigerator or combined fridge freezer *own_fridge*	1	2
		9	Electric stove *own_elec_stove*	1	2
		10	Gas stove *own_gas_stove*		
		11	Microwave oven *own_microwave*	1	2
		12	Built-in kitchen sink *own_sink*	1	2
		13	Geyser, providing hot water *own_geyser*	1	2
		14	Car (e.g., bakkies, etc.) *own_car*	1	2
		15	Cell phone *own_cellphone*	1	2
		16	Tablet device *own_tablet*	1	2

1.31 *gov_grant_type*	**For each of the following government grant types, indicate how many grants your household received over the last 12 months on average. If no one in the household received a specific grant, just write "0"** **For example, if there are usually 3 children living in the household for whom the Child Support Grant was received, write "3".** ***<u>Interviewer</u>: Read out and select all that apply.***	Child Support Grant		
		Old Age Pension		
		Social Relief of Distress (Covid Grant)		
		Disability Grant		
		Foster Child Grant		
		Care Dependency Grant		
		War veterans grant		
		Grant in aid		
		NSFAS		
		Other (specify) *gov_grant_type_other*	97	
		Don't know	98	
		Refused	99	
1.32 *hhinc_main*	**In the last 12 months, which of these sources of income was the MAIN or BIGGEST source of income for this household?** ***<u>INTERVIEWER</u>: Don't read out response options.***	Income from employment	1	
		Income from a business	2	
		Government grants	3	
		Money from friends or family or strangers	4	
		Household had no income in the last 12 months	5	
		Pension	6	
		Other (Specify) *hhinc_main_other*	97	
		Don't know	98	
		Refused	99	
1.33 *hhinc_month*	**What is the income category that best describes the gross monthly income of the household in the last 12 months? This includes all sources of income e.g. social grants UIF, remittances, rentals, investments, sales or products, services etc BEFORE deductions**	No income	1	
		R1 - R400	2	
		R401 - R800	3	
		R801 - R1600	4	
		R1 601 - R3 200	5	
		R3 201 - R6 400	6	
		R6 401 - R12 800	7	
		R12 801 - R25 600	8	
		R25 601 - R51 200	9	

	INTERVIEWER: If respondent is uncomfortable to respond, give questionnaire to them to complete	R51 201 - R102 400	10	
		R102 401 - R204 800	11	
		R204 801 - R1 228 800	12	
		R1 228 801 - R2 457 600	13	
		R2 457 601 or more	14	
		Don't know	98	
		Refused	99	

SECTION 3: WATER

INTERVIEWER READ OUT: I am now going to ask about your household's water source, water reliability, and water storage.				**SKIPS**
3.1 *water_source*	**Where did the household collect the water that is stored for drinking?**	Piped (tap) water inside the dwelling provided by municipality	1	**3.3**
		Piped (tap) water on site or in the yard provided by municipality	2	**3.3**
		Municipal public tap	3	**3.3**
		Public tap NOT installed by municipality	4	**3.3**
		Municipal water-carrier/ tanker	5	**3.3**
		Piped (tap) water inside the dwelling which was installed by household (not municipal)	6	**3.3**
		Piped (tap) on site or in the yard which was installed by household (not municipal)	7	**3.3**
		Rainwater tank on site/ JoJo tank	8	
		Flowing water/ stream	9	**3.3**
		Dam/ pool/ stagnant water	10	**3.3**
		Well	11	**3.3**
		Spring	12	**3.3**
		Other (specify) *water_source_other*	97	**3.3**
		Don't know	98	**3.3**
		Refused	99	**3.3**
3.2 *water_jojo*	**How is the rainwater collected into the Jojo tank/ rainwater tank?**	From the roof into the tank	1	
		From the gutters into the tank	2	
		Other (specify) *water_tank_other*	97	
		Don't know		
		Refused		
3.3 *water_distance*	**How far is this water source for drinking from the dwelling?** **<u>INTERVIEWER</u>: Read out options.**	Water on site (in the house or in the yard)	1	
		Less than 100m	2	
		100m - less than 200m	3	
		200m - less than 500m	4	
		500m - less than 1 km	5	
		1 km or more	6	

