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Groundwater investigation on Onotoa Island

Republic of Kiribati

By Aminisitai Loco, Anesh Kumar, Andreas Antoniou and Peter Sinclair

NEW ZEALAND
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TE MAURI TE RAOI AO TE TABOMOA

GEM
Geoscience, Energy and Maritime Division

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List of abbreviations

BOM	Bureau of Meteorology, Australia
CSIRO	Commonwealth Science and Industry Research Organisation, Australia
GoK	Government of Kiribati
ITCZ	Intertropical Convergence Zone
KIRIWATSAN	Kiribati Water and Sanitation Improvement for the Outer Islands Project
KMS	Kiribati Meteorological Service, Kiribati Government
l	Litres
MFAT	Ministry of Foreign Affairs and Trade, New Zealand Government
MHMS	Ministry of Health and Medical Services, Kiribati Government
MIA	Ministry of Internal Affairs, Kiribati Government
MISE	Ministry of Infrastructure and Sustainable Energy, Kiribati Government
ML1-DB	MiniLog1 data logger
ML	Mega litres
ml	Millilitres
mS/cm	millisiemens per centimetre
µS/cm	micro Siemens per centimetre
NZD	New Zealand Dollar
QGIS	Quantum Geographical Information System software
RWH	Rainwater harvesting
SCOPIC	Seasonal Climate Outlook for Pacific Island Countries
SODIS	Solar-disinfection
SPC	Pacific Community
TB3	Tipping bucket rain gauge
UN	United Nations
WASH	Water, sanitation and hygiene
WHO	World Health Organization (UN)
WRA	Water resources assessment
WSEU	Water Sanitation and Engineering Unit

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Acknowledgements

This field investigation was part of the “Strengthening Water Security in Vulnerable Atoll States” project funded by New Zealand’s Ministry of Foreign Affairs and Trade (MFAT), to support Pacific Island governments and communities to build skills, systems and basic infrastructure to better anticipate, respond to, and withstand drought and its impacts on supplies of safe and adequate drinking water.

Being a cross-sectoral project, several government stakeholders contributed immensely towards the implementation and successful completion of this mission. Many thanks to the following stakeholders:

- Ministry of Infrastructure and Sustainable Energy (MISE), particularly its Water Engineering and Sanitation Unit (KMS)
- Kiribati Meteorological Service (KMS)
- Ministry of Health and Medical Services (MHMS)
- Ministry of Internal Affairs (MIA)

The communities and councillors of Onotoa, together with the island mayor, Mr Uarai Tion, are also acknowledged for supporting the survey activities, including their active participation during the consultation meetings.

Summary

As part of the New Zealand's Ministry of Foreign Affairs and Trade (MFAT) funded "Strengthening Water Security in Vulnerable States" project, a field mission to Onotoa Island, in Kiribati was undertaken between 28 February and 19 March 2019. The mission focused on the assessment of groundwater around all the villages – namely Taboarorae, Aiaki, Tekawa, Tanaeang, Buariki, Tameo and Otoae – using a suite of investigation techniques, including groundwater well assessment, *Escherichia coli* (*E. coli*) contamination analysis and geophysical surveys using the electromagnetic method, EM34.

GROUNDWATER WELL AND INFRASTRUCTURAL ASSESSMENT

A total of 184 wells, both private and community owned, were surveyed. The measured groundwater salinity range was 0.9–3.9 mS/cm, and the water table below ground level was between 1.47–2.49 m. Variations in the quality of well infrastructure, such as their protection capabilities, abstraction technologies and water usage, were also established. These indicated the efforts and investments that have been undertaken to date to improve groundwater access and use at both household and community levels, despite the inherent threats of extreme hydro-meteorological events and poor land use and water-use practices.

WATER QUALITY TESTING - E. COLI ANALYSIS

A total of 39 groundwater samples and three rainwater samples were analysed for *E. coli* using the filtration membrane technique. Of these samples, 42% showed to have *E. coli* counts of 0, which is in line with the World Health Organization (WHO) drinking water guidelines. The remaining samples showed varying levels of contamination, from tolerable to unsuitable for drinking (without proper treatment). These analyses suggest that the freshwater sources, existing well infrastructure and the abstraction and distribution systems are vulnerable to bacteriological contamination, which necessitates pragmatic mechanisms and apt infrastructural improvements to ensure adequate water source protection and safety.

FRESHWATER LENS MAPPING

The completion of 49, EM34 survey lines, which covered an estimated distance of 17.3 km around the atoll of Onotoa, permitted the mapping of estimated fresh groundwater thickness, which would be translated to the variable groundwater development potential for the villages. Taboarorae exhibited extremely limited groundwater potential, and Aiaki and Otoae showed low groundwater potential although pockets of moderate fresh groundwater thickness were mapped relatively far from the inhabited areas. Tekawa and Tanaeang showed good groundwater potential (> 10 m thickness) covering extensive ground of around 24% of land. Buariki and Tameo recorded moderate (> 6 m thickness) groundwater potential in localised areas. The influence of tidal processes on the groundwater system was also investigated using automatic data loggers – tidal lag was calculated to be between 1 hour 20 minutes and 3 hours and a tidal efficiency of 5–30% was estimated. This variability can be attributed to the variation in thickness and texture of marine sediments, coupled with the proximity of the monitoring sites to the coast, and allowing for either a more pronounced or slightly dampened groundwater–seawater interaction.

RAINWATER HARVESTING ASSESSMENT

The assessment of the existing rainwater harvesting (RWH) systems suggested that the communal buildings such as churches and village *manneabas* were the best options based on their large roof catchment areas and appropriate roofing materials, which would be capable of collecting substantial

rainwater if these buildings were equipped with proper accessories such as downpipes, gutters, fascia boards, transmission pipes and tanks. Onotoa was the recipient of the 2015 European Union (EU) funded KIRIWATSAN RWH improvement project. It was very disappointing to see the appalling status of these newly built structures, largely due to vandalism. This misuse and mismanagement of resources clearly demonstrates the need to strengthen governance and policy around water supply protection in the outer islands before any infrastructural investment is implemented.

RAINGAUGE INSTALLATION AND TRAINING

The installation of a TB3 automatic rain gauge and the training of the island's water technician has both established the tools and skills that are essential for the continued recording and sharing of monthly rainfall data on Onotoa. This will be valuable in terms of storing and analysing historical rainfall data in order to prepare, predict and plan for climatic extremes. This, however, will require coordinated efforts and support between the Onotoa Island Council, the Ministry of Infrastructure and Sustainable Energy (MISE) and the Kiribati Meteorological Service (KMS) to ensure the long-term maintenance and operation of the rain gauge, which in turn should yield better water resource management and disaster preparedness benefits for the island and the entire country.

PROPOSED WATER SECURITY IMPROVEMENTS

Based on the groundwater investigation, the following water supply improvements are proposed:

- Infiltration galleries and public water reticulation systems to be developed in Tekawa and Tanaeang villages based on the substantial freshwater lens thickness that has been mapped. It will be appropriate that monitoring-wells are installed near the galleries to monitor the fluctuation in lens thickness in response to abstraction and climatic variabilities.
- Small-scale galleries and community wells with multiple hand pumps to be installed for Buariki and Tameo where a freshwater lens has been identified.
- Emergency galleries to be considered for Aiaki and Otoae where moderate groundwater potential has been mapped.
- Desalination plant and improved rainwater harvesting facilities to be considered, including additional storage systems, such as cisterns, to support the Taboarorae village's needs, including the continued operation of the primary school and medical centre.

The use of integrated water resources management strategies around the island will be required for the protection and appropriate use of these water supply systems. These will include (but not limited to) regular monitoring of groundwater salinity, the use of groundwater flow and salinity meters during the development of infiltration galleries systems, the strengthened collection and analysis of rainfall data for decision making, and the establishment of appropriate rainfall and groundwater salinity thresholds to ensure timely and sound water conservation actions prior to and during extreme climatic conditions.

These proposed water supply options will require improved community engagement and strengthened ownership and governance through a coordinated approach between the communities, Island Council and national government in order to ensure the sustainable operation and management of these systems, and the achievement of long-term security and resilience for the local communities.

1.0 Introduction

The project “Strengthening Water Security of Vulnerable Island States”’ is supported by New Zealand’s Ministry of Foreign Affairs and Trade (MFAT) and implemented by the Disaster and Community Resilience Programme (DCRP) of the Pacific Community (SPC). The five-year project (2015–2019), with a total funding amount of NZD 5 million, was carried out in five vulnerable states, namely Cook Islands, Kiribati, Republic of Marshall Islands, Tokelau and Tuvalu, in order to support these countries to build skills, understanding, systems and basic infrastructure to better anticipate, respond to and withstand the devastating impacts of droughts.

1.1 Mission background, objectives and expected outcomes

This Onotoa Island field assessment was conducted to determine the groundwater development potential in areas close to the communities, to build capacity within the Government of Kiribati (GoK) to undertake groundwater assessment surveys, and to install, operate and maintain rainfall monitoring stations. The mission was linked to the several output areas of the project – these include SPC’s technical support to establish and improve water resources assessment and monitoring, the use of appropriate and innovative technologies that are essential for minimising the risk of droughts, and provide platforms that work towards sustainable water resource management in Onotoa.

The Onotoa survey was designed to:

1. utilise EM34 geophysics equipment to determine both the fresh groundwater thickness and development potential in the villages amid the threats of tidal inundation, seawater intrusion, droughts, as well as anthropogenic bacteriological contamination;
2. assess existing groundwater wells around the villages based on infrastructural and protection capacities, groundwater and salinity levels, abstraction technologies and water bacteriological quality;
3. assess potential rainwater harvesting centres based on roof catchment dimension, and identify infrastructural needs to optimise rainwater collection and use;
4. install an automated rain gauge and train relevant staff members on its maintenance, calibration, and routines associated with data download and dissemination;
5. transfer water resources assessment skills and build confidence within the Water Sanitation and Engineering Unit (WSEU) of the Ministry of Infrastructure and Sustainable Energy (MISE) to allow the continued delivery of this technical service within the GoK as and when required; and
6. hold community engagement and awareness raising to share the preliminary findings, collect information of pressing water issues and explore appropriate solutions.

The island mission was linked to the MISE’s strategic vision of “I-Kiribati utilizing appropriate, well-maintained and Climate Change-resilient infrastructure and utility services”, and is expected to contribute towards the GoK Development Plan (KDP) 2016–2019 *KPA 4 and 6,* “to supply clean drinking water throughout the villages” and to “provide 75% of the population with access to potable water by the end of 2020.” (Areke Tiareti, WSEU-OIC, pers. Communication, 27 May 2019)

The field mission allowed multi-sectoral interventions where representatives from the project’s key stakeholders – namely the Water Sanitation and Engineering Unit (WSEU) of the Ministry of Infrastructure and Sustainable Energy (MISE), Kiribati Meteorological Services (KMS) and the Ministry of Health and Medical Services (MHMS) – delivered their respective mandatory roles including groundwater assessment, rain gauge installation and the demonstration of solar disinfection (SODIS). It is hoped that GoK representatives and the communities of Onotoa will appreciate the evidence-based knowledge generated from this assessment to guide the planning and selection of water supply infrastructural and/or technological options.

1.2 Field team and survey schedule

The Onotoa field visit was collaboratively undertaken by SPC, MISE-WSEU, KMS and MHMS. The survey team was led by Amini Loco and Anesh Kumar from SPC, together with the assistance of 10 government officials. These GoK staff members, their current positions and organisations are illustrated in

The Government of Kiribati staff members, their current positions and organisations are listed in Table 1 below.

Table 1. Government of Kiribati staff members involved in the field survey and representing different Government agencies.

Name	Position	Organisation
Areke Tiareti	Water Engineer (WSEU-officer in charge)	WSEU-MISE
Taina Tamaroa	Water Monitoring Officer	
Martin Mataio	Hydrogeologist	
Maiango Enota	Water Security Officer	
Kokoria Bokeang	Water Technical Officer	
Kitareti Burangke	Water Technical Officer	
Michael Rabaere	Onotoa Island Water Technician	
Mauna Eria	Meteorologist	KMS
Roonga Iabeti	Technical Officer	
Miria Bwauro	Environmental health officer	MHMS

The field assessment covered all the villages in Onotoa; these are Taboarorae, Aiaki, Tekawa, Tanaeang, Otoae, Buariki, and Tameo as illustrated in Table 2 below.

Table 2. Schedule of activities around Onotoa Island

Date	Activities	Team
28 February 2019	Travelled to Tarawa, Kiribati and conducted initial discussions with Secretary, Director and WSEU at MISE	SPC
1–4 March 2019	Carried out Onotoa trip preparation and EM34 field calibration exercise	SPC and MISE
5 March 2019	Travelled to Onotoa Island and held initial discussions with Island Council staff members and selected representative from all the Aiaki, Taboarorae, Tekawa, Tanaeang villages	All teams (SPC, MISE, KMS and MHMS)
6–9 March 2019	Carried out field WRA, EM34 and well assessment in Taboarorae, Aiaki, Tekawa, Tanaeang	SPC and MISE
	Installation of rain gauge and associated training	SPC, KMS and MISE
	Demonstration of SODIS and climate updates consultation in communities	KMS and MHMS
11 March 2019	Preliminary results presentation and community engagement in Taboarorae, Aiaki, Tekawa and Tanaeang	All teams
12 March	Returned to Tarawa	SPC, KMS and MHMS
12–16 March 2019	Continued EM34 and well survey in Otoae, Tameo, Buariki	MISE
18 March 2019	WRA results community engagement in Otoae, Tameo, and Buariki	MISE
19 March 2019	Completed mission and return to Tarawa	MISE

2.0 Background

2.1 Geographical location and governance

Onotoa is one of the southern islands of the Gilbert Islands group within the Republic of Kiribati. The atoll extends between longitudes 175°31’16.55”E and 175°37’45.40”E and latitudes 1°47’33.50”S and 1°58’02.52”S. Onotoa is located 450 km southeast of Tarawa, where the main urban centre and national government offices are located. Towards the southernmost islands in the Gilbert Islands group (Figure 1), Onotoa is situated around 75 km southwest of Beru Island and 160 km northwest of Arorae.

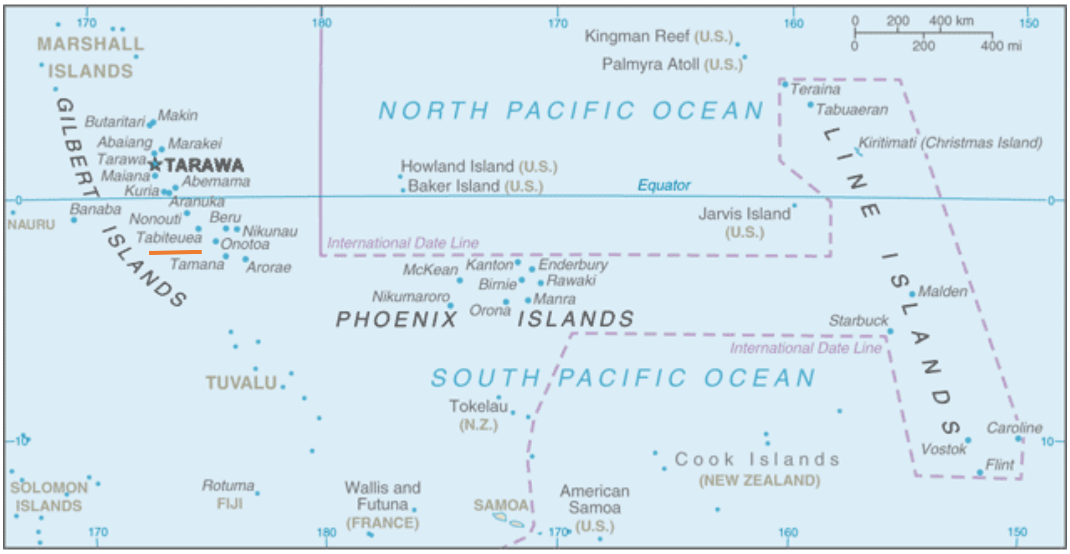

Figure 1. Location of Kiribati within the globe (Onotoa is underlined)
(source: https://www.cia.gov/library/publications/the-world-factbook/attachments/maps/KR-map.gif/)

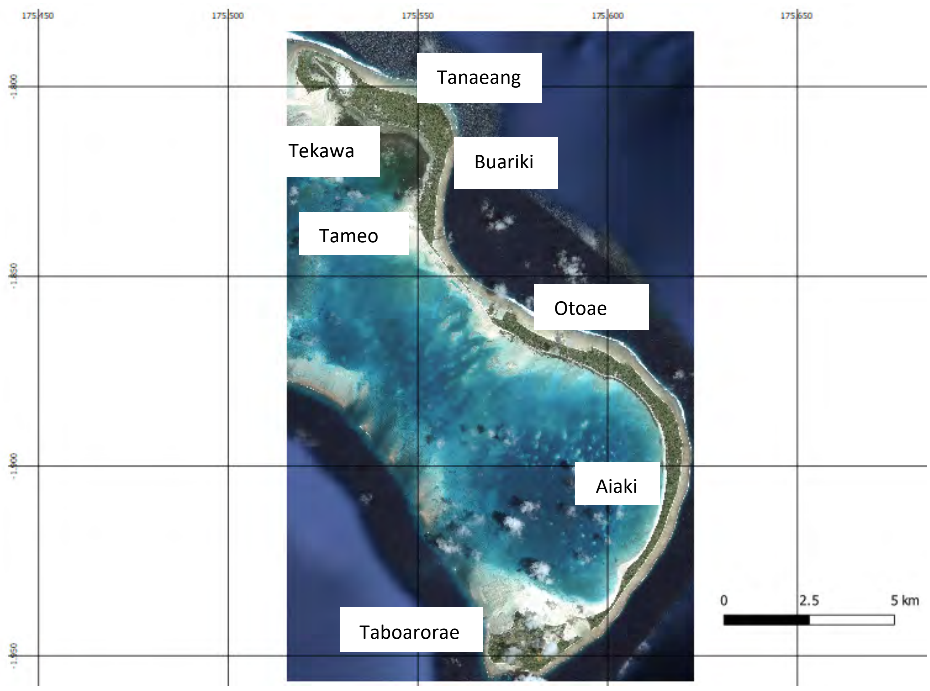

Figure 2. Onotoa Island and location of the villages surveyed during this mission (image source: QGIS Google Satellite hybrid).