		Don't know		98	
		Refused		99	
3.4	**How would you rate the taste, smell and colour of the water at the water source:** **INTERVIEWER: If applicable Record Don't know = 98 Refused =99**	3.4.1 Taste *water_taste*	Good	1	
			Average	2	
			Bad	3	
		3.4.2 Smell *water_smell*	Good	1	
			Average	2	
			Bad	3	
		3.4.3 Colour *water_colour*	Good	1	
			Average	2	
			Bad	3	
3.5 *water_reliability*	**Do you have problems with reliable access to drinking water? In other words, is the water supply sometimes interrupted, i.e. no water coming out of the tap or pipe>**	Yes		1	
		No		2	**3.7**
		Don't know		98	
		Refused		99	
3.6 *water_shortages*	**How often do you experience problems with water interruptions, i.e. water not coming out of the tap/ water shortages?**	Never		1	
		3-4 times a year		2	
		Once a month		3	
		Once a week		4	
		Most of the time		5	
		Almost never have enough water		6	
		Don't know		98	
		Refused		99	
3.7 *water_alternative*	**If your main source of drinking water is not available, where do you get your drinking water from?** **INTERVIEWER: select all that apply**	Tap inside dwelling		1	
		Outdoor tap in the yard		2	
		Public tap which is not in the yard		3	
		Private water seller		4	
		Water tanker/ truck		5	
		Borehole		6	
		Rainwater tank		7	
		River/ stream/ dam		8	
		Other (specify) *water_alternative_other*		97	
		Don't know		98	
		Refused		99	
3.8 *water_conainer_size*	**What is the size of the container in which you store your water and are drinking from at the moment?** **INTERVIEWER TAKE NOTE: The following questions refer to the container from which the household is drinking water at the moment. If there are 2 or more being used simultaneously, select the one that was filled up the longest ago (i.e. oldest water)**	5 litres		1	
		20 litres		2	
		Other (specify) *water_container_size_other*		97	
		Don't know			
		Refused			
3.9	**What material is the container made of?**	Metal		1	
		Plastic		2	

water_container		Other (specify) *water_container_other*	97	
		Don't know	98	
		Refused	99	
3.10	**Where do you keep the container**	Inside the house	1	
		Outside the house but under a roof/cover	2	
		Outside the house and not under a roof/cover	3	
		Don't know	98	
		Refused	99	
3.11	**Give the date and time of when you collected the water in this container.**	Date: ________/________/________		
		Time _______:___________		
		Don't know	98	
		Refused	99	
3.12 *water_container_lid*	**Does the container have a lid that closes the entire top of the container?**	Yes	1	
		No	2	**3.15**
		Don't know	98	
		Refused	99	
3.13 *water_container_top*	**Is the top of the container entirely open, or mostly covered but with a small opening?**	Entirely open	1	
		Mostly covered but with a small opening	2	
		Don't know	98	
		Refused	99	
3.14 *water_container_opening*	**Is the opening large enough that an adult hand can enter?**	Yes	1	
		No	2	
		Don't know	98	
		Refused	99	
3.15 *water_purify*	**For the water stored in the container, do you purify the water in any way before drinking it?**	All of the time / most of the time	1	
		Some of the time	2	
		Never	3	**3.18**
		Don't know	98	
		Refused	99	
3.16 *water_purify_how*	**How do you purify your water?** **<u>INTERVIEWER</u>: Select all that apply**	Boil the water	1	**3.18**
		Add Jik / bleach	2	
		Add chlorine	3	
		Add Jeyes Fluid	4	
		Add lime / calcium	5	
		Other (specify) *water_purify_how_other*	97	
		Don't know	98	
		Refused	99	
3.17	**Explain how much jik/bleach/chlorine etc you add to the water to purify it.**			

water_purify_often	**For example "I add a teaspoon of Jik to a 5 litre container of water"**			
3.18 *water_container_wash*	**How often do you wash your drinking water storage container?**	Daily	1	
		More than twice a week but not daily	2	
		Once or twice a week	3	
		Monthly	4	
		Never	5	
		Other (specify) *water_container_wash_other*	97	
		Don't know	98	
		Refused	99	
3.19 *water_container_fresh*	**When do you add a fresh supply of water to the container?** **INTERVIEWER: Read out options.**	When totally empty	1	
		When half of more than half empty	2	
		Don't know	98	
		Refused	99	
3.20 *water_container_take*	**How do you take water out of the container when you want to drink water?**	Using a utensil (scoop, cup, jug)	1	
		Hands	2	**3.23**
		Tap	3	**3.23**
		Other (specify) *water_container_take_other*	97	**3.23**
		Don't know	98	
		Refused	99	
3.21 *water_container_cup*	**Is there a dedicated cup or jug used specifically for scooping and drinking water from the container**	Yes	1	
		No	2	**3.23**
		Don't know	98	
		Refused	99	
3.22 *water_container_cup_drink*	**Do household members also sometimes drink from this special cup or jug used to scoop out water from the container?**	Yes	1	
		No	2	
		Don't know	98	
		Refused	99	
3.23 *water_swim*	**Does anyone in the household ever swim in a nearby water body such as a water reservoir, dam, or river?**	Yes	1	
		No	2	
		Don't know	98	
		Refused	99	
3.24 *water_cook*	**What is this household's main source of water for cooking?**	Piped (tap) water in dwelling	1	
		Piped (tap) water on-site or in yard	2	
		Public tap	3	
		Municipal water tank	4	
		Public tap NOT installed by municipality	5	
		Piped (tap) water inside the dwelling which was installed by household (not municipal)	6	
		Piped (tap) on site or in the yard which was installed by household (not municipal)	7	

		Rainwater tank on-site/Jojo tank on site	8	
		Flowing water/ stream	9	
		Dam/ pool/ stagnant water	10	
		Well	11	
		Spring	12	
		Other (specify) *water_cook_other*	97	
3.25 *water_cook_distance*	**How far is this water source for cooking from the dwelling?** **<u>INTERVIEWER</u>: Read out options.**	Water on site (in the house or in the yard)	1	
		Less than 100m	2	
		100m - less than 200m	3	
		200m - less than 500m	4	
		500m - less than 1 km	5	
		1 km or more	6	
		Don’t know	98	
		Refused	99	
3.26 *water_clean*	**What is this household's main source of water for cleaning?**	Piped (tap) water in dwelling	1	
		Piped (tap) water on-site or in yard	2	
		Public tap	3	
		Municipal water tank	4	
		Public tap NOT installed by municipality	5	
		Piped (tap) water inside the dwelling which was installed by household (not municipal)	6	
		Piped (tap) on site or in the yard which was installed by household (not municipal)	7	
		Rainwater tank on-site/Jojo tank on site	8	
		Flowing water/ stream	9	
		Dam/ pool/ stagnant water	10	
		Well	11	
		Spring	12	
		Other (specify) *water_clean_other*	97	
3.27 *water_clean_distance*	**How far is this water source for cleaning from the dwelling?** **<u>INTERVIEWER</u>: Read out options.**	Water on site (in the house or in the yard)	1	
		Less than 100m	2	
		100m - less than 200m	3	
		200m - less than 500m	4	
		500m - less than 1 km	5	
		1 km or more	6	
		Don’t know	98	
		Refused	99	
3.28	***<u>INTRERVIEWER READ OUT</u>*:** ***I am now going to collect 500ml of the stored water in your house.* Can you please take me**			

	to the container in which you store your drinking water? **<u>INTERVIEWER: OBSERVE, SO WITHOUT ASKING THE PARTICIPANT</u>** **Write down** • **Size of container** • **Material container made of** • **Container inside or outside the house** • **Lid on container or not** **If refusal to collect a sample of water, write down "Refused"**	

SECTION 4: SANITATION, WASTEWATER AND HYGIENE

INTERVIEWER READ OUT: Now I am going to ask about your toilet facility and handwashing				**SKIPS**
4.1 *toilet*	**What type of toilet facility is used most often by this household?** **INTERVIEWER: Select one.**	Flush toilet	1	
		Chemical toilet	3	
		Pit latrine with ventilation pipe	4	
		Pit latrine without ventilation pipe	5	
		Bucket toilet	6	
		Bush	7	
		None	8	
		Other (specify) *toilet_other*	97	
		Don't know	98	
		Refused	99	
4.2 *toilet_public*	**Is this toilet a public toilet or not?**	Yes	1	
		No	2	
		Don't know	98	
		Refused	99	
4.3 *water_disposal*	**How do you dispose of household water used for cooking, laundry and bathing?**	Sink/ drain connected to sewer	1	
		Open ground outside the house	2	
		Not applicable (cooking, laundry and bathing are done away from the household)	3	
		Other (specify) *Water_disposal_other*	97	
		Don't know	98	
		Refused	99	
4.4 *handwash*	**Where do you and other members of your household most often wash your hands after going to the toilet?**	Fixed sink with tap in dwelling	1	
		Fixed sink with tap in yard/ plot	2	
		Moveable containers like a bucket/ jug/ kettle	3	
		No handwashing place in dwelling/ yard/ plot	4	
		Other (specify) *handwash_meal_other*	97	
		Don't know	98	
		Refused	99	
4.5 *handwash_soap*	**Do you have soap, hand sanitiser or detergent for washing hands?**	Yes	1	
		No	2	**4.8**
		Don't know	98	**4.8**
		Refused	99	**4.8**
4.6 *handwash_soap_type*	**What type of soap is used?**	Bar or liquid soap	1	
		Detergent (powder/ liquid/ paste)	2	
		Ash/ mud/ sand	3	
		Nothing	4	
		Other (specify)	5	

		handwash_soap_type_other		
		Don't know	98	
		Refused	99	
4.7	**FIELDWORKER CHECK: soap is present as described**			
4.8 *refuse_located*	**Where do you keep your rubbish?**	In a container with a lid	1	
		In a container without a lid	2	
		Refuse bag	3	
		Dispose waste directly to open ground or solid waste body (rubbish heap)	4	
		Don't know	98	
		Refused	99	
4.9 *bins_located*	**Where are your rubbish bins or bags located?**	Inside the house	1	
		Outside the house	2	
		Both inside and outside the house	3	
		Don't know	98	
		Refused	99	