Onotoa atoll has a total land area of 15.6 km^2, which spans 22 km of the island’s length. The atoll has two main islands and an inhabited islet in the south that are all connected by a cause-way (Figure 2).

The island accommodates three primary schools, one junior secondary school, five health clinics and seven villages. All, except one, of the villages are concentrated along the lagoon coastal area. Aiaki and Otoae villages are on the central island, with Tameo, Buariki, Tanaeang and Tekawa village on the northern main island. The Onotoa Island Council office and other government offices are located in Buariki village, which also has an accommodation centre. The island airstrip is located adjacent to Tekawa, which is effectively the northern tip of the island. Taboarorae village, in contrast, is scattered around the southernmost islet.

Governance and economic development on the island are administered by the Island Council, which is hosted under the Ministry of Internal and Social Affairs (MISA 2018). The Council is led by an Island Mayor – who is elected from the Council of *unimwane*[1] – and representatives from each village/ward who are elected every four years. The Council meets on a monthly basis to discuss matters pertaining to the operation of the Island Council and development initiatives, together with issues affecting the various wards and the island as a whole – this forum also has representatives from the *unimwane*, women and youth groups.

2.2 Population and water reliance

The 2015 census record showed that the population and household count in Onotoa was 1393 and 323, respectively. This is 1.2% of the total population in Kiribati, which is 110,136. Although the 2015 total population in Kiribati registered a growth rate of 20% from 1995, Onotoa population has been declining (Table 3). The population growth rate in Onotoa – based on the1995, 2005 and 2015census records – is -15%. This decline, which may suggest internal migration to Tarawa, or other islands, could have impacts on the water usage and reliance.

Table 3. Onotoa census data between 1995 and 2015 (source: National Statistics Office).

Village	1995		2005		2015	
	Population	Households	Population	Households	Population	Households
Tekawa	182	35	164	36	145	38
Tanaeang	258	49	249	44	189	40
Buariki	452	93	213	45	183	41
Tameo	207	45	348	66	279	66
Otoae	235	46	238	49	164	32
Aiaki	301	72	186	45	227	57
Taboarorae	283	62	246	47	206	49
Total	**1918**	**402**	**1644**	**332**	**1393**	**323**

The Onotoa Island profile documented by the Ministry of Internal and Social Affairs (MISA 2008), showed that more than 90% of the population and households depend on groundwater. Sources of groundwater (Figure 3) consist of (a) open wells, where bailers are used, and (b) closed wells that use hand pumps and piped water, which include solar pumps. Five per cent (5%) of the population rely on rainwater tanks, while there was no record of bottled water dependence. This rainwater reliance is likely to increase after the rainwater harvesting (RWH) improvement that was undertaken in 2015 through the EU funded water and sanitation improvement for the outer islands of Kiribati (KIRIWATSAN).

[1] *Unimwane* are elderly men who are nominated by the village to oversee the decision-making within the community and all others are considered to be of an equal standing (Falkland 2003).

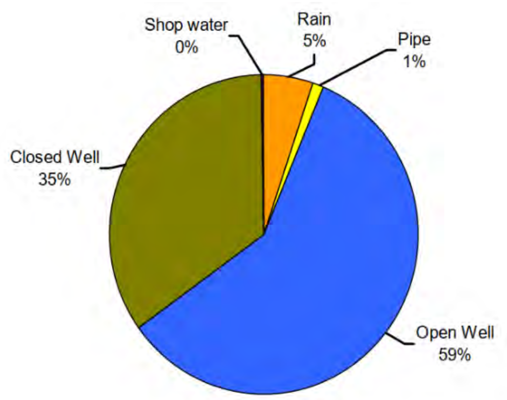

Figure 3. Water reliance in Onotoa Island (MISA 2008). Note that rain refers to households that have good roof catchments and rainwater tanks that provide reliable water supply, while the pipe system refers to improved water supply systems that have wells, and solar-powered pumps that distribute water through a newrok of pipes to parts of the communities.

By using the above population data, one can also approximate the water demand. A nominal 70l/person/day of safe water is adopted as guidance on safe water resource requirements for drinking, cooking, and for personal and domestic hygiene purposes in the Pacific (after WHO 2013). By using the current population and projected growth data, the daily water demand per village will be between 10,050 l and 19,530 l. It is clear that despite the decline in population in the last two decades, the availability, usability and management of freshwater resources, including groundwater, will be key for supporting, securing and sustaining the livelihood of the Onotoa communities.

2.3 Climate, rainfall and drought trend

The Kiribati islands, including Onotoa, are surrounded by the vast Pacific Ocean. Having the easterly trade wind, the climate is largely influenced by the variations in sea-surface temperatures of the surrounding ocean, which causes periodical shifts of either warm temperatures or high rainfall *El Niño* conditions, or cooler and severely dry *La Niña* conditions, with both these conditions happening around two to seven years (BOM and CSIRO 2011). Also contributing to the variability in climate is the adjacent global atmospheric circulation features phenomena such as the Intertropical Convergence Zone (ITCZ) and the South Pacific Convergence Zone (SPCZ). It is clearly shown in Figure 4 below that the proximity of the ITCZ, SPCZ and the influence of the western Monsoon zone from the far west dictates the formation, movement, intensification and impacts of El Niño and La Niño in Kiribati.

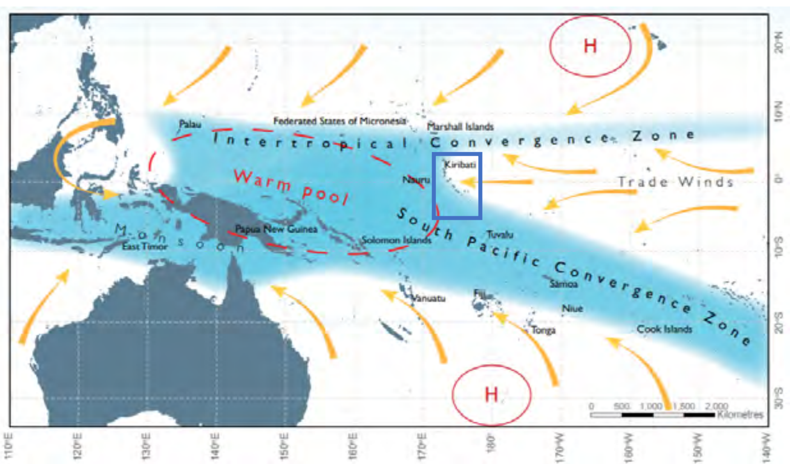

Figure 4. Location of the Gilbert Islands group (blue box), Kiribati and the strong influence of the ITCZ and SPCZ (source: BOM and CSIRO 2011).

Rainfall

Onotoa does not have good monthly rainfall records, with only discontinuous historical rainfall data from 1936 to 2003, provided by KMS and MISE (Falkland 2003). Although 35 years of complete annual rainfall was extracted from this dataset, records of recent climatic extremes such as 1998–2000, and 2010–2011 are missing. These events had 7-10 months of very low rainfall (defined as monthly rainfall falling below the 10th percentile of all monthly rainfall data from 1949 to 2019, which was calculated to be 20 mm of rain), and below which drought is usually declared. This unavailability of recent extremely low rainfall periods for Onotoa limits statistical analysis in order to establish past rainfall trends and provide additional insights into the extreme climatic conditions for Onotoa to aid the understanding of how these anomalous conditions can be best predicted, prepared for and responded to. Fortunately, data from three rainfall stations in the Gilbert Island group – namely, Tarawa, Beru and Arorae – was provided by KMS and used to approximate climatic conditions in Onotoa. Further, the Seasonal Climate Outlook for Pacific Island Countries (SCOPIC) programme was used to perform statistical analysis on these available rainfall records. The SCOPIC programme was designed as a decision support tool that uses monthly continuous rainfall data for a minimum of 30 years permitting the statistical analysis for rainfall seasonal outlooks for rainfall, as well as illustrating characteristics of extreme climatic events such as droughts.

Table 4. Variability in annual, monthly and seasonal rainfall in the four stations, together with their associated coefficient of variation (CV).

Data sets	Months	Onotoa	Beru	Arorae	Tarawa
All historical data	Average annual rainfall (mm)	1229	1326	1701	1722
	Maximum annual rainfall (mm) and (year)	2849 (1987)	3104 (1987)	4604 (1987)	4356 (1993)
	Minimum annual rainfall and (year)	166 (1950)	247 (1950)	125 (1999)	149 (1989)
	Average monthly (mm)	112	113	141	169
	Average monthly CV	1.09	1.06	0.94	0.62
Wet season	Average monthly rainfall (mm)	136	133	161	189
	CV	1.05	1.12	0.96	0.87
Dry season	Average monthly rainfall (mm)	89	94	122	130
	CV	1.13	1.01	0.93	0.89

Beru and Arorae islands, which are both situated around the southern end of the Gilbert Island group and located around 70 km NE of Onotoa and 150 km SE of Onotoa, respectively, have better rainfall records. Beru Island station has continuous monthly rainfall data for three periods: 1945–1989, 2001–2002, and 2010–present. Arorae has 99% of its monthly records from January 1950 to May 2004. Comparison of the annual rainfall data for these islands yielded around 5% variation for Beru and a 20% variation for Arorae.

Tarawa has completed monthly rainfall data from 1946 to present and records an annual rainfall variation of around 120%. Despite this degree of variability, data from Beru, Arorae and Tarawa will be used together with limited Onotoa records to establish rainfall trends and derive drought impacts with improved confidence. Table 4 and Figure 5 clearly illustrate the variation in rainfall on all four islands, where the seasonal variation is easily noticed.

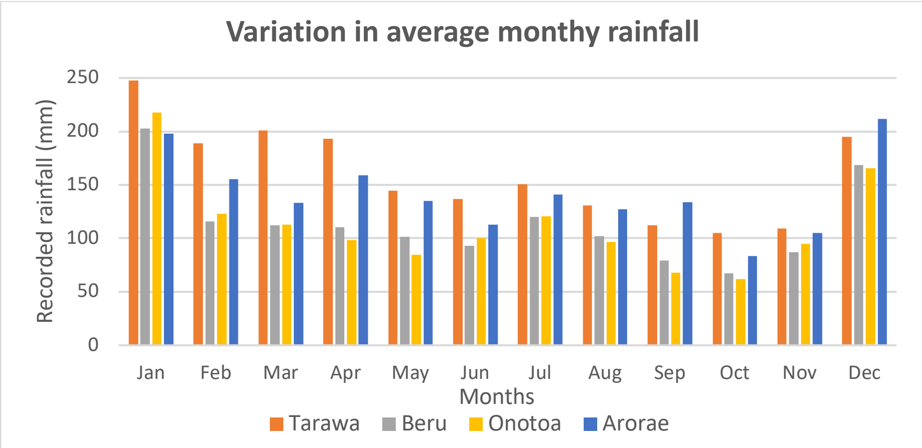

Figure 5. Variation in monthly rainfall in Tarawa, Beru, Onotoa and Arorae (source: KMS).

Based on the available rainfall data (Table 4), Onotoa recorded a mean monthly and annual rainfall 112 mm and 1229 mm, respectively. Given the distinct rainy period from November to April and dry periods in the other months, the seasonal monthly rainfall averages are 136 mm and 89 mm for these two climate conditions with around 70% of annual rainfall being recorded during the wet months. The minimum annual rainfall recorded in Onotoa was 166 mm in 1950. Interestingly, Beru recorded its lowest annual rainfall in the same year. In contrast, the maximum rainfall of 2489 mm was recorded in 1987, with similar conditions recorded on both Arorae and Beru.

The variation of rainfall on an annual or monthly basis is expressed through the coefficient of variation, CV (Table 4), showing that Onotoa and the southern islands experience higher variability of 0.9–1.1, compared with 0.6 recorded in Tarawa. This variability is clearly exhibited by Figure 6 where the annual rainfall variability in four atolls, coupled with a strong seasonal influence, is depicted.

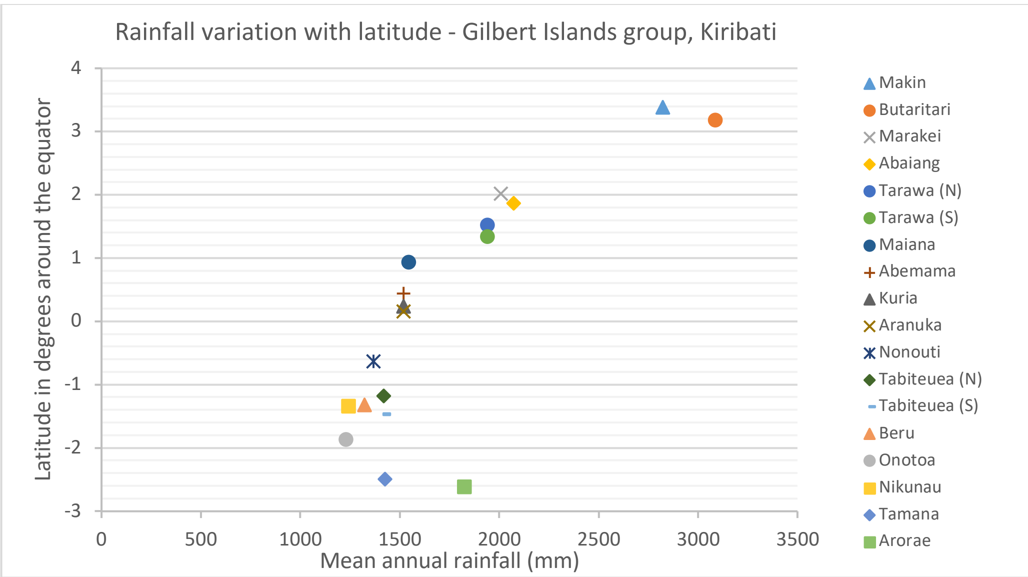

Figure 6. Rainfall variability in the Gilbert Islands group, showing reduced annual rainfall in atolls located between latitudes 2°N and 2°S.

An analysis of the mean annual rainfall around the Gilbert Islands group shows a trend of decreasing rainfall patterns in the central islands and some of the southern islands (Figure 6), while the northernmost and southernmost islands seem to record an elevated mean annual rainfall – this clearly illustrates the rainfall variability in Beru, Onotoa, Arorae and Tarawa. This would suggest that Onotoa and Nikunau islands receive lower annual rainfall, which in turn will increase the vulnerability of freshwater resources, be it groundwater or rainwater storage and availability for use.

Droughts

Droughts in Kiribati can be defined by using the percentile method as being a period of rainfall in which the sum of the rainfall for the specified period (e.g. three, six or 12 months), is below the lowest 10% (20 mm) of the summed-up recorded rainfall for that specified period. In other words, the sum of rain recorded over a three-month period – for example from September to November in Onotoa – will constitute a drought if it falls in the lowest 10% of the summed recorded rainfall for the same three-month period across the entire recorded rainfall history.

Considering the heavy reliance on both groundwater and rainwater harvesting for potable purposes, as presented earlier, it is appropriate to use a three-month and six-month period of rainfall to assess the impact of drought using the percentile method. A statistical analysis of rainfall records for Beru, Arorae and Tarawa, using both the three-month and six-month drought indices, (Table 5. Three-month index and six-month index (in brackets) using SCOPIC conducted from Beru, Onotoa and Tarawa historical rainfall.) provides some insight into average drought lengths and estimated drought occurrence for both central and southern Kiribati. These results, particular the Beru and Arorae conditions, could approximate the potential severity and frequency of past and future extremely dry conditions for Onotoa.

Table 5. Three-month index and six-month index (in brackets) using SCOPIC conducted from Beru, Onotoa and Tarawa historical rainfall.

Drought Parameters	**Beru (Jan 1945–March 2019 with gaps)**				**Arorae (Jan 1950–May 2004 with gaps)**				**Tarawa (Feb 1947–April 2019)**			
	Total	El Niño	La Niña	Neutral	Total	El Niño	La Niña	Neutral	Total	El Niño	La Niña	Neutral
Number of droughts	21 (17)	2 (NA)	10 (8)	9 (9)	21 (13)	1 (NA)	12 (6)	8 (7)	21 (14)	1 (NA)	10 (9)	10 (5)
Average length of drought (months)	8.7 (11.1)	4.5 (NA)	9.3 (9.9)	9.0 (12.1)	8.8 (11.5)	2.0 (NA)	9.2 (10.0)	9.1 (12.7)	10.2 (14.6)	29.0 (NA)	9.5 (13.9)	9.0 (16.0)
Average recurrence (months)	33.8 (42.8)	23.0 (NA)	36.1 (31.6)	33.8 (54.0)	24.1 (42.6)	19.0 (NA)	24.6 (52.6)	24.0 (35.4)	36.1 (48.8)	18.0 (NA)	28.9 (45.8)	36.2 (55.8)

Table 5, above, showing historical rainfall data in the three-month index and six-month index (in brackets) using SCOPIC conducted from Beru, Onotoa and Tarawa illustrates that most of the historical droughts in Kiribati occurred during La Niña and neutral conditions. Using the three-month index, the estimated length of drought is around 9 and 9.5 months with Tarawa recording an extreme 29-month period during an El Niño, where the recurrence time ranged between 1.5 and 3 years. It is expected that during these conditions, the private rainwater storages would completely fail whereas additional storages such as tanks and cisterns in churches and *manneabas* would offer some water security options if both accessibility and abstraction are regulated. The six-month index, in contrast, showed an estimated drought length of 9–16 months while the recurrence of these severe conditions is between 2.6 and 4.6 years. This would suggest that fresh groundwater will be severely stressed due to a prolonged rainfall deficit.

A closer look at the impacts of drought was also made on the 1998–2000 event, simply to provide insight into the severity of such events and their potential impacts (Table 6). A comparative analysis was conducted on the Tarawa and Arorae rainfall datasets, which have complete measurements between July 1998 and April 2000.