SECTION 6: ENERGY

INTERVIEWER READ OUT: Next, we want to ask you some questions about cooking meals and heating the house.				**SKIPS**
6.1 *elec*	**Does this household have electricity even if it is currently disconnected?** ***[FIELDWORKER NOTE: THIS COULD INCLUDE AN ILLEGAL CONNECTION]***	Yes	1	
		No	2	
		Don't know	98	
		Refused	99	
6.2 *cook_fuel*	**What is the <u>main</u> source of energy / fuel for this household for *COOKING*?** **[FIELDWOKER: PROMPT THAT THIS QUESTION REFERS TO COOKING ONLY]**	Solar energy	1	
		Electricity	2	
		Paraffin	3	
		Gas	4	
		Wood	5	
		Coal	6	
		Crop waste / cow dung	7	
		Other (specify) *cook_fuel_other*	97	
		None	9	
		Don't know	98	
		Refused	99	
6.4 *heater*	**What is the <u>main</u> source of energy / fuel for this household for HEATING IN WINTER/WHEN IT IS COLD?**	Open fire	1	
		Stove	2	
		Oil heater	3	
		Electric heater	4	

	[FIELDWOKER: PROMPT THAT THIS QUESTION REFERS TO HEATING IN WINTER/WHEN IT IS COLD ONLY]	Paraffin heater	5	
		Donkie boiler	6	
		Imbhawula/galley	7	
		Other (specify) *heater_other*	97	
		None	9	
		Refused	99	
		Don't know	98	
6.5 *energy_light*	**What is the <u>main</u> source of energy / fuel for this household for lighting?** **[FIELDWOKER: PROMPT THAT THIS QUESTION REFERS TO LIGHTING ONLY]**	Electricity	1	
		Gas	2	
		Paraffin	3	
		Wood	4	
		Coal	5	
		Animal dung	6	
		Solar energy	7	
		Other (specify) *energy_light_other*	97	
		None	9	
		Refused	99	
		Don't know	98	

SECTION 7: ATTITUDES AND RISK

<u>INTERVIEWER READ OUT</u>: Now we would like to ask some questions about how you view the municipality and how you feel about risk-taking				**SKIPS**
7.1 *mun_qual*	**In the past 12 months, how often have you or your household had interactions with the municipality (or ward councillor) about the quality of your drinking water?**	Never	1	
		Once a year	2	
		Once every 6 months	3	
		Once every 2-3 months	4	
		Once every month	5	
		More than once a month	6	
		Don't know	98	
		Refused	99	
7.2 *mun_interrupt*	**In the past 12 months, how often have you or your household had interactions with the municipality (or ward councillor) about water interruptions – i.e. where water was not available in your community?**	Never	1	
		Once a year	2	
		Once every 6 months	3	
		Once every 2-3 months	4	
		Once every month	5	
		More than once a month	6	
		Don't know	98	
		Refused	99	

7.3 *trust1*	**How much do you trust the municipality to make sure that you have good quality water that is available at all time (i.e. not interrupted)?** **Rate your answer on a scale from 1 to 10.** **1 represents "no trust at all" and 10 represents "full trust",**			
		Don't know	98	
		Refused to answer	99	
7.4 *trust2*	**Would you describe yourself as someone who has a lot of trust in other people and institutions in general?**	Strongly disagree	1	
		Disagree	2	
		Neutral	3	
		Agree	4	
		Strongly agree	5	
		Don't know	98	
		Refused	99	
7.5 *Risk1*	**Would you describe yourself as someone who often takes risks?**	Strongly disagree	1	
		Disagree	2	
		Neutral	3	
		Agree	4	
		Strongly agree	5	
		Don't know	98	
		Refused	99	

APPENDIX E: WATER SAMPLE PROCESSING RESULTS

Table D1. Sample processing and Validation of Petrifilm™ analysis results

House Number	CFU/ 100 mL	
	Petrifilm™ EC Plate Counts	HiCrome™ Coliform Agar
4	4.00×10^2	0
8	3.20×10^3	1.40×10^4
18	1.00×10^2	0
19	1.00×10^2	0
24	1.00×10^2	5.00×10^2
26	3.70×10^3	0
27	1.30×10^4	0
28	2.00×10^2	0
30	1.00×10^2	0
33	1.00×10^2	0
36	3.00×10^3	0
43	TNTC	3.50×10^3
49	3.00×10^2	0
51	1.00×10^2	0
57	1.00×10^2	0
60	1.00×10^2	0
70	1.00×10^3	0
72	TNTC	1.58×10^8
77	1.00×10^2	0
79	5.00×10^2	0
84	3.60×10^3	1.00×10^3
86	6.80×10^3	6.00×10^3
96	2.00×10^2	0
97	1.40×10^3	0
101	1.10×10^3	1.00×10^3
102	1.20×10^4	1.65×10^4
104	5.00×10^2	0
105	9.00×10^2	0
111	2.00×10^2	0
112	3.00×10^2	0
116	1.00×10^2	0
119	1.00×10^2	0
121	2.00×10^2	7.00×10^4
123	7.50×10^3	4.30×10^4
124	TNTC	1.18×10^5
126	1.10×10^3	0
141	1.00×10^2	0
142	1.50×10^3	0
146	9.00×10^2	0

149	1.00×10^2	0
160	TNTC	8.50×10^5

Table D1. (Continued) Sample processing and Validation of Petrifilm™ analysis results

House Number	CFU/ 100 mL	
	Petrifilm™ EC Plate Counts	HiCrome™ Coliform Agar
162	5.00×10^2	0
172	6.00×10^2	0
201	6.00×10^2	0
233	5.00×10^2	0
244	1.30×10^3	3.50×10^3
250	8.00×10^2	2.50×10^3
281	3.00×10^2	0
291	6.80×10^3	2.06×10^5
352	1.00×10^2	0
356	TNTC	0
420	4.00×10^2	0
435	1.00×10^2	0
456	1.00×10^2	0
462	1.00×10^2	0
483	2.00×10^2	0
494	7.20×10^3	7.15×10^4
503	1.00×10^3	0
508	2.00×10^2	0
525	1.00×10^2	0
531	1.00×10^2	0
542	1.00×10^2	0
547	1.00×10^2	0
554	5.00×10^2	0
558	3.00×10^2	0
567	1.00×10^2	0
568	2.40×10^3	0
573	2.00×10^2	7.50×10^3
574	1.00×10^2	1.00×10^3
580	1.00×10^2	0
581	1.00×10^3	0
582	4.10×10^3	0
587	5.40×10^3	0
588	6.10×10^3	1.00×10^3
733	2.00×10^2	6.00×10^3
801	2.00×10^2	0

APPENDIX F: FOCUS GROUP DISCUSSION GUIDE FOR DEVELOPING A VIDEO INTERVENTION

Focus group discussion guide

Exploring household water collection behaviour and informing a film on household water safety in Siyanyanzela and Khotsong, Grabouw

Tentative date: 29 April 2025

***Instructions to facilitator and convenor**:*

- Two focus group discussions of maximum 6 people per group, mostly likely women who take on the caregiver role in the household.
- One group from Siyanyzaela and one from Khotsong (explore dynamics in each group separately, given varying socio-economic status in groups.
- Open groups with broad getting-to-know-each-other questions to build trust in group.
- Groups have three main objectives and the discussion guide has been structured to address these objectives:
  a) To get a better understanding of household water behaviour;
  b) To understand who are trusted authority figures for households in these communities;
  c) To establish/test (in qualitative sense) whether more or better *information* on ideal water safety behaviour will make a difference to the way households manage the safety of water stored and consumed in the household.
- Groups should not take longer than a maximum duration of 1 hour 30 minutes, including introduction and winding down.
- Get an overall sense of the community culture in terms of how “open-minded” or “closed-minded” the residents are in general to information and advice regarding how they manage their households (and hygiene).

Nr	Focus group question	Indicative timing
1	**Welcome and introduction**	
	Ask the women/participants to provide: • their names, • some background on themselves (e.g. whether they are currently in school, staying at home or working), and perhaps also • general information about their household, i.e. children (number, ages etc.). Tell us a little bit about yourself. What do you like doing in your free time (hobbies)?	**10-15 minutes**
2	**Household water storage and management behaviour**	
	We are now going to discuss how we use water in the community: Where do you get your daily household water from? Did you install a tap outside your home or do you walk to the municipal tap?	**Maximum 50 minutes to an hour**