Table 6. Assessment of the rainfall trend in Tarawa and Arorae during the 1998–2000 drought (sources: KMS and National Statistical Office).

Island	South Tarawa	Arorae
Population (2005 census)	40,311	1256
Number of months of rainfall analysed (July 1998–April 2000)	22	22
Total rainfall recorded (mm)	867.8	304.0
Average monthly rainfall (mm)	39.4	13.8
Number of months (and percentage of time) with NO rainfall	0 (0%)	15 (68%)
Number of months (and percentage of time) with less than 10 mm rainfall	9 (41%)	2 (9%)

Table 6 above shows that the varying intensity of drought events across the Gilbert Islands group. Based on rainfall alone, Arorae and most probably the southern islands would have experienced extremely dry conditions, as indicated by the 304 mm of total rainfall that was recorded in those 22 months, with no rain recorded in 15 months, and two months where rainfall of less than 10 mm was recorded. However, the different population density, coupled with the presence of businesses and government departments in Tarawa, would suggest that South Tarawa has more severe impacts due to the high water demand, which would have affected rainwater storages and caused severe stress to the Bonriki Water reserve that supplies potable groundwater to more than 50,000 residents of South Tarawa.

The above analyses suggest that the most extreme droughts on record can be repeated and may indeed worsen. This can easily threaten the availability and quality of fresh groundwater for water supply purposes, which in turn may severely impact the security of communities. This necessitates the establishment of integrated water management approaches that are based on an improved understanding of available freshwater resources and apt development options, and raising awareness on appropriate conservation and evidence-based actions in communities, which are linked to timely disaster planning, prediction, and risk reduction. Inherent to this is the need to have good and reliable rainfall measurements for Onotoa to ensure the interpretation and sharing of reliable and localised data for the island.

2.4 Geology and hydrogeology

As an atoll island, Onotoa originated from a fringing reef, and reef platform growth that is contiguous to a now submerged basaltic volcanic foundation (Figure 7 below). These reef platforms are later capped by varying thickness, composition and texture of unconsolidated marine sediments that are deposited due to a combination of eustatic sea level changes and dynamic wave processes (Warner at el; 2017). Thus the landform on Onotoa is composed of three major geological layers – that is, an upper sediment that comprises Holocene unconsolidated fine-medium coral sand and gravel, which accommodates the near-surface areas; a lower zone that comprises Holocene coarse sand and unconsolidated or semi-consolidated coral gravels; and a dense, compact and porous limestone sand and mud, that overlays basal Pleistocene limestone (Bailey 2012). The unconformity between the recent marine sediments and the limestone is referred to as the Thurber Discontinuity and has an estimated depth range between 5 and 25 m.

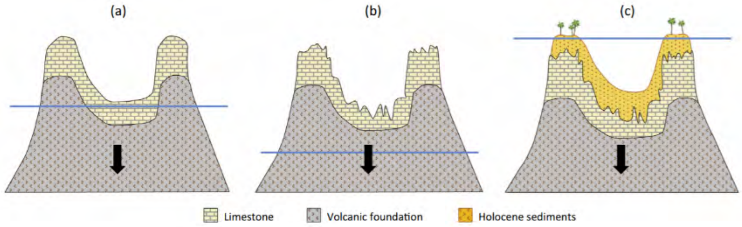

Figure 7. The process of atoll formation following the (a) submergence of volcanic foundation and growth of reef platform, (b) the continued submergence of the entire platform and formation of an erosional surface on the limestone, and (c) the deposition and growth of unconsolidated marine Holocene sediments and the eustatic sea level changes (source: Warner et al. 2017).

As documented in many reports, fresh groundwater develops and occurs in atoll settings as a thin lens that is buoyantly supported by dense underlying saline water (Figure 8). The potential of freshwater development depends on rainfall recharge, island width, permeability of unconsolidated sediments, depth to the Thurber discontinuity, and presence of reef-flat plate, as observed in Onotoa. Wider islands that receive appreciable rainfall have recorded a lens thickness of up to 20 m and reach the discontinuity. The high permeability of basal limestone cannot support the formation of a freshwater lens due to immediate mixing with underlying saltwater.

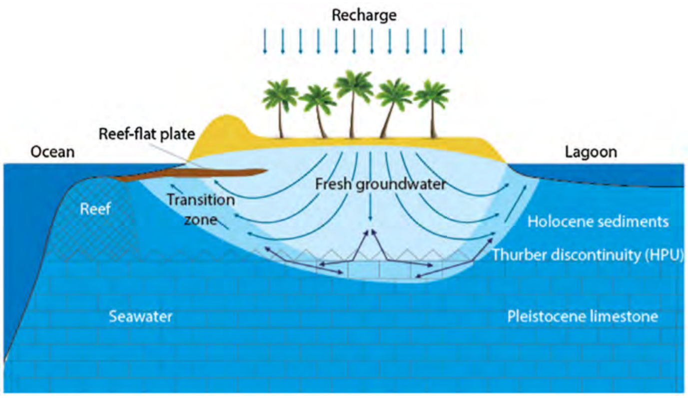

Figure 8. Fresh groundwater lens development in atolls within unconsolidated sediments as dictated by rainfall recharge and tidal processes from underlying saline water and surrounding ocean (source: Warner et al. 2017).

Figure 8 shows the potential shape of the freshwater lens with maximum thickness that is expected around the middle of the island because of the increased thickness of unconsolidated materials while the edge of the islands allow for less lens thickness as influenced by the surrounding tidal processes and a very shallow transition zone.

2.5 Previous work and status of existing water supply

As stated earlier, groundwater is the main drinking water source for the households and schools in Onotoa. Several water improvement projects have been undertaken to ensure that safe and accessible water is available for the communities of Onotoa. Falkland (2003) documented that the Outer Islands Community Water Supply Project, funded by the United National Capital Funds, supported the installation of lined wells some distances away from villages, the distribution of pipes fitted with hand pumps (Southern Cross design) and taps at standpipes. Following the failures of Southern Cross pumps, there was a demand for solar pumps and *Tamana* hand pumps, with the latter adopted as the preferred pumping technology due to its low unit cost and ease of operation and maintenance.

Figure 9. Village well at Taboarorae, which uses a solar-powered pump.

Figure 10. Concrete-ring cased well that has three (3) hand pumps installed and discharging at different points in Aiaki village.

Currently, the water supply's infrastructural levels and associated water usage varies from buildings that have proper rainwater harvesting facilities – including storage tanks – to communal groundwater wells that have either solar-powered pumps that serve most families, or multiple hand pumps that serve a cluster of families. Communal groundwater systems that have solar-powered pumps and have distribution lines to nominated outlet points within the villages were observed in Taboarorae and Otoae – these systems were not operational due to damaged pumps.

The construction status of wells varies from concrete lining or casings and coral rocks, with a majority of privately owned wells left uncovered and unfenced. Abstraction is mainly performed through bailers, such as buckets and tins, while the use of hand pumps is preferred in shared and communal wells.

Rainwater harvesting is not widely practiced due to the predominance of thatched roofs observed. A number of churches, and private buildings were equipped with proper rainwater harvesting facilities including storage tanks, as a result of the EU funded KIRIWATSAN project where rainwater harvesting improvements were undertaken to better access to safe drinking water.

Figure 11. TRUNZ desalination unit installed at the Biken Aioto Primary School near Aiaki Village with the survey team assessing the abstraction well.

Recently a TRUNZ desalination unit, Model TSB 003 (Figure 11), was installed in Biken Aioto Primary School, located between Otoae and Aiaki Island. The unit was offline during the survey due to a heavy rainfall period and has the capacity to produce 250 l of freshwater in an hour (equivalent to 0.07 l/s) and was reported to be beneficial to the school community and nearby villages during the 2018 prolonged dry periods. Measured conductivity at the abstraction well was 6.13 mS/cm while the salinity of processed water was 0.07 mS/cm, with a count of 0 *E. coli* per 100 ml sample detected. This indicates the effectiveness of such a technology to produce good quality drinking water, however, it will be important to understand the mechanisms in place maintaining and operating the desalination unit in the long term.

3.0 Field assessment technique

3.1 EM34 geophysics

The success of electromagnetic (EM34) geophysics to estimate spatial variability and thickness of freshwater lens underlying atoll islands has been widely recognised and well documented by *Kiribati water resources assessment – Promotion of effective water management, policies and practices* (Falkland 2003)*, Water Resources Assessment – Notoue* (GWP 2011a) *and KIRIWATSAN water resources assessment: Maiana Island* (Loco et al. 2015).

EM34 uses two magnetic coils, a transmitter, and a receiver that sends electrical signals into the ground where a secondary signal, that represents the ground bulk electrical conductivity, is measured in mS/cm. The exploration depth of these signals is dependent on the separation length between the two the coils, (i.e. 10 m, 20 m and 40 m in length), while the overall subsurface response is influenced by the conductivity of rock formation, percentage of pore spaces, and the conductivity of pore water. As described in section 2.4, fresh groundwater in low-lying carbonate islands floats as a lens above dense saltwater. Thus, a high bulk conductivity reading would represent little to no freshwater development due to the dominant influence of either surrounding or underlying seawater. A reduced bulk conductivity reading, in contrast, may indicate an increasing fresh groundwater occurrence. It is expected that the thickest part of a freshwater lens would develop in the middle of the island, while the opposite is expected around the edge of the island. Establishing accurate freshwater lens thickness, however, requires a calibration exercise where EM34 readings are taken against known groundwater salinity at different depths, and recorded through a monitoring point that is ideally located along the survey line.

Field calibration

In the absence of groundwater monitoring bores in Onotoa, the field calibration was undertaken at the Bonriki Water Reserve (BWR) in South Tarawa where an operational monitoring network exists. Two sets of Geonics EM34 units were used in this mission – one owned by MISE, and the second one by SPC. Both sets of equipment were calibrated in the field to ensure that they generated comparable readings while simultaneously providing reasonable approximates for the expected field conditions in Onotoa.

The calibration exercise consisted of two components. First, the groundwater salinity measurements were obtained from multi-depth tubes that were installed in selected monitoring bores, BN 1, 2, 11, 21, 26 and 27 to provide the freshwater lens thickness estimates (Figure 12. Groundwater samples taken from multi-depth tubes at BN 21 using the 12 V Flojet pump, and salinity readings being taken using the TPS-WP84.). Note that the lens thickness will be largely influenced by the current high rainfall regime, which was assumed to be similar for Onotoa. Groundwater was abstracted through a battery-powered *flojet* diaphragm pump while salinity measurements were read through the portable TPS-WP84 unit.

EM34 measurements were then collected at each of the monitoring sites, using a 10 m and 20 m coil separation. The vertical coplanar orientation or horizontal dipole (Figure 13) was used as this generated the ideal depth resolution down to 7.5 m and 15 m, respectively, for the two coil separation lengths used (0.75 factor). The salinity and EM34 measurements were later compared in order to generate a reasonable "salinity vs bulk conductivity" logarithmic relationship that better reflected the current rainfall conditions, and thus allowed the accurate freshwater lens estimation.

Figure 12. Groundwater samples taken from multi-depth tubes at BN 21 using the 12 V Flojet pump, and salinity readings being taken using the TPS-WP84.

Figure 13. EM34 measurement at BN 21 using 10 m and 20 m vertical coil arrangement or horizontal dipole.

Please note that periods of heavy rain were encountered prior to and during the calibration exercise and thus, groundwater salinity and EM34 readings would indicate a high recharge period. To prevent any over-estimation of freshwater lens thickness and to consider variability in climatic and groundwater conditions, three sets of calibration results were considered and analysed. This includes (a) the March 2019 results, (b) the KIRIWATSAN and the Kiribati Sanitation, Public Health and Environmental (SAPHE) Improvement projects data collected in 2003, 2012 and 2013, and (c) all historical calibration data that combines these datasets. As illustrated in Figure 14, the KIRIWATSAN and SAPHE dataset showed a stronger correlation and more reasonable variations between salinity and lens thickness and thus was later used to estimate the freshwater lens thickness in Onotoa.

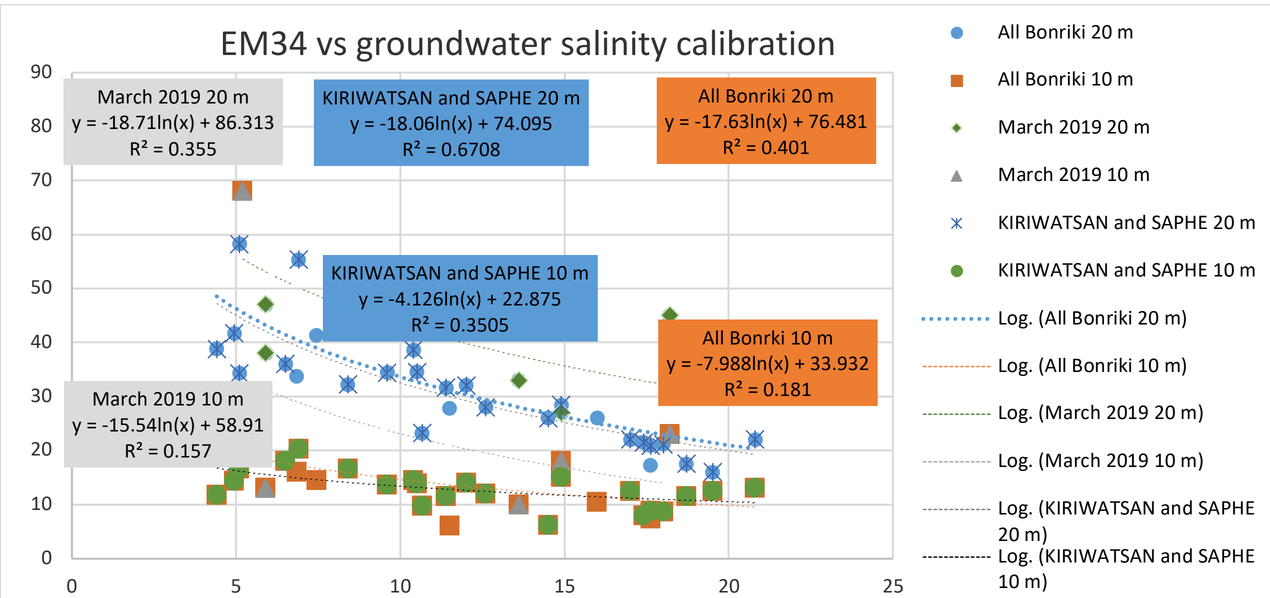

Figure 14. Relationship for bulk conductivity and groundwater salinity readings at monitoring bores 1, 2, 11, 21, 26 and 27. Note: The estimated freshwater lens thickness in Onotoa, which will be spatially presented in the village maps in later sections, is derived from the "All Bonriki" datasets, which combines all the datasets.

As part of the capacity building exercise, MISE staff members were trained in the equipment set-up and operation, data entry and analysis, and other survey protocols and considerations.

A total of 49 EM34 transects were completed around the villages, covering an estimated ground distance of 17.3 km. This resulted in the acquisition of 627 bulk conductivity readings, each having associated eastings and northings, and captured using a Garmin GPS unit. The survey transects were undertaken around the available roads and tracks that extend from the lagoon coast to the ocean coast – this is essential for capturing the lateral and vertical variability of bulk conductivity that may or may not suggest freshwater occurrence. A summary of the survey lines completed in each village is presented in Table 7 below.

Table 7. Summary of EM34 survey lines in Onotoa Island.

Village	Number of survey lines	Number of EM34 measurements	Total distance covered (km)
Taboarorae	8	45	1.1
Aiaki	11	113	2.3
Otoae	7	60	1.2
Tameo	4	46	1.6
Buariki	10	127	3.6
Tanaeang	4	83	3.2
Tekawa	5	153	4.4

The field measurements were then converted into freshwater lens thickness using the salinity bulk conductivity relationship that was generated following the calibration exercise. These estimates were later migrated into Quantum GIS (QGIS), a mapping platform, where all the maps were generated.

The mapped groundwater development potential was classified as low potential (2.5-6 m thickness), moderate potential (6-10 m thickness) and high potential (> 10 m thickness), based on previous work conducted in Kiribati. The *Water Resources Assessment – Notoue, North Tarawa* (GWP 2011a) reported that fresh groundwater bodies that are thicker than 2.5 m may be suitable for providing drinking water sources in shallow private wells used at the household level, although vulnerable during prolonged dry periods. The 6 m classification was based on previous modelling work in the Bonriki water reserve (Falkland 2003; Allam et al.,2002, Fraser Thomas Partners 2010), which demonstrated that an extreme drought scenario (such as the 1997–1998 event) in Kiribati could result in a maximum freshwater lens thickness reduction of 5.5 m. This would mean that parts of the Bonriki freshwater lens of 6 m or more thickness would still be able to provide usable water during prolonged and severe drought conditions. Although this estimation is site-specific and based on a heavily pumped Bonriki water reserve and having an island width range of 0.35–1.1 km, it provided useful guidance and a reference on the potential groundwater responses and lens shrinkage during droughts. The illustration of > 10 m thickness was simply to show where maximum lens thickness is located, which is consistent with the project's recent groundwater investigation work completed in the Republic of the Marshall Islands and Tuvalu.

It should be noted that the survey was conducted during a high rainfall period. This will likely elevate the moisture content of the unsaturated zone, decreasing the bulk conductivity readings and therefore increasing the estimated freshwater lens thickness. Thus, the interpreted results may be slightly over-estimated.

3.2 Well survey

A survey of all existing groundwater wells around the villages was undertaken. This entailed marking the exact coordinates of all existing wells using a portable GPS unit, assessing the current well infrastructure, protection capacity and abstraction technology, and measuring the groundwater level and salinity using a measuring tape and a calibrated TPS-WP84 kit. The critical elements of this well assessment were the need to determine the status of well infrastructures, particularly the type of well construction and groundwater abstraction, and the groundwater level below ground level and the salinity level. The upper limit of salinity that was adopted for fresh groundwater was 2500 µS/cm or 2.5 mS/cm.