	How do you collect this water? Do you use a bucket inside your house? How often do you clean this bucket or container? Can you please explain how you clean this?	
	If you use a bucket, where in the house do you keep the bucket? (*Probe whether it is stored in a place out of reach of animals and children. Also probe (without asking the question) whether the bucket always has a lid on.)*	
	Once the water is in your house, do you have separate buckets (or containers) for washing water and drinking water?	
	How do you get drinking water from your water bucket (container)? *If the group answers that a cup is used:* • Where do you keep the cup? • How often do you wash this cup or replace it with a cleaned one? • Do you or your family members ever drink from the cup? Does anyone ever put the hands in the bucket to cool or wash their hands or to scoop water from the bucket?	
	Do you trust that the tap water is clean? Do you think the tap water helps to keep your family healthy? *(Probe whether any steps/precautions are taken to boil the water to ensure further safety.)*	
	Think of a recent situation where there was a lot of diarrhea in the community/ or when you had diarrhea in your household: What do you think was a source for this outbreak? Did you make any changes to where you get your water during this time? Did you make any changes to how you store your household water during this time?	
	What do you think will help you the most to keep the water in your house always clean and safe?	

3	**Community authority figures/influencers**	
	If you have to name one woman/lady who is a leading figure and who is respected in your community, who would that be?	**10 minutes**
	If you have to name one man who is a leading figure and who is respected in your community, who would that be?	
	Who in your community would you trust to give you **health information**, for example: • information on preventing diarrhea among children or • even vaccines (immunization for children)? Please explain why you trust this person.	
4	**Testing framing and tone of intervention narrative**	**10 minutes**
	(Testing positive versus negative tone) Which of the following messages do you prefer: a) Cleaning my water bucket every day will keep me and my family healthy. **Or** b) A dirty bucket may cause me and my family to get sick. Please explain your answer.	
	(*Testing risk avoidance/ loss prevention framing)* Which of the following messages do you prefer: a) Clean water helps to prevents diarhea in the household. or b) Dirty water may cause diarhea in the household. Please explain your answer.	
	(Testing social norms in framing) Which of the following messages will inspire you most to keep your household water clean: a) Everyone in my community keeps their drinking water clean. or b) I follow a routine/ have a habit of keeping the water in my household clean. Please explain your answer.	

5	**Will more or better information to households make a difference?**	**15 minutes**
	Imagine that someone that you trust told you that your household drinking water would be safer if you get water at the municipal tap, and not at the tap in your own yard. Would you make the effort to walk to the municipal tap every day to collect water? Why/why not?	
	Imagine someone your trust told you your baby and children will not get diarrhea if you boil the water you take from the tap in your yard before storing it. Would you make the effort to boil the water before storing it? Why/why not? *(This is a very exploratory question and will have to be probed carefully.)*	
	What information do you need to keep your household water always safe and clean?	
	What problems do you have in your household to keep your water always safe and clean?	
	What would help you/ your children/ family members to always keep your household water safe and clean?	
	THE END	

APPENDIX G: FINAL ENGLISH SCRIPT FOR VIDEO INTERVENTION

SHOOTING SCRIPT – 27 JUNE 2025

WHO	*SCRIPT / VO*
INTRO Fieldworker Voice over	In two communities in Grabouw, Siyanyanzela and Khotsong, families get diarrhoea more than they should. Let's explore why this happens and what we can do to improve our health in these communities simply by using clean water in our houses.
SCENE 1 Nurse At municipal tap	Hello, my name is ____ . I am a nurse at _____ in Siyanyanzela and Khotsong. Clean water is important to keep us hydrated, energised and healthy. Dirty water can cause diarrhoea, vomiting, fever, headaches and other illnesses. We are going to show you how to use and treat water correctly to make sure you and your family stay healthy. If you follow these steps, it will make a big difference in your household. Children will not miss school due to illnesses from drinking dirty water. And you will not miss work due to illness, which means less income and medical costs. Dirty water can also mean that babies and little children grow slower and shorter than they should. They could even die from dehydration.
SCENE 2 Field worker and ward councillor At shared municipal tap.	No VO No VO Sound up greeting (1s) <u>Councillor</u> Hello, my name is _____. I am the ward councillor / ward committee member in Siyanyanzela and Khotsong. <u>Nurse</u> Councillor, what can you tell us about the water that comes from the municipal tap? <u>Councillor</u>

<table>
<tr><td></td><td>The water is of a very high quality and the local municipality makes sure that the water is safe and clean for drinking purposes.

This is the best possible water to drink – straight from this tap. The water gets tested often to make sure that there is no risk of bacteria or any contamination.

<u>Nurse:</u>
And why is this water so brown? What about if the water smells like chlorine? Is it safe even with the brown colour and the smell?