Figure 15. Assessment of well infrastructure, showing a concrete-ring cased well with a concrete apron to avoid surface-water ingress and a bailer placed on the ground, which is a common practice.

Figure 16. Measurement of groundwater salinity level using TPS-WP84 kit.

A survey form that captured all the different elements, was completed on site and transferred digitally to develop a database of well inventory in Microsoft Excel prior to its geo-reference conversion in QGIS. MISE staff members were engaged throughout the entire assessment.

Water samples were also collected for bacteriological analyses. A total of 38 groundwater wells were sampled either using bailers or at discharge points of hand pumps. Three rainwater tanks were sampled at the tank outlets to assess the safety of the collected rainwater. The 3M^{TM} Petrifilm^{TM} plates were used through a filtration membrane procedure. The procedure entailed the extraction of two or three samples of 1 ml of water and discharged onto separate agar plates for repeatability purpose. This was followed by a 24-hour incubation period where the plates were placed in an esky, which had a temperature of 35°C, before the *E. coli* growth were evaluated. The *E. coli* count per sample was then done through averaging the *E. coli* and total coliform colonies in the plates for each sample before expressing these per 100 ml.

Figure 17. Preparation of samples for *E. coli* analysis.

Proper quality control measures, including the use of detergents and hand sanitisers to avoid any cross contamination, were used while both bottled water and boiled rainwater were used as controls. The *E. coli* count and water supply safety was then determined based on the WHO guideline provided by Wisner and Adams (2002) for water supplies in disaster prone areas (Table 8).

Table 8. Water safety guideline (source: Wisner and Adams 2002).

***E. coli* count/100 ml**	**Water Safety level**
0	WHO guideline compliant
1–10	Tolerable
11–100	Requires treatment
> 100	Unsuitable for consumption without proper treatment

This exercise was linked to the capacity building aspect of the mission and aimed at introducing the *E. coli* test technique to the MISE staff members as a water quality assessment tool that can be utilised remotely during their periodical monitoring and water, sanitation and hygiene (WASH) related diseases outbreak periods. Due to the limited timeframe, groundwater sample collection was focused on drinking water wells that are accessed through either hand pumps or bailers, as well as on a few rainwater tanks.

Groundwater salinity and water level was monitored continually in three wells through the investigation period using automatic loggers (Eijkelkamp divers). Two loggers were installed in Buariki and one in Tekawa. The loggers were set-up to take measurements every 6 minutes and were suspended on stainless steel wire at a pre-defined depth that always ensured their complete submergence below the water table. A barometric logger was installed to compensate for barometric influences. Manual water level and EC readings were taken at the beginning and at the end of the monitoring period in order to validate the readings recorded by the loggers.

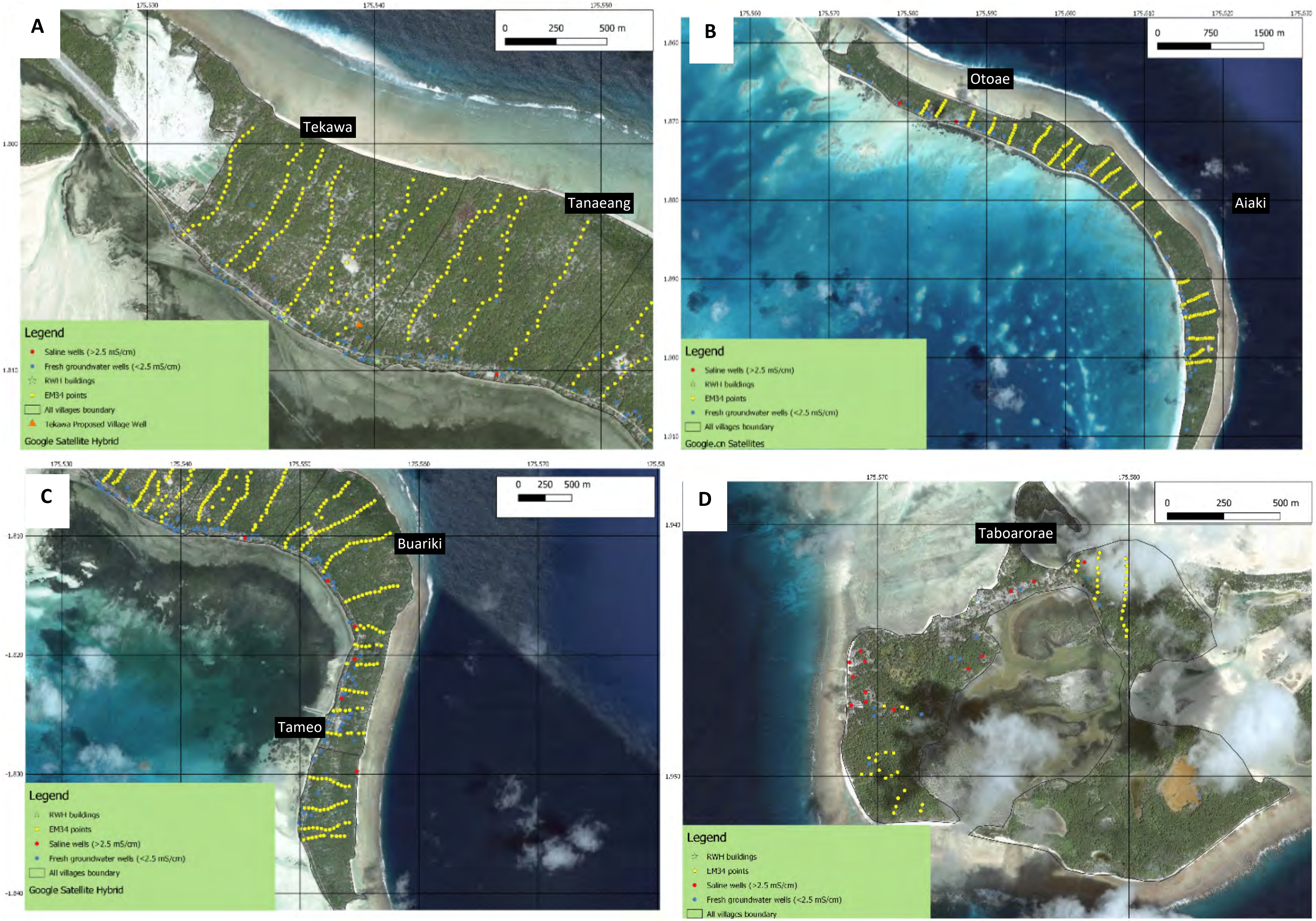

Figure 18. Groundwater investigation maps in (a) Tekawa and Tanaeang, (b) Otoae and Aiaki, (c) Buariki and Tameo, and (d) Taboarorae

3.3 Rainwater harvesting (RWH) assessment

During the assessment of current RWH infrastructure, the focus was only on communal buildings, such as churches and *manneabas*. These buildings are commonly equipped with proper roofing materials and are generally known to have large roof catchments and thus have the potential for providing a secure water supply alternative if rainwater harvesting is improved. This RWH assessment entailed the measurement of roof catchment dimensions, the assessment of rainwater harvesting accessories (such as fascia boards, downpipes and storage tanks), and the assessment of the existing tanks' storage volume and conditions.

Figure 19. Kiribati Protestant Church in Taboarorae village, which has a good roof catchment but no guttering and downpipes.

Figure 20. Five KIRIWATSAN tanks, which have a combined storage volume of 30,000 l and connected to the Taboarorae village's *manneaba roof catchment* that only has 50% gutter coverage

This survey extended to some general observations on the effectiveness and status of the recent EU funded KIRIWATSAN RWH improvement project. It was clear that a number of communal and private houses were equipped with the installation of fascia boards, downpipes, transmission pipes, 5000 l storage tanks and tap stands. It was observed that a private house was over equipped due to the relatively small roof catchment area. Also shown in Figure 22, a recently built structure for RWH was left abandoned with only the tanks and tap stand remaining while the other elements have been removed and probably used for other purposes.

Figure 21. Private building selected and used for improved RWH in Tekawa village next to the thatched roof village's *manneaba*, located towards the northern end while the properly thatched church *manneaba* is located 300 m.

Figure 22. Abandoned 30,000 l tanks, tap stands and two PVC posts, which are remnants of the RWH structure built in an isolated area, south of Aiaki village.

3.4 Rain gauge installation

Figure 23. The 0.5 mm tipping bucket housed inside the rain gauge and connected to a ML1 logger, which allows for the recording of rainfall events.

This was an infrastructural component of the mission. The installation of a new rain gauge and its associated operation and maintenance training was undertaken. Rainfall data is essential for both the national and island governments to measure, record and disseminate rainfall data in water resources planning, disaster prediction, and disaster preparation purposes. Critical to the protection and long-term benefit of this rain gauge is the engagement, collaboration, and logistical support provided by both national and island governments through KMS, MISE and the Onotoa Island Council.

A 0.5 mm tipping bucket (TB3) (Figure 23) automated rain gauge was installed around the Onotoa Island Council centre. The TB3 is connected to a MiniLog (ML1-DB) data logger, which is housed within the rain gauge – the logger is powered by an internal battery that has a 1-year life and the logger can record up to 100,000 events, each with its associated date and time of occurrence (Yuen 2009). The tipping bucket used an integrated siphoning mechanism to accurately measure rainfall intensities between 0 and 700 mm per hour. The TB3 technology was successfully introduced in the Pacific region since the Pacific Hydrological Cycle Observation System (Pacific-HYCOS) in 2008 and many countries continue to benefit from this robust instrument.

Three ML1-DB loggers were assigned to this new rain gauge to facilitate transfer of data to and from this remote location and to avoid any missing data in the rainfall records. It was agreed between KMS, MISE and the Island council that the Onotoa Island Water Technician would be responsible doing the monthly data download and the maintenance of the rain gauge. In a data download event, the used data logger will be disconnected and will be replaced by the second unit, which will allow data logging to continue. The third logger remained with the water technician at all times, as a backup. The used logger will then be securely transported to Tarawa via the weekly domestic flight to and from Onotoa. The expectation is such that upon the receipt of data logger in Tarawa, KMS and MISE will transfer and analyse the monthly rainfall data, before sending the device back to Onotoa.

Figure 24. Installation site near the old manual rain gauge.

The installation site was selected through a consensus between the Island Council, MISE and KMS, and as such the new TB3 was erected beside the old manual rain gauge near the Island Council Office (Figure 24) – the site is already fenced and is currently on lease. This eliminates the issue of lease acquisition, which usually takes time, and ensures that the instrument is secured.

Additionally, the Onotoa Island Water Technician was trained on the equipment calibration, download and transfer of rainfall records, under the guidance of KMS and SPC staff members. Calibration was undertaken using a 653 ml field calibration device, to ensure that the equipment was reading correctly: 41 to 43 bucket tips were deemed a calibration pass.

Figure 25. Demonstration of how an ML logger is connected and placed in the rain gauge (undertaken by KMS staff members).

Figure 26. Use of field calibration device demonstrated together with the recoding of calibration result on the field sheet.

4.0 Results and discussion

4.1 Groundwater potential and freshwater lens mapping

The assessment of the 184 groundwater wells and the completion of the EM34 survey provided a snapshot of the groundwater potential in terms of the thickness and salinity of groundwater. The extent and variability of a freshwater lens thickness was mapped across Onotoa.

Well survey and groundwater quality

The well assessment resulted in groundwater salinity that ranged from 0.9 to 3.9 mS/cm and the depth to water table ranged from 1.47 to 2.49 m below ground level. As expected, elevated salinities were recorded in wells situated close to the coast and/or located in areas that do not offer suitable conditions for groundwater lens development. As illustrated in Table 9, all but one village showed usable fresh groundwater qualities. Taboarorae recorded the highest number of saline wells with 63% of the wells exceeding the salinity limit of 2.5 mS/cm. It was interesting that wells in Taboarorae were still used for washing and bathing due to the limited availability of freshwater options. This high salinity suggests the fresh groundwater potential is extremely low and may be present as localised pockets around the village.

Well construction facilities

The quality of construction and materials used in groundwater wells indicate the level of investments made towards the use and protection of wells at a household level. Fifty-nine per cent (59%) of the wells had concrete casings, 40% had coral rock while 1% accounts for either unlined wells or wells that use polyethylene or steel drums. In terms of groundwater protection, 29% of the wells did have covers, while 21% and 14% account for wells with an apron and fence, respectively. This would suggest that groundwater is vulnerable to contamination from rubbish, insects, vermin and other animals, as wells as surface-water ingress during a heavy downpour.

Groundwater abstraction technology

The use of bailers, in the form of buckets and tins, is prevalent around the villages and accounted for 64% of the surveyed wells. This is a concern because of the unrestricted access that people have to the wells, in combination with the practice of placing bailers on the ground, which makes them vulnerable to contamination. Hand pumps accounted for 30% of the wells – these wells are usually shared and located away from the abstraction or collection points. Solar-powered pumps, which were observed in the medical clinics, accounted for 1%.

As mentioned in section 2.5, the villages of Taboarorae and Otoae have village wells that are equipped with solar-powered pumps, elevated storage tanks and distribution pipes. The pumps appeared to be non-operational due to technological failure.

Bacteriological contamination

Out of the 38 groundwater samples that were analysed for *E. coli* quantification, 16 (42%) showed no *E. coli* contamination (WHO compliant), 5 (13%) showed contamination levels that require some treatment, while the remaining 17 samples (45%) showed very high contamination levels, rendering these sources unsuitable for drinking without proper treatment. It should be noted that these sampled wells were all used for drinking water purposes with some of them being used for periodical salinity monitoring by the Onotoa Island Water Technician.

It appears that the well construction and the quality of materials used, including the abstraction technology used, largely defines the level of groundwater contamination in the wells. Out of the 16 samples that had no contamination, 14 (88%) were collected from wells that are cased with concrete rings, 9 of these were collected from completely covered wells, and 11 samples were collected from wells that use hand pumps with discharge points that are far away. Although 5 WHO-compliant samples were from private wells, where buckets and tins are used for accessing groundwater, the common practice of placing these bailers on the ground before and after use is always a concern, as this could introduce contamination into the abstracted groundwater.

The very high contamination level detected in 17 wells can be attributed to poor abstraction practices and inadequate well protection; these require improvements in well infrastructure and the adequate boiling of groundwater prior to use. It was a concern that 53% of the highly contaminated wells use hand pumps, which would indicate either a contaminated source or a compromised water distribution system. A water safety plan in which the source of contamination is identified, and necessary actions taken to improve groundwater protection and quality is recommended. As proposed in the KIRIWATSAN project reports (Loco et al. 2015), boiling of all groundwater prior to use is highly recommended for all households in Onotoa, considering the presence of *E. coli* bacteria in the tested groundwater samples, to prevent any issues related to ingestion of contaminated water.

Three rainwater tanks, namely the accommodation centre, the Tanaeang Catholic Church and the Taboarorae village *manneaba*, all recorded an *E. coli* count of 0 per 100 ml.

The above *E. coli* results should be treated with caution as the method used for the analysis is only limited to a sample volume of 1 ml. Although duplicate or repeated samples were taken, it would have been better if other sample volumes, such as 10 ml and 50 ml, were used to provide further insights in samples with low *E. coli* counts. For instance, 4 groundwater samples from wells using hand pumps recorded an *E. coli* count of 50 per 100 ml, which effectively meant that 1 plate showed a count of 1 and the other showed a count of 0, which equates to an *E. coli* count of 50 per 100 ml. Having other sample volumes would certainly improve the confidence of these readings by further quantifying the numbers into either the tolerable or requiring some treatment categories.

Table 9. Summary of all groundwater wells surveyed in Onotoa.

Village	Taboarorae	Aiaki	Tekawa	Tanaeang	Otoae	Buariki	Tameo
Number of wells	24	40	17	22	24	38	19
Number of households (2015 census)	49	57	38	40	32	41	66
Average depth to water table (m below ground level)	1.47	2.39	2.28	1.84	2.49	1.94	2.23
Average salinity level (mS/cm)	3.96	1.17	1.14	0.91	1.59	1.02	1.08
	WELL CONSTRUCTION AND PROTECTION						
Number of well having cement ring casing	7	16	12	18	9	30	16
Number of wells having coral rock casing	17	24	5	4	15	7	3
Unlined well	0	0	0	0	0	1	0
Wells having well cover	1	1	3	8	5	27	8
Number of wells having apron	5	11	3	4	2	8	5
Number of wells having fence	1	2	1	0	2	18	1
	ABSTRACTION TECHNOLOGY						
Number of wells using solar-powered pumps	1	1	0	0	0	0	0
Number of wells using hand pumps	1	5	4	5	7	19	15
Number of wells using bailers (buckets/tins)	22	34	12	17	14	15	3
Unused wells	0	0	1	0	3	4	1
	WATER QUALITY						
Number of saline wells (> 2.5 mS/cm)	15	1	0	1	3	7	0
Percentage of saline wells	63%	3%	0%	5%	13%	18%	0%
Number of *E. coli* samples collected	4	4	3	5	4	14	4
Samples showing no contamination (0 count/100 ml)	0	3	1	2	0	8	2
Samples showing tolerable contamination levels (1–10 count/100 ml)	0	0	0	0	0	0	0
Samples requiring some treatment (11–100 count/100 ml)	2	0	1	1	1	1	0
Samples unsuitable for drinking without proper treatment (> 100 count/100 ml)	2	1	2	2	3	5	2

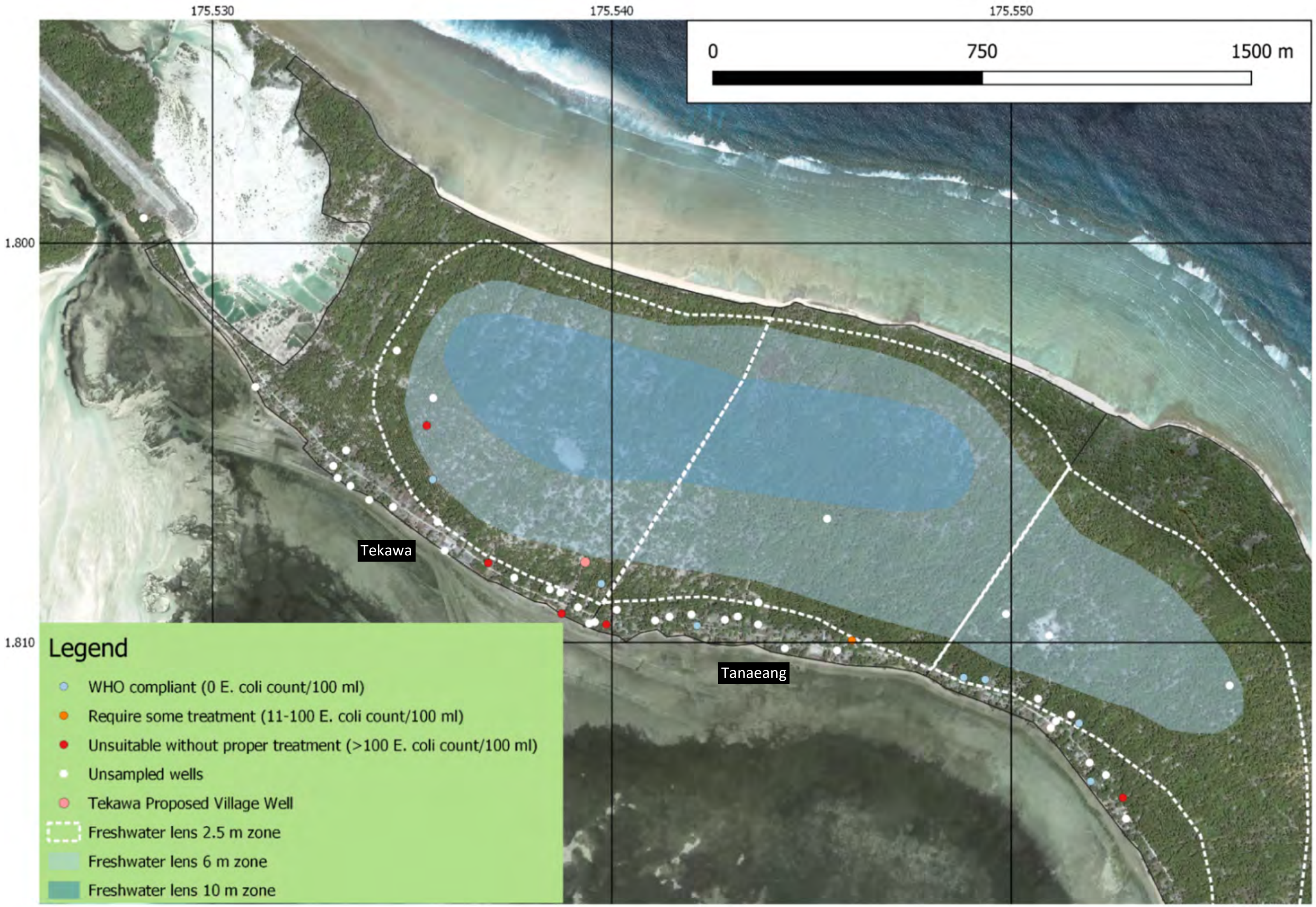

Figure 27. Mapped freshwater lens for Tekawa and Tanaeang with the E. coli contamination status

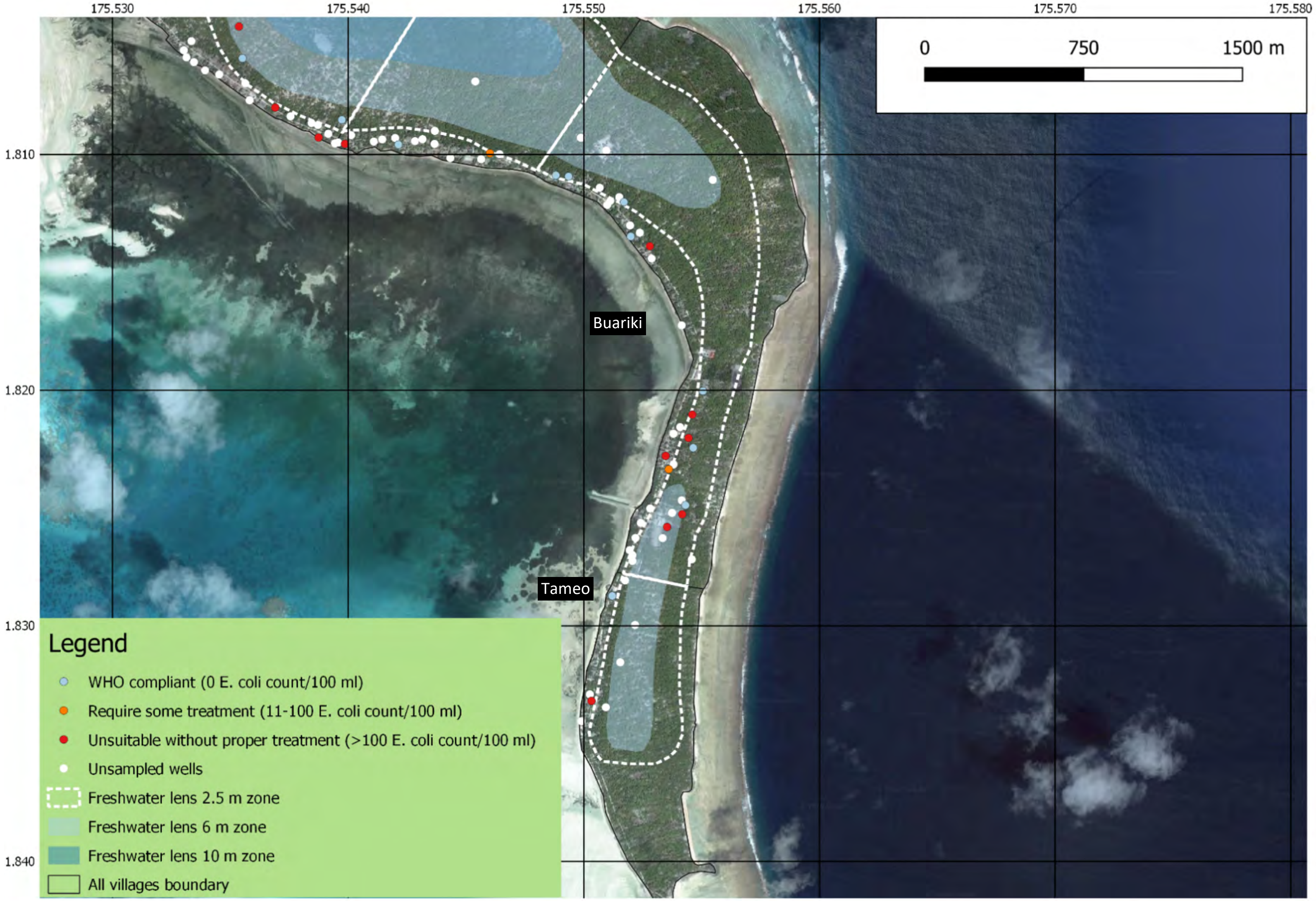

Figure 28. Mapped freshwater lens for Buariki and Tameo and the E. coli contamination status.

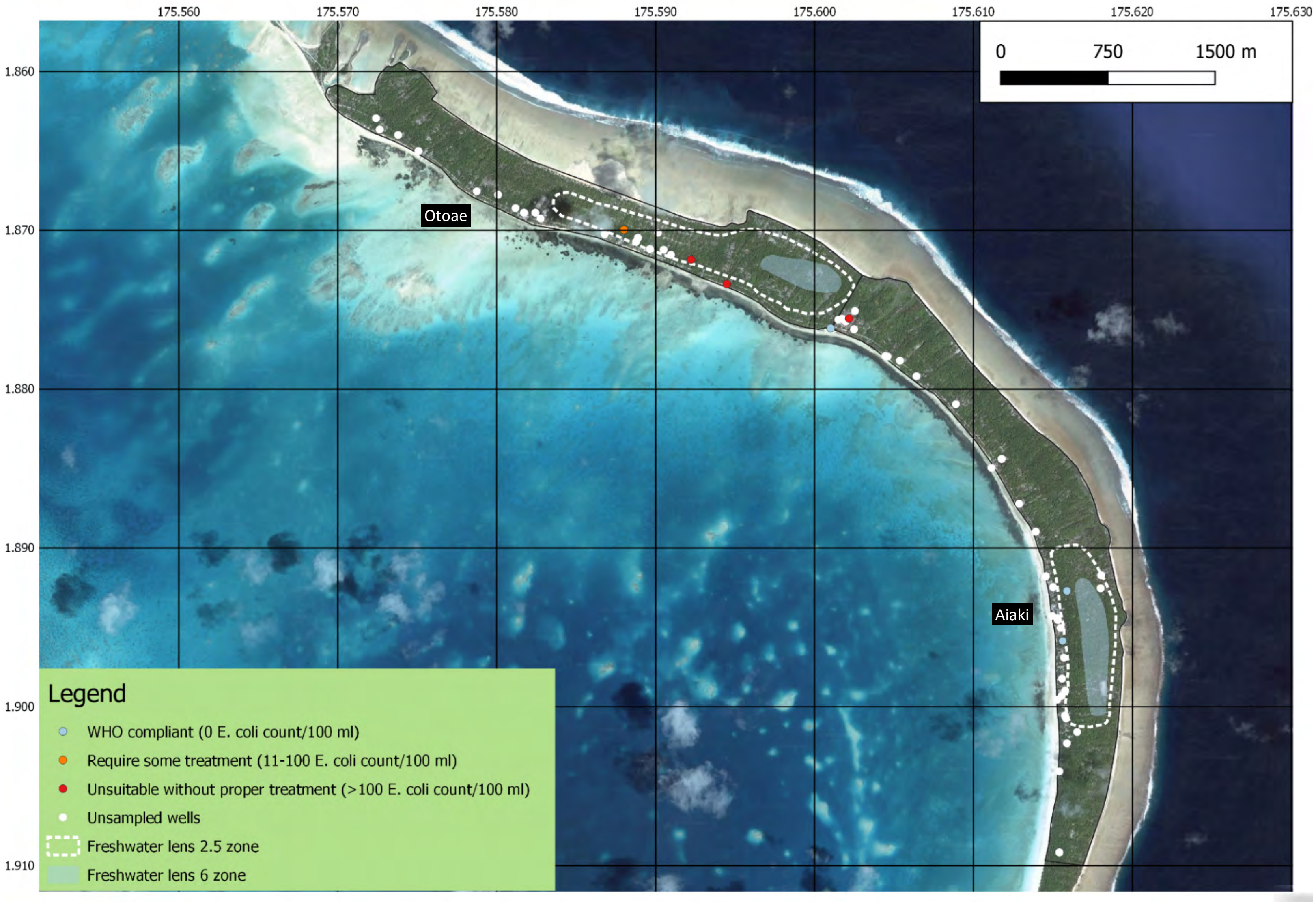

Figure 29. Mapped freshwater lens for Otoae and Aiaki and the E. coli contamination status.

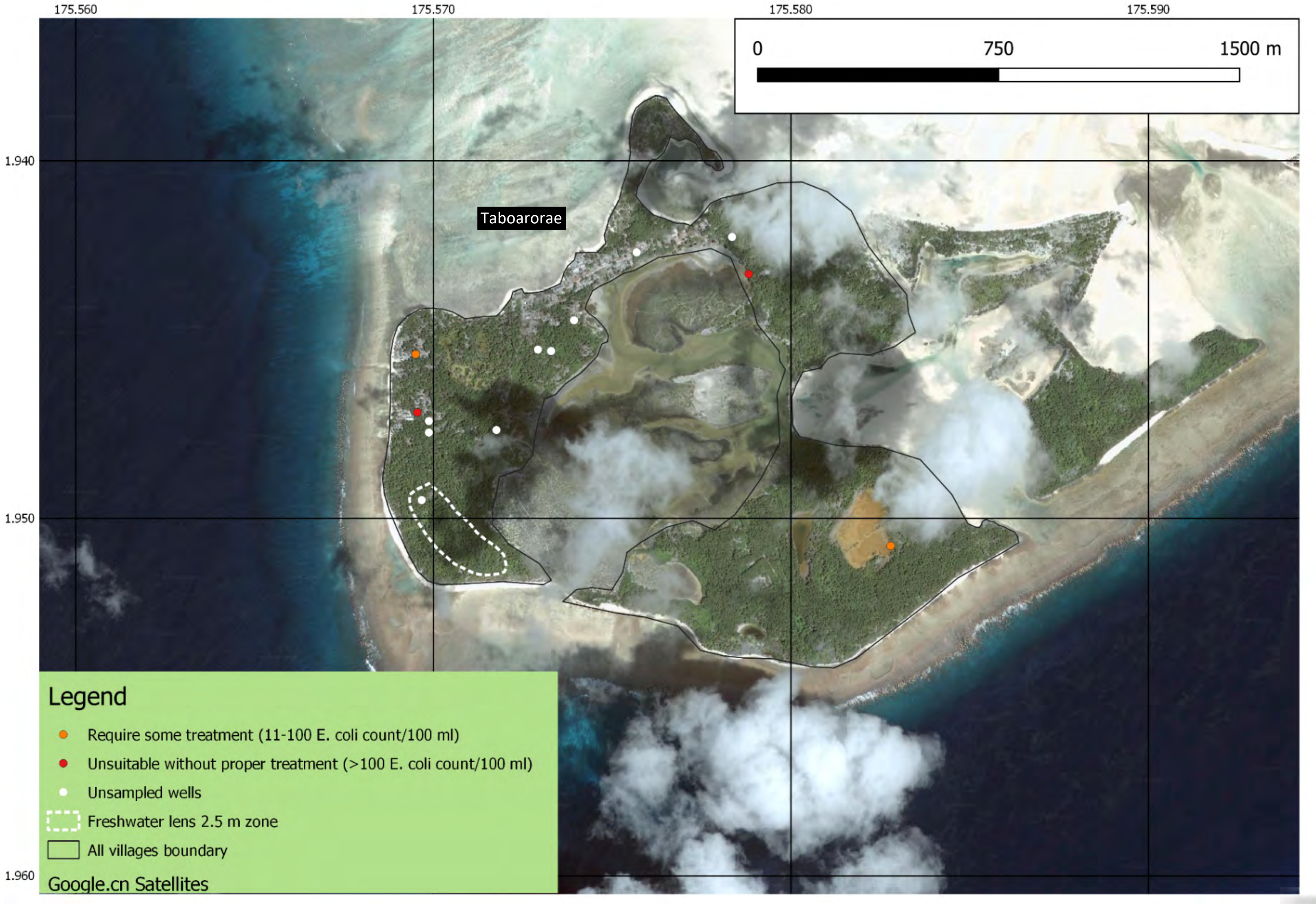

Figure 30. Mapped groundwater resources for Taboarorae with the E. coli contamination status

The generation of a freshwater lens map for each village indicated the variability of surficial and near-surface atoll sediments to allow fresh groundwater storage and flow atop the porous limestone platform. Table 10 below shows a summary of the mapped lens area and the associated groundwater resources volume.

The Tekawa and Tanaeang areas showed extensive and substantial lens thicknesses of > 6 m and > 10 m, respectively (with the latter accounting for 48% of the total lens area). The available groundwater volume at Tekawa was around 1500 Ml for the > 6 m zone and 880 Ml within the > 10 m zone. Tanaeang, on the other hand, recorded 1600 Ml and 803 Ml as available groundwater resources for > 6 m and > 10 m, respectively. These substantial volumes may be attributed to the extensive island width of between 0.9 and 1 km across this part of the atoll, allowing for substantial accumulation of unconsolidated marine sediments coupled with sufficient rainfall recharge. The mapped groundwater bodies in Tekawa and Tanaeang and particularly the location of the thickest zone would suggest that the villages have sufficient groundwater resources to support their water supply needs in both normal and extreme climatic conditions.

Moderate groundwater potential was mapped in both Buariki and Tameo, where lens thicknesses of > 2.5 m and > 6 m occupied 52% and 23% of the land area, respectively. This reduced groundwater potential compared with Tekawa and Tanaeang, which could be attributed to the reduced island width from 1 km around Tanaeang to 250–700 m in Buariki and Tameo and thereby reducing the thickness of unconsolidated sediments, which are the main aquifer materials. These mapped freshwater areas in Buariki and Tameo would suggest that the area with a freshwater lens thickness of 2.5 m is adequate to support the household wells while the area with a freshwater lens thickness of 6 m may be able to provide a reliable groundwater resource during extreme events and requires proper management.

The Aiaki and Otoae areas showed low groundwater potential, albeit with extensive areas with a freshwater lens thickness of > 2.5 m, which could support the existing shallow wells. Areas with > 6 m lens thickness occupy about 6–8% of ground coverage and their distant location may suggest that the communities may consider developing and utilising these resources as an emergency reserve.

The Taboarorae area showed extremely limited groundwater potential with 4% of the land area covering a freshwater lens thickness of > 2.5 m. This extremely limited freshwater lens area is probably due to the relatively small land area and the predominant swampy and estuary areas surrounding the village. This would raise the concerns of the village's vulnerability to saline intrusion and tidal inundation. Furthermore, the high level of groundwater mixing with basal sea water and tidal influences will always threaten the long-term development and availability of usable groundwater. This was clearly expressed by 63% of the shallow wells that exhibited salinity readings above 2.5 mS/cm.

Note that the EM34 survey does not provide any indication of potability of the groundwater with respect to pathogens, and it does not identify its risk to contamination. Water quality testing for *E. coli* bacteria is used in combination with the assessment of potential or existing contamination sources and threats to help identify the risk of contamination of groundwater. Improved water quality monitoring will be imperative should the mapped freshwater areas be developed for drinking purposes in the future.