<u>Councillor</u>
During the winter months, the water can change colour because of more rain which brings the colourants of plant roots into the water. Even if the water is slightly brown, if it comes from the municipal tap, it is the safest water to drink. The smell comes from the chlorine which the municipality uses to clean the water. The water is safe to drink even when it smells like chlorine.

<u>Nurse</u>
It is important to know that we cannot tell if water is safe or not by just using our senses. The smell, taste and colour of the water does not mean that the water is not safe to drink. To see if the water is safe, we would have to do a test in a laboratory, like the ones that the municipality does.

Ad lib: Greeting and thank you + handshake

No VO</td></tr>
<tr><td>SCENE 3

Field worker

At makeshift tap outside house</td><td>VO: It is important to have good hygienic practices to avoid getting sick.

Let's start with the best type of container to use and how to keep it clean.

Ad lib:
- Demonstrate the types of containers which are acceptable. [Example text: Here I have two examples of containers that are safe to use for storing water]
- Explain WHY they are acceptable. [Example text: The first thing to check is to make sure that they are meant for storing food or water. In other words they were not previously used to store paint or chemicals. A good sign is usually if you can see this number at the bottom of the container. This means it is of the right quality to store food or water]
- Demonstrate how to clean the bucket before filling it with water. [Example text: Every time before you collect water, empty the container and now use water and soap like dishwashing soap and a brush to wash the container along the sides and the bottom. If you do not wash the inside of the container, a slimy layer, called biofilm, starts to grow on the inside which can make the fresh water dirty again]
- Explain advantages of a container with a small mouth [Example text: If you choose a container, make sure it has a lid that fits very well and</td></tr>
</table>

<table>
<tr><td></td><td>closes the entire container. Otherwise, it is also good to have a container with a small opening or a tap. This means that you do not have to put your hand or a cup into the container to get water. This keeps the water clean]

Now that you know how to prepare a container or bucket, it's important to remember that everyone in your household should only touch the water container with clean hands. Hands are only clean when we have washed them with soap and rinsed with clean water. This will keep the water clean and prevent germs and bacteria to spread in our families when a family member is ill. Remember to make sure that your children also know about this rule.

Ad lib:
- Hand-washing – show how and encourage use of soap every time before collecting and scooping water

When you collect water, it is better if you collect it from a municipal standpipe because we know the water is clean.

If you already have a self-made tap in your yard, it is important that you know that the water from these taps is not always clean. Even though it comes from the same pipe as the municipal water, the place where the self-made tap is connected to the municipal pipe is not always closed-off or sealed properly. If it is not sealed properly, all of the bacteria from the ground around the pipes might come into your water. Remember, the ground around the pipes has animal dung and rubbish and rotten food in it, and if these things come into the pipe it makes the water very dirty. So it is safer to just use the water from the municipal tap.</td></tr>
<tr><td>SCENE 4

Field worker

From makeshift tap into house
+
demonstration</td><td>VO: Once you've collected the water, put the water inside your house in a cool and dark spot where it is away from rubbish, children, animals and covered with a lid to be stored safely.

When you need to use the water in your household there are a few important steps to keep in mind.

Ad lib:
- Demonstrate safe scooping or pouring of water.[Example text: If you are scooping water, use a cup that is used ONLY for this purpose. Do Not drink from the same cup and then use it again to scoop water. Rather scoop and pour the water into a bottle, which you can drink from. Keep this cup stored away safely so that it is not used for anything else.]
- Demonstrate a smaller dedicated container with a small mouth containing only drinking water, and a separate larger container with a larger opening for water for cleaning and cooking and washing.[If you are not sure whether your water is clean or not, a good idea is to boil the water you want to drink for at least 1 minute. Then pour this drinking water into a smaller bottle with a small opening and keep only drinking water in that. And then you can still have a bigger container with the water that you use for washing and cleaning and cooking.]</td></tr>
</table>

	- Discuss solid waste removal practices.[Example text: If you throw away your rubbish, including left-over food, it is safer to keep it in a container that is closed with a lid outside of your house. Take the rubbish to the rubbish heap as often as possible. If the waste is kept in or around your house for a long time, then there is a chance that you can make the water dirty by touching the rubbish and then the water or through flies that come and sit on the rubbish and then touch the water. All of this can make the water dirty]
SCENE 5 Field Worker Wrap up	I hope the information I have shared can help you and your family. If you follow these instructions, you can avoid everyone in your family getting sick from the water used in your home. Staying healthy means your children will grow well and not miss school. This also means you will be able to go to work and avoid having to pay for medicine and doctor's visits.