Additionally, caution is required when applying estimated thicknesses of freshwater lenses for calculations of water demand and water resource potential, as these estimates are relevant to the heavy rainfall conditions at the time of the survey and will vary over time. Freshwater lenses are dynamic, contracting and expanding in response to climatic variations. El Niño and La Niña conditions have a significant impact on the rainfall in equatorial regions and therefore the freshwater lens. During La Niña conditions, drier conditions are experienced in Kiribati and the reducing of freshwater lens thicknesses are expected due to reduced rainfall recharge and vice versa during El Niño conditions. Thus, it is necessary to monitor the freshwater lens thickness over time, with salinity measurements in selected wells and, where possible, with repeated EM34 surveys under different climatic conditions. The monitoring and reporting of rainfall and of salinity variations in wells over time will be important for developing the sustainability of groundwater abstraction and drought management plans, and actions that the village communities can consider.

Table 10. Groundwater resources estimation based on EM34 survey.

Village	Tekawa	Tanaeang	Buariki	Tameo	Otoae	Aiaki	Taboarorae
[1]Maximum width (m)	900	1000	900	500	540	500	450
[2]Land area (m^2)	1,070,500	886,800	1,562,400	639,200	1,619,600	1,935,800	1,286,800
ESTIMATED FRESHWATER LENS > 2.5 m							
[3]Freshwater lens area (> 2.5 m) (m^2)	666,630	730,690	892,240	306,000	564,400	387,800	52,900
Average estimated thickness (m)	8.2	8.3	5.5	5.2	3.8	4.7	4.1
Lens/total land ratio (%)	62%	82%	57%	48%	35%	20%	4%
[4]Estimated groundwater resource volume (m^3)	5,466,366	6,064,727	4,907,320	1,591,200	2,144,720	1,822,660	216,890
[5]Available groundwater volume (m^3)	1,639,910	1,819,418	1,472,196	477,360	643,416	546,798	65,067
ESTIMATED FRESHWATER LENS > 6 m							
[3]Freshwater lens area (> 6 m thick) (m^2)	517,600	606,400	337,200	155,600	91,200	150,000	NA
Average estimated thickness (m)	9.8	9.1	7.2	7.3	6.5	6.9	
Lens/total land ratio	48%	68%	22%	24%	6%	8%	
[4]Estimated groundwater resource volume (m^3)	5,072,480	5,518,240	2,427,840	1,135,880	592,800	1,035,000	
[5]Available groundwater volume(m^3)	1,521,744	1,655,472	728,352	340,764	177,840	310,500	
ESTIMATED FRESHWATER LENS > 10 m							
[3]Freshwater lens area > 10 m thick (m^2)	257,500	216,000	NA				
Average estimated thickness (m)	11.4	12.4					
Lens/total land ratio	24.1%	24.4%					
[4]Estimated groundwater resource volume (m^3)	2,935,500	2,678,400					
[5]Available groundwater volume(m^3)	880,650	803,520					
GROUNDWATER POTENTIAL							
Estimated groundwater potential	Good	Good	Moderate	Moderate	Low	Low	Poor

Note:

[1]Maximum island width estimated from QGIS

[2]The total land area covered by the EM34 survey, which, in some places, did not cover the entire village

[3]Freshwater lens area generated in QGIS using in-built area calculator

[4]Estimated freshwater lens volume = average freshwater lens thickness from EM34 measurement x estimated lens area[3]

[5]Available groundwater volume represents the usable groundwater based on the assumed specific yield of 0.3 for coral sands (Falkland 2003), hence available groundwater equals estimated freshwater volume x 0.3

4.2 Groundwater vulnerability

Over pumping

It follows from the well assessment and EM34 results that the lens thickness is variable and hence is vulnerable to elevated salinity if single pumping wells are used and are not monitored and/or regulated. The use of appropriate abstraction technologies is important. These include hand pumps in single wells or low flow submersible pumps to be considered in gallery-type systems to minimise and/or prevent the pumping-induced up-coning and saline intrusion.

Groundwater contamination

The level of groundwater *E. coli* contamination presented earlier reflects the variable levels of exposure of groundwater to bacteriological contamination. The current infrastructural levels and practices, such as the poor well construction, the prevalence of buckets and tins lying on the ground, and the close proximity of wells to contamination sources (such as pigpens, *bwabwai* pits, rubbish disposal sites and pit latrines) increase the possibility of groundwater contamination; at least around the villages. However, the correlation between adequately constructed and protected wells that are situated away from the villages and the use of hand pumps, and negative *E. coli* bacterial counts provide an approach towards improving and maintaining safe water quality.

Elevated salinity in groundwater wells also reduces the usability and value of groundwater for potable purposes. This can be attributed to drought-induced freshwater lens reduction, coupled with unregulated pumping that can result in the up coning of underlying seawater, which in turn can cause elevated salinity that may render the groundwater unusable. This necessitates the selection of suitable pumps as well as the regular monitoring of groundwater during nominated periods, such as monthly or quarterly.

Reduced rainfall

The severe impacts that prolonged dry periods have on groundwater are clear and well covered in the earlier sections. This is because the availability and development of fresh groundwater is dependent on rainfall recharge. An extreme reduction in rainfall or a long period of below average rainfall would lead to the thinning of freshwater lenses, which would lead to serious socio-economic and environmental problems. It is then important for water resource authorities within the national and island governments to be active in monitoring changes in rainfall and climatic patterns. This again demonstrates the value of the newly installed automatic rain gauge in that it allows the island government to record, analyse and predict potential reduction in rainfall, which should trigger appropriate water resource management actions.

4.3 External influence of groundwater

The continuous monitoring of groundwater-level fluctuations in three private wells in relation to the tidal sea-level fluctuation, based on the modelled tidal level for Onotoa (Ramsay 2008), allowed the approximation of the percentage of the tidal signal, which indicates the signal propagation through the limestone and the overlying marine sediments, and may demonstrate the variability in response or delay time in these localities (Table 11). The monitoring well in Tekawa, located around 250 m distance from the coast, showed the most tidal lag and dampens the tidal signal the most, with a little more than 3 hours and 5%, respectively. The two wells in Buariki recorded relatively shorter lag time and recorded high tidal signal. These would suggest that the permeability of sediments around the island's widest part in Tekawa is lower compared to the other investigation locations.

Table 11. Estimated tidal lag and signal propagation recorded in three monitoring-wells.

Logger	Village	Well owner	Distance to shore (m)	Well total depth (m)	Tidal lag (h)	Tidal signal %
P5150	Tekawa	Communal well	250	3.15	3.07	5.7
M7426	Buariki	Mwea	60	1.45	2.27	27.0
V1304	Buariki	KUC Church	80	1.77	1.31	38.0

Also displayed in Figure 31 **Erreur ! Source du renvoi introuvable.** below are the impacts from abstraction, which causes rapid conductivity increases whereas events of abrupt reduction in salinity would indicate rainfall recharge. The communal well in Tekawa is equipped with multiple hand pumps and is used by several families (similar to the well shown on Figure 10), hence, water demand and frequency of abstraction will be high during the day.

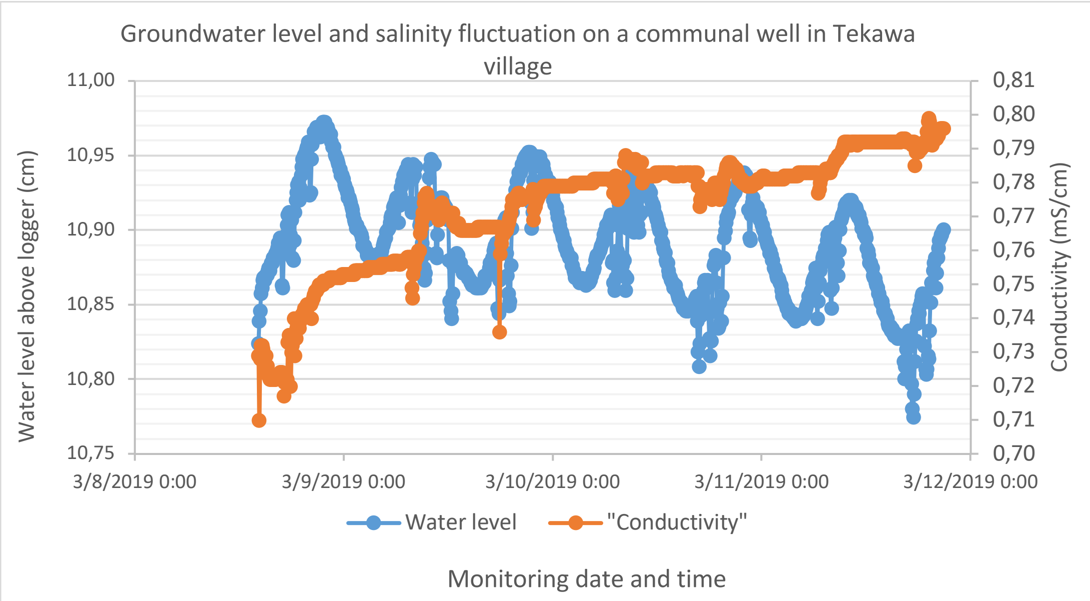

Figure 31. Fluctuation in water level and salinity in response to tidal cycles, abstraction and rainfall recharge.

4.4 Rainwater harvesting potential

The rapid assessment of several communal buildings in the villages suggests that the buildings have the potential to store substantial rainwater for community water supply purposes if the accessories such as fascia boards, downpipes and storage tanks are installed.

Table 12. Summary of the surveyed communal buildings with their RWH potential.

Building	Village	Roof area	Guttering coverage (%)	Downpipe	Fascia board	Storage (L)
KPC Church	Taboarorae	249.7	25%	None	None	0
Manneaba	Taboarorae	385.4	50%	Good	Good	30,000
KPC group *manneaba*	Aiaki	159.1	0	None	None	0
KPC Church	Tekawa	285.0	75%	None	Good	0
KPC *manneaba*	Tekawa	352.2	0%	None	Good	0

Table 12 above show that the surveyed churches and *manneabas* both have suitable roofing materials and adequate catchment areas, thereby suggesting good RWH potential. The detailed RWH analysis conducted, as conducted through the *Kiribati Adaptation Project, the Rainwater harvesting assessment in Tuvalu and the KIRIWATSAN water resources assessment* (White 2010, 2014), and Loco et al (2015), will not be repeated here. However, conclusions from these studies suggest that the proper installation of fascia boards, good quality and appropriately sized gutters, downpipes, transmission pipes and rainwater tanks will significantly improve the RWH system. The installation of underground cisterns has also been successfully trialled in various areas in Kiribati and should be considered as part of RWH improvements in Onotoa, particularly for poor groundwater potential areas, such as Taboarorae, in order to provide additional storage and enhance the communities' water security.

The brief assessment of the KIRIWATSAN RWH improvement project in 2015 saw the selection and use of a handful of privately owned buildings, which appeared to be overly equipped due to their small roof catchment (Figure 21). In isolated areas, new RWH structures were constructed – these structures were observed to be badly vandalised where roofing materials, gutters and transmission pipes were removed with only the 30,000 l tanks and tap stands remaining (Figure 22). This clearly indicates the lack of governance and protection mechanisms in the villages for these communal facilities, which in turn reinforces the need to utilise those community buildings such churches and *manneabas* which have custodial ownership, and are respected within the community, for these purposes. These buildings are usually maintained due to either village or church by-laws, which ensure the protection of these investments, assuming the custodial ownership, does not limit or restrict the accessibility and use of water during extreme climatic conditions.

4.5 Community consultation

Several engagement meetings were organised prior to and after the field assessment. These meetings were an opportunity to introduce the assessment objectives and techniques, share the preliminary results and, in turn, get communities' views on results and other pressing water issues. A summary of the meetings in Tekawa, Taboarorae and Aiaki are as follows:

1. Communities were grateful for the coverage of this mission and generally expressed appreciation for the community engagement and knowledge sharing as their understanding of groundwater potential variability and vulnerability has improved following this mission.

2. Tekawa village members, particularly the elders, valued the preliminary findings because a recent government survey led to the selection of a proposed village water supply site without any scientific backing. However, the use of EM34 geophysics equipment and the presentation of the findings via understandable maps provided sufficient evidence-based information to inform and convinced the elders and government authorities that any future development should be focused around the thickest part of the lens.

3. Taboarorae villagers have enhanced their understanding and embraced the poor groundwater potential status surrounding the village, and as such have agreed to the installation of improved RWH facilities in the church, including the construction of cisterns, together with the installation of a small-scale desalination unit, which would increase the availability of freshwater for potable uses in both normal and extreme climatic conditions.

5.0 Water resources development

Based on the assessed status of water supply infrastructure, together with the inferred groundwater potential that is based on the estimated freshwater lens thickness, several options for improved water supplies from groundwater and rainwater sources have been identified. These take into account accessibility to water sources and existing infrastructure with consideration given to sustainability, reasonable construction and maintenance costs, social acceptance and gender appropriateness.

5.1 Rainwater harvesting

It follows from the survey that community buildings – such as schools, *manneabas* and churches – that have permanent roofing materials with available roof catchment areas are ideal RWH centres. These can either be for water supply purposes in areas that have vulnerable and poor groundwater potential like Taboarorae, Otoae and Aiaki, or emergency sources for other villages. Essential to this option is the selection and use of communal buildings and equipping them with suitably sized accessories, such as fascia boards, downpipes, transmission pipes, tanks and base, as well as secured taps. The status of the recent KIRIWATSAN improvements work clearly favoured the use of communal buildings compared with privately owned houses due to existing associated governance structures that aid the protection and management of these. It is suggested that efforts be made on transferring the unused tanks to nearby unequipped churches or *manneabas* and making sure that these buildings are equipped with proper accessories to enable the reuse of these tanks and taps. Furthermore, consideration for the construction of cisterns, again, will be essential for low groundwater potential areas such as Taboarorae, to increase storage capacity and, in turn, should improve the community's resilience during extremely dry periods.

Nevertheless, the long-term accessibility, maintenance and protection of these RWH systems will require collective, coordinated and committed efforts from the communities and island councils to ensure that the benefit of having these systems is shared and optimised in a sustained manner. Designs proposed for rainwater harvesting systems have been developed in consultation with the Government of Kiribati, villages and with recent practitioners. Refer to *KIRIWATSAN Technical Notes on Water Supply Design Principles* (Sinclair et al. 2015) for details.

5.2 Groundwater development

a. Household well improvements

This option targets the improvement and protection of household wells. General features of improved groundwater abstraction systems can be found in the *KIRIWATSAN Technical Notes on Water Supply Design Principles* (Sinclair et al. 2015). This option will be ideal for households seeking to improve their household water supply, although it is more cost-effective and generally preferred to promote and develop communal style water supply systems. It is recommended that the individual households, as the beneficiaries of this water supply option, would contribute towards the cost of improvements. However, based on the variable *E. coli* contamination levels established during this survey, it is recommended that all drinking water should first be boiled.

b. Communal wells

Communal wells allow a number of households to access and abstract their water needs from the same well – this would be a relevant option for Aiaki and Otoae, where limited groundwater (< 2.5 m) is detected within the village residential area. This option can provide potable and non-potable domestic water, and should be considered when households agree to access, manage and maintain a shared well. It is suggested that the ownership would remain with one household, with a formal arrangement that allows other nominated parties to access and abstract water through a hand pump for domestic purposes. Shared wells should be situated away from contamination sources and at distances suitable for the use of a single or multiple hand pumps (*Tamana* pumps) to offer regulated groundwater abstraction and allow the delivery of water to the household.

Detailed designs are provided in *KIRIWATSAN Technical Notes on Water Supply Design Principles* (Sinclair et al. 2015).

c. Village wells – small-scale infiltration galleries

Village wells are proposed for villages where moderate groundwater potential is mapped either close to or at a distant from the village. These are small-scale infiltration galleries that have up to 10 m gallery arms. This option is probably relevant for Tameo and Buariki, where groundwater potential areas (> 6m) exist, while similar zones in Aiaki and Otoe communities, although limited and relatively far from the main village centres, may be developed as an emergency source. Village wells will be recommended if the community regards this as appropriate and there is a "village water action plan" (described in section 5.3 below) to address issues of maintenance, repair/replacement, access and ownership. The village well would be situated where an appreciable freshwater lens thickness (i.e. > 6m) has been confirmed in consultation with community members and the village Unimwane. The well would be equipped with appropriately sized solar-powered pump and water distributed through a header tank to tap stands at appropriate locations. Detailed designs are provided in *KIRIWATSAN Technical Notes on Water Supply Design Principles* (Sinclair et al. 2015).

d. Infiltration galleries

Horizontal infiltration galleries are proposed where there is a large village population and the mapped groundwater potential has a substantial thickness of more than 10 m.

As successfully trialled in the Bonriki water reserve in South Tarawa, infiltration galleries are designed to skim the top and freshest part of the of the lens to provide substantial groundwater volume for drinking water supply purposes. As trialled during the KIRIWATSAN, it is proposed that galleries be equipped with variable-speed submersible pumps and be solar-powered. Raised reservoirs and appropriately sized pipes will be required to provide enough gravity-induced flow for all the households around the village. Based on the inferred freshwater lens mapping, Tekawa and Tanaeang villages could have infiltration galleries installed for both villages.

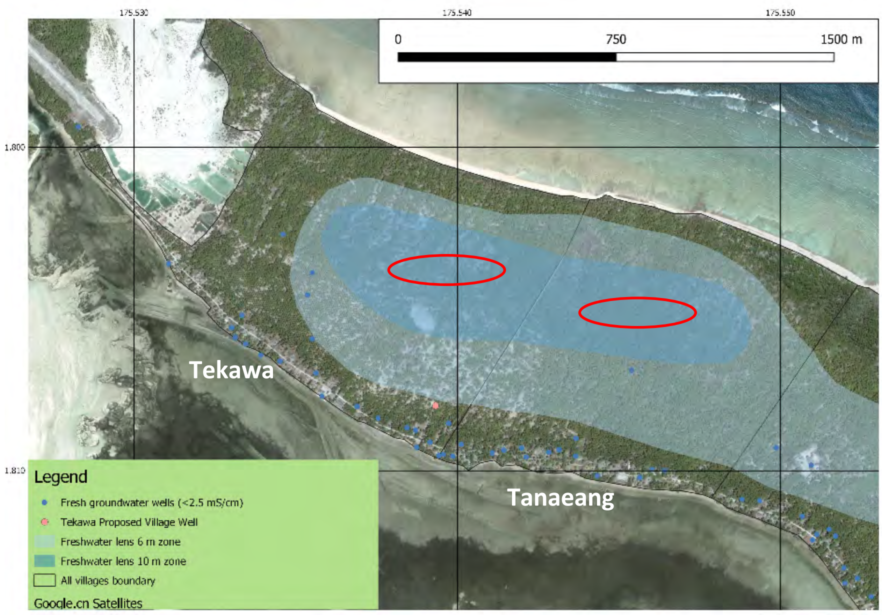

Figure 32. Proposed location of infiltration galleries in Tekawa and Tanaeang. Note the value of EM34 survey in providing evidence-based information, which will now shift the location of the village well in Tekawa that was identified earlier without any survey.

Inherent to this option would be the installation of monitoring bores near the galleries and around the mapped freshwater lens extent. This is to establish measurement points near the galleries to allow MISE and the island government to monitor the periodical changes in lens thickness and extent. Flow meters will also be required outside the galleries to record groundwater abstraction volume in different climatic periods.

This installation and long-term success of galleries would require inclusive engagement and consultation with communities and landholders to discuss operations, management, and land access issues, as well as future projected demands. Gallery designs are based on the work of Falkland (2003), and GWP Consultants (2011a), and incorporating experiences from the Kiribati Adaptation Project Phases 1 and 2. Detailed designs are provided in *KIRIWATSAN Technical Notes on Water Supply Design Principles* (Sinclair et al. 2015).

e. Desalination

Because of the potential severity of droughts and the poor groundwater potential in one of the villages, desalination technologies will need to be considered as an emergency source. This will be most relevant for Taboarorae due to its remote location and extremely poor groundwater potential. Given that there are 49 families in the area, together with the need to support the primary school and a medical centre, it is essential that the installation of a solar-powered desalination plant be considered for Taboarorae. Similar to the one installed in Bukin Aioto Primary (Figure 11), north of Aiaki village, the 250 l/h plant would provide a useful drinking and cooking water source of up to 30 l/household and could well supplement the rainwater tanks stationed near the *manneaba*. Consideration on long-term maintenance and operation support needs to be collectively coordinated and provided by the communities, and both island and national governments.

5.3 Integrated groundwater protection and management

The coordinated development and integrated management of freshwater resources in Onotoa will be key to the community's long-term health and water security. Thus, the following is recommended:

- The selection and installation of water supply options listed above should be aligned to the current water supply, the communities' needs under normal and extreme conditions, coupled with its capacity to operate and manage infrastructural systems. It is critical that a village water action plan (Loco et al. 2015), be agreed upon and documented to demonstrate the communities' willingness and commitment to support the installation, operation and maintenance of water supplies' infrastructure to avoid or minimise any possible risks associated with issues of land-ownership, and the long-term accessibility and use of these water supply systems.
- Monitoring bores should be installed around the groundwater mapped areas in Tekawa and Tanaeang to prove the thickness of the freshwater lens, together with groundwater volume and quality, and to determine the long-term fluctuation in lens thickness in response to seasonal rainfall variation.
- A flow meter and salinity meter should be installed in any future gallery installations to allow the assessment of groundwater abstraction, water usage, salinity fluctuation and potential leakages.
- Regular rainfall data collection and analyses from the newly installed TB-3 rain gauge should be carried out. Subsequent dissemination of the data to relevant authorities is equally as important in order to determine the temporal and long-term variability of rainfall, and provide valuable information related to island-wide water resource management issues. This requires the strengthened links and improved coordination between the Island Council, KMS and MISE

on the field calibration, data download, safe transportation of loggers to and from Tarawa, data sharing and the continued logging, operation and maintenance of the rain gauge.

- Suitable trigger levels for groundwater salinity and rainfall should be identified and operationalised to support water resource management during prolonged dry periods.
- A drought awareness and drought action plan on WASH should be developed with a focus on pragmatic water conservation and management responses or actions under the extreme climatic conditions.
- Appropriate water restrictions or rationing actions during extreme climatic conditions across all communal water supply sources should be considered (e.g. rainwater, groundwater and desalinated water).
- The restricting of land-use activities around the thickest part of the mapped lens should be considered to minimise potential contamination of the groundwater and maintain water quality suitable for potable purposes.
- Conjunctive use and management of all freshwater resources should be considered and integrated into a village and/or island-wide strategy to ensure that the use and potential use of limited freshwater resources captures climatic and demand variability.

6.0 References

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Annexes

Annex 1: Village maps

Annex 2: Rainfall data

Annex 3: Diver data

Annex 4: EM34 results

Annex 5: Selected field photos

ANNEX 1 – Village maps

ANNEX 1.1 – TEKAWA & TANAEANG

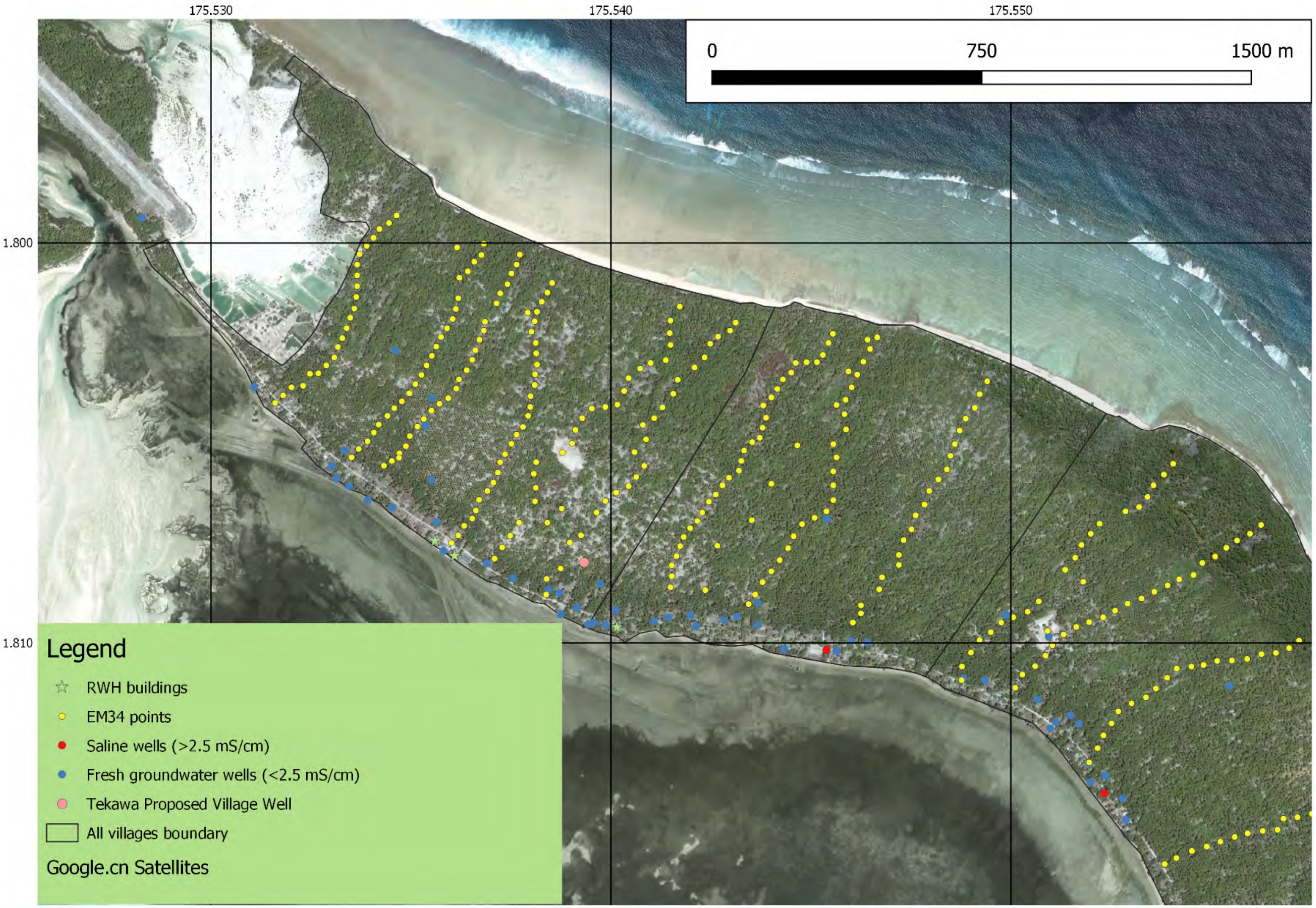

Figure A1.1a: Water resources assessment field map around Tekawa and Tanaeang villages

Figure A1.1b: Freshwater lens extent and groundwater *E. coli* contamination status around Tekawa and Tanaeang villages

ANNEX 1.2 – BUARIKI

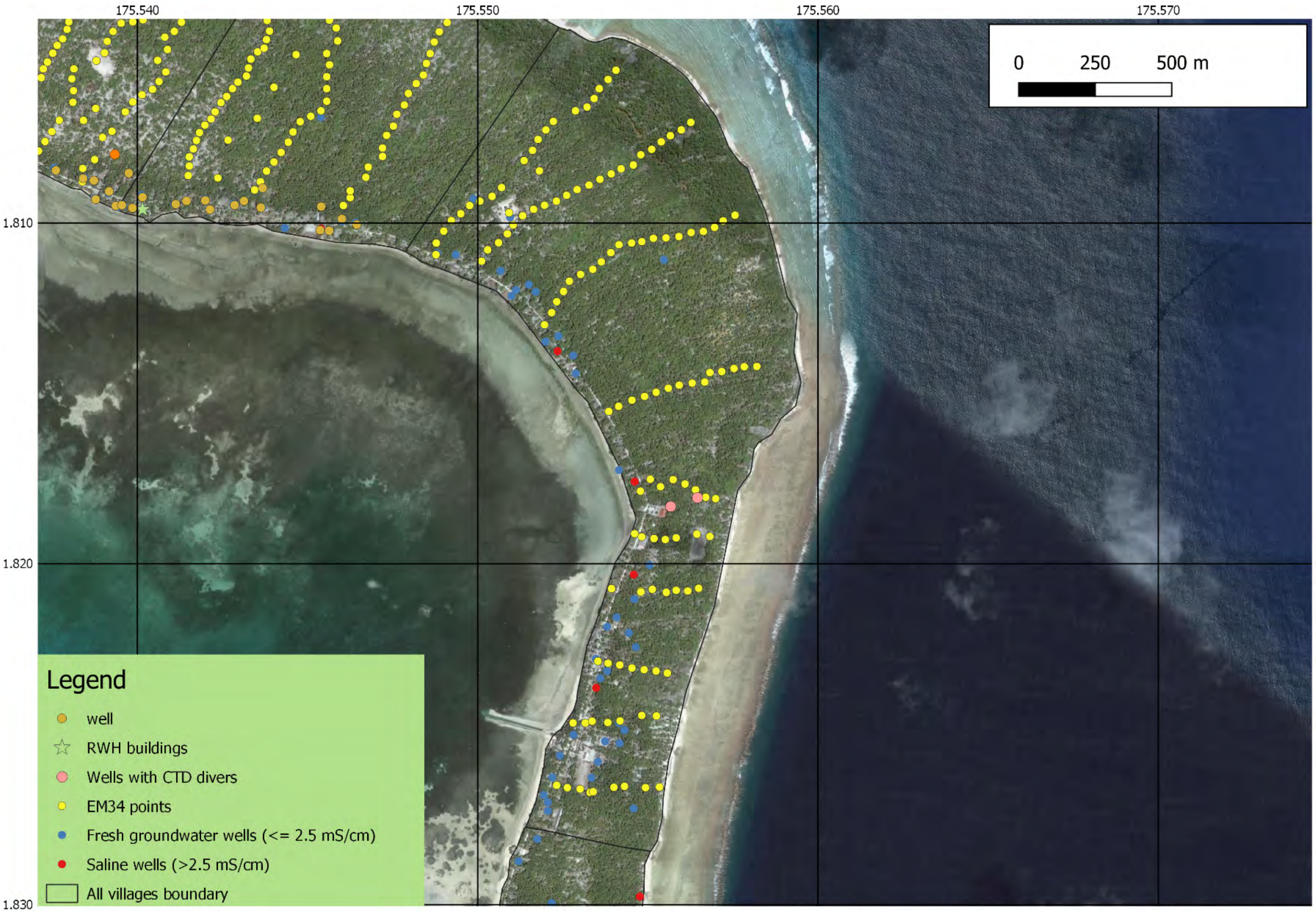

Figure A1.2a: Water resources assessment field map for Buariki village

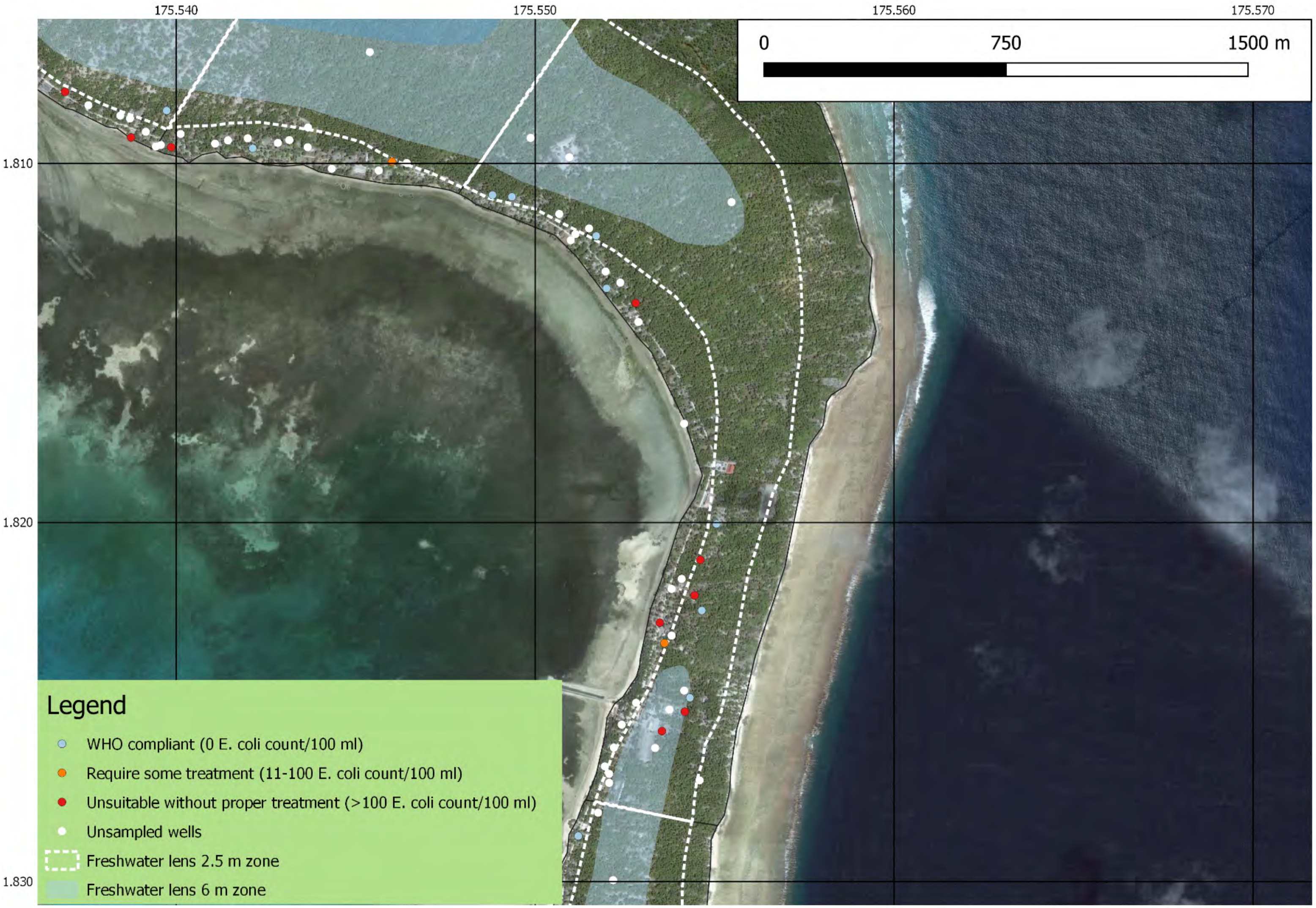

Figure A1.2b: Freshwater lens extent and groundwater E.coli contamination status around Buariki village