APPENDIX H: BALANCE BETWEEN TREATMENT AND CONTROL GROUPS (ONLY INCLUDING HOUSEHOLDS IN ENDLINE SAMPLE)

Table 11: Balance of sample at baseline

Variable	Control group mean (standard deviation)	Treatment group mean (standard deviation)	Differences in means (C-T) t-statistic
Proportion of sample where *E. coli* was present in water sample	0.118 (0.324)	0.139 (0.347)	-0.651
Proportion of sample which reported that any household member had diarrhoea in past 30 days	0.233 (0.423)	0.211 (0.409)	0.573
Proportion of sample residing in Siyanyanzela	0.877 (0.329)	0.848 (0.360)	0.919
Proportion of sample that had soap present at hand-washing area	0.374 (0.485)	0.327 (0.470)	1.053
Proportion of sample that had designated space for handwashing in the house or yard	0.585 (0.494)	0.618 (0.487)	-0.727
Proportion of households with at least one child under the age of 5 years	0.301 (0.460)	0.327 (0.470)	-0.611

Proportion of households where container had a lid on	0.864 (0.343)	0.896 (0.305)	-1.051
Proportion of sample who make use of a makeshift tap as their main source of drinking water	0.766 (0.424)	0.774 (0.419)	-0.197
Frequency of washing storage container (per week)	1.464 (0.807)	1.473 (0.870)	-0.117
Proportion of sample reporting that they retrieve water from the storage container using a dedicated cup which they do not drink from	0.099 (0.299)	0.078 (0.268)	0.7877
Sample size	236	223	

APPENDIX I: MICROBIOLOGICAL SAMPLE PROCESSING AT ENDLINE

Table 1 Sample processing of Petrifilm™ analysis

Sample Identifier	Petrifilm™ EC Plate Counts (CFU/100 mL)
6	2.00×10^2
8	2.00×10^2
26	1.00×10^2
27	1.80×10^3
30	6.30×10^4
31	1.00×10^2
32	8.00×10^2
33	8.80×10^4
42	5.00×10^2
43	3.00×10^2
49	2.50×10^3
62	8.70×10^4
67	1.00×10^2
70	7.00×10^2
72	1.00×10^2
82	4.00×10^2
88	1.00×10^2
99	3.70×10^3
103	1.00×10^2
111	6.00×10^2
113	2.00×10^2
116	4.00×10^2
118	4.00×10^2
124	2.60×10^3
125	5.00×10^2
138	4.10×10^3
151	1.60×10^3
172	2.00×10^2
173	1.00×10^2
181	1.40×10^3
186	1.00×10^2
187	4.00×10^2
188	6.70×10^3
191	6.00×10^2
199	3.00×10^3
202	9.00×10^2
204	1.00×10^2
218	1.10×10^3
219	6.40×10^3
223	2.40×10^3
225	5.40×10^3

227	6.00×10^2
228	3.50×10^3
232	2.30×10^4
236	1.00×10^2

Table 1 continued

Sample Identifier	Petrifilm™ EC Plate Counts (CFU/100 mL)
239	2.90×10^3
248	7.00×10^2
249	5.20×10^3
252	1.80×10^3
266	3.70×10^3
268	5.70×10^3
281	2.00×10^2
284	2.30×10^3
290	2.00×10^2
306	4.90×10^3
307	2.50×10^3
311	4.00×10^2
342	1.00×10^2
343	1.00×10^2
347	9.60×10^4
350	2.00×10^2
353	3.20×10^3
354	3.60×10^3
361	1.30×10^3
363	6.30×10^3
382	6.00×10^2
385	1.00×10^2
388	1.00×10^2
389	2.00×10^2
398	2.10×10^3
399	5.00×10^2
405	2.00×10^2
412	1.00×10^2
429	1.66×10^4
437	1.45×10^4
439	2.10×10^3
440	8.00×10^2
442	2.60×10^3
451	4.00×10^2
454	1.00×10^2
462	5.00×10^2
470	2.80×10^3
471	8.00×10^2
480	1.60×10^3
481	1.00×10^4
484	1.80×10^3

488	2.00×10^2
490	1.00×10^2
496	3.00×10^2
523	5.00×10^2
534	1.00×10^2
539	6.00×10^2
548	2.70×10^3
557	2.00×10^3

Table 1 continued

Sample Identifier	Petrifilm™ EC Plate Counts (CFU/100 mL)
559	4.40×10^3
561	1.00×10^2
563	2.00×10^2
572	1.00×10^2
577	7.70×10^3
591	2.46×10^4
592	5.70×10^3
703	9.00×10^2
704	3.00×10^3
707	2.00×10^2
807	3.90×10^3
823	1.10×10^3