ANNEX 1.3 – TAMEO

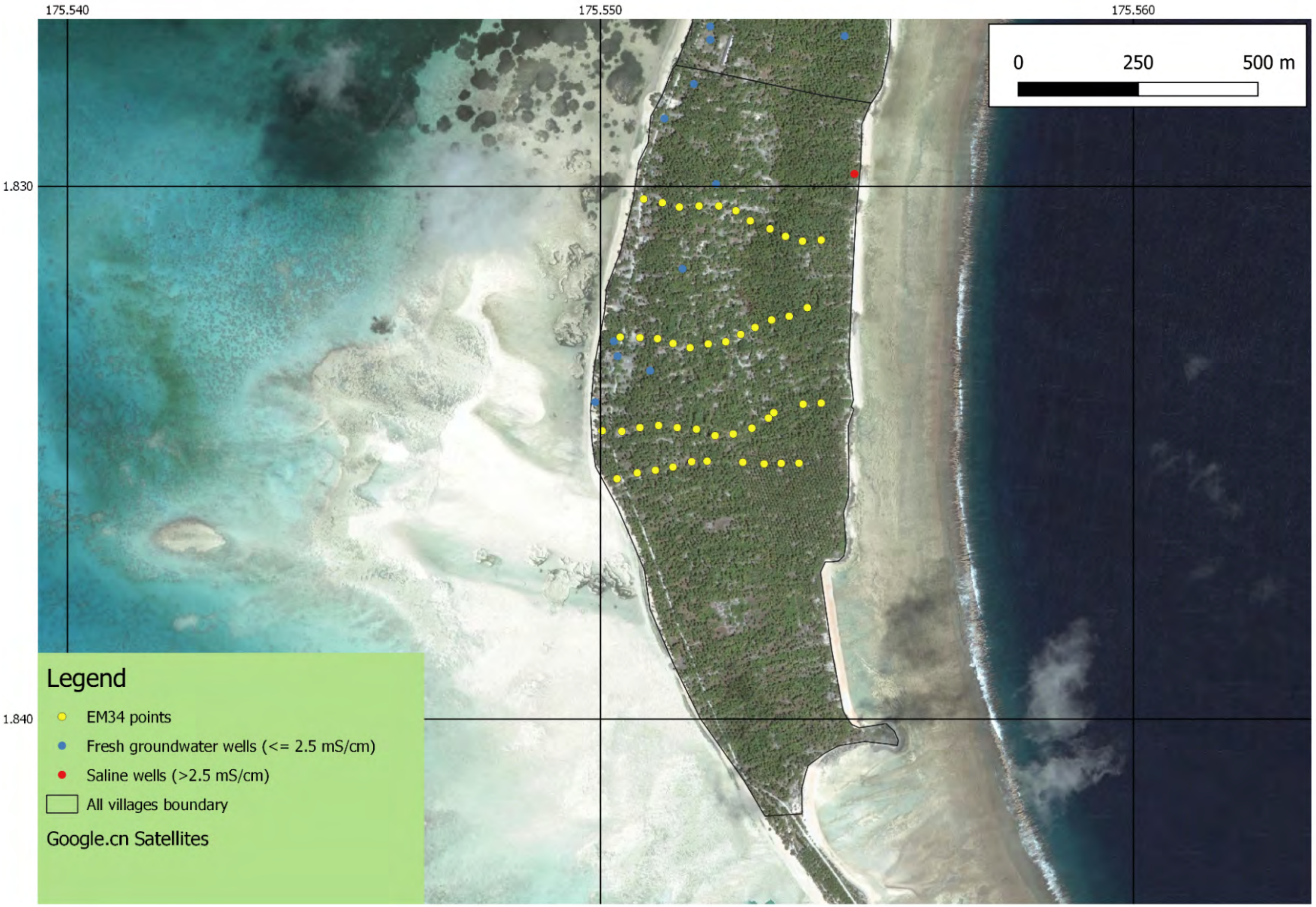

Figure A1.3a: Water resources assessment field survey map for Tameo village

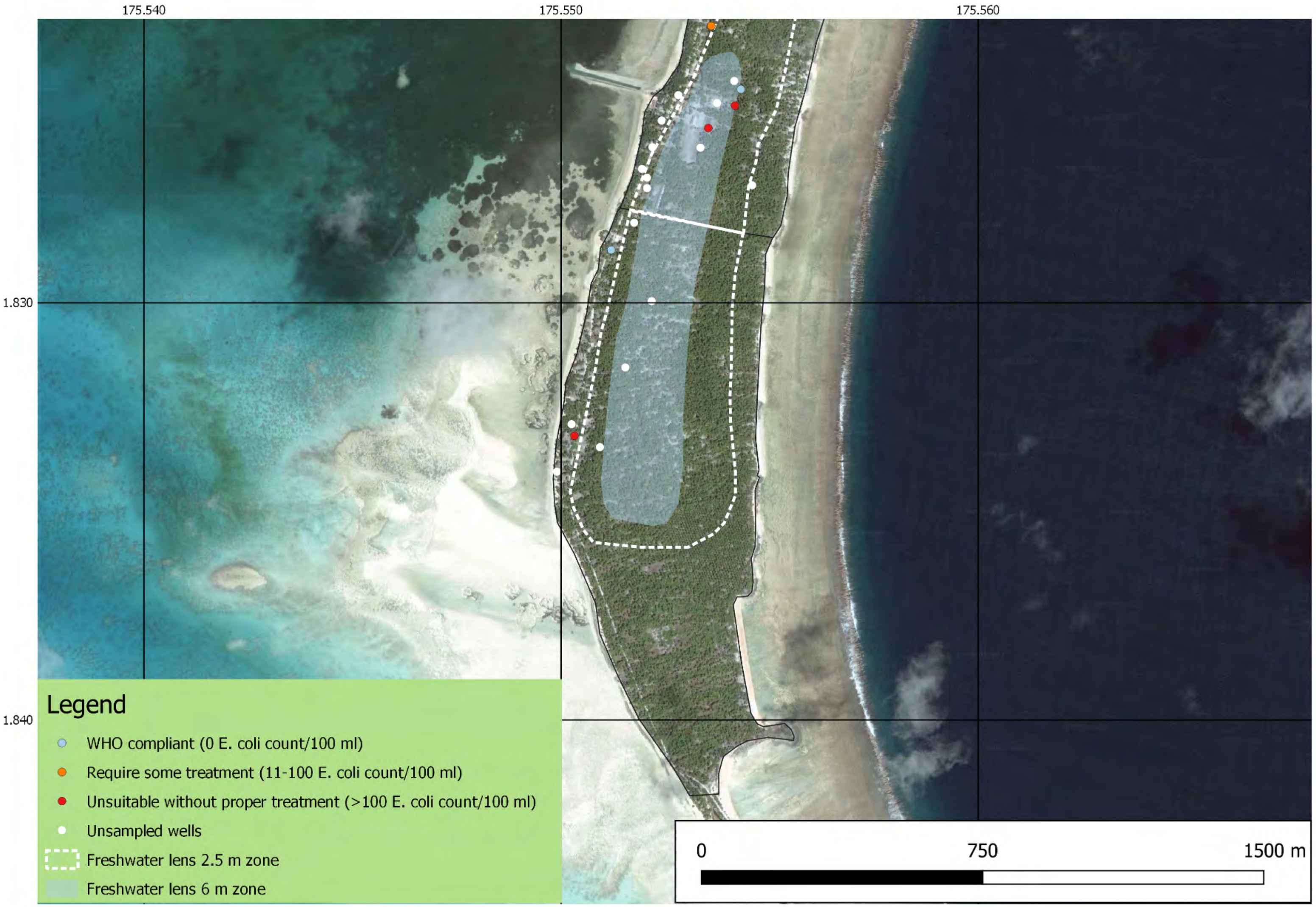

Figure A1.3b: Freshwater lens extent and groundwater E.coli contamination status around Tameo village

ANNEX 1.4 – OTOAE VILLAGE

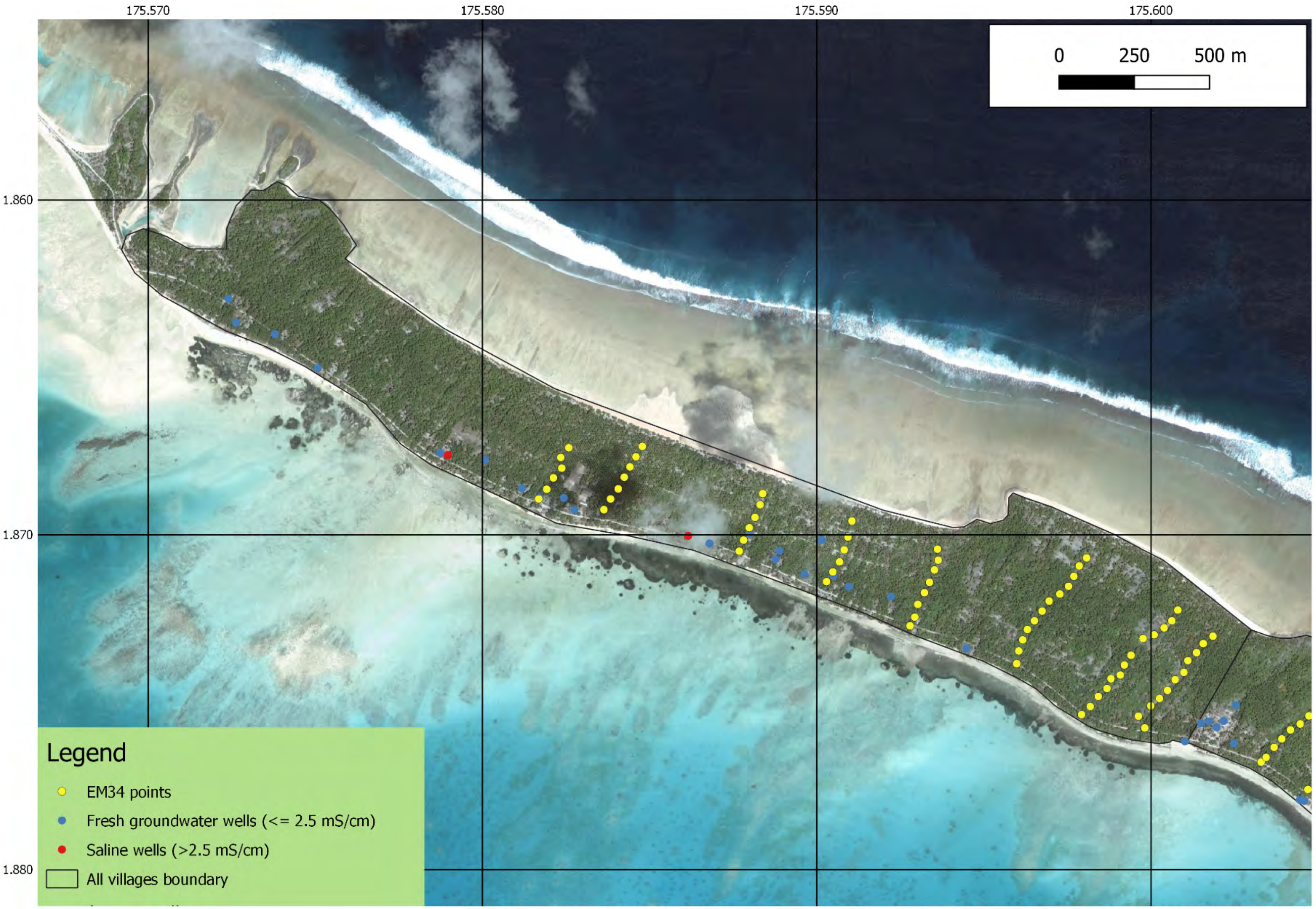

Figure A1.4a: Water resources assessment field survey map for Otoae Village

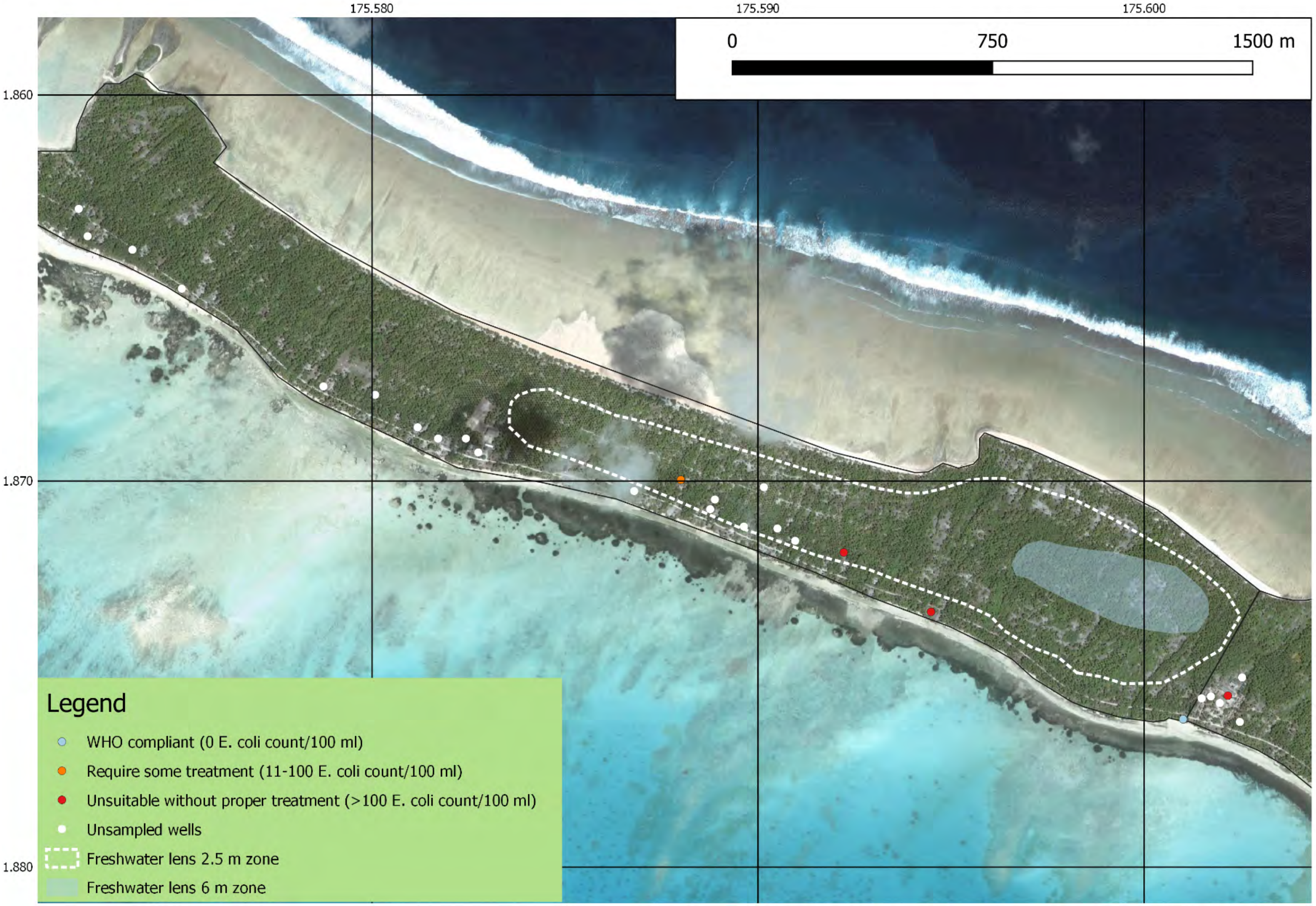

Figure A1.4b: Freshwater lens extent and groundwater bacteriological contamination status for Otoae village

ANNEX 1.5 – AIAKI VILLAGE

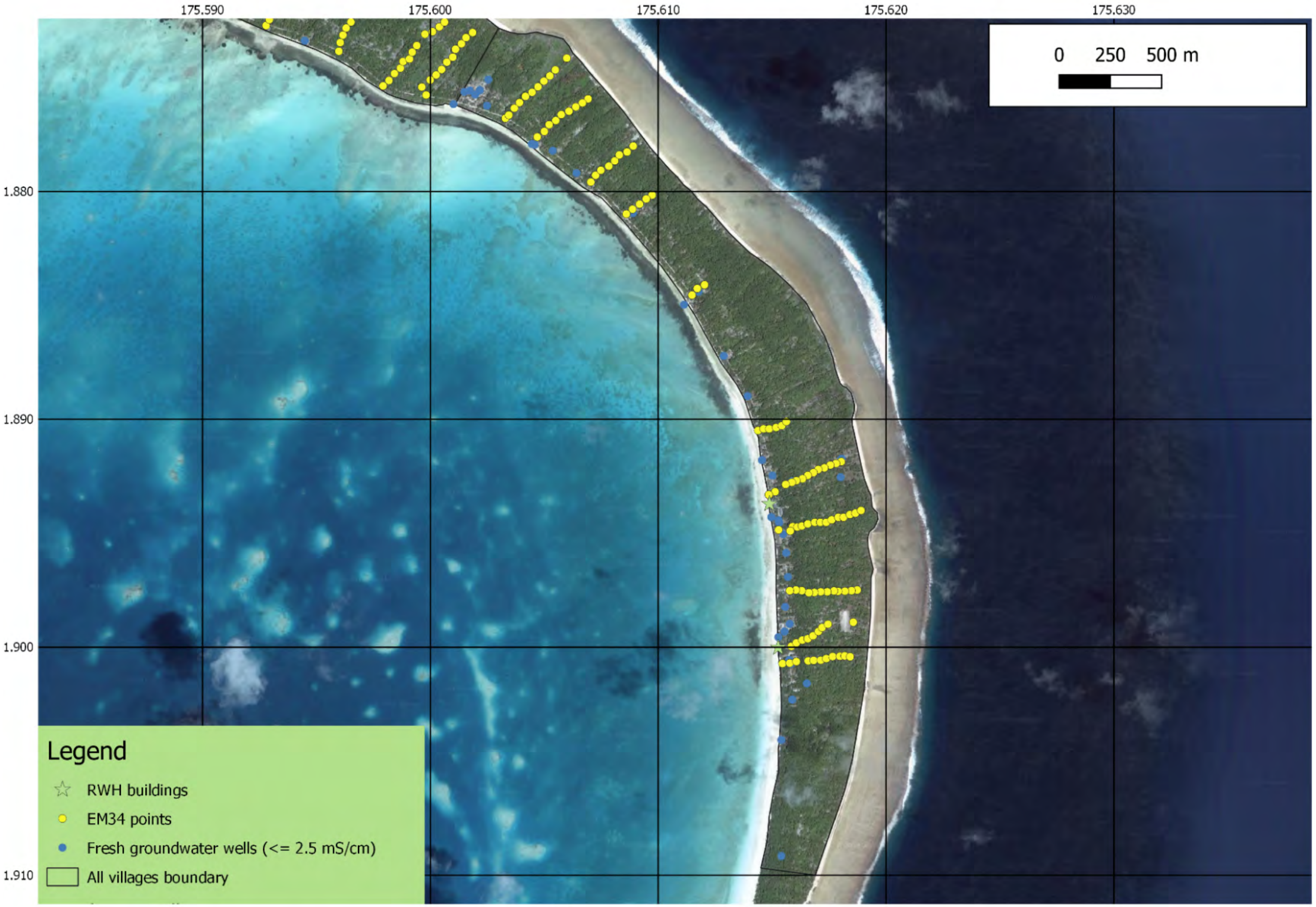

Figure A1.5a: Water resources assessment field map for Aiaki village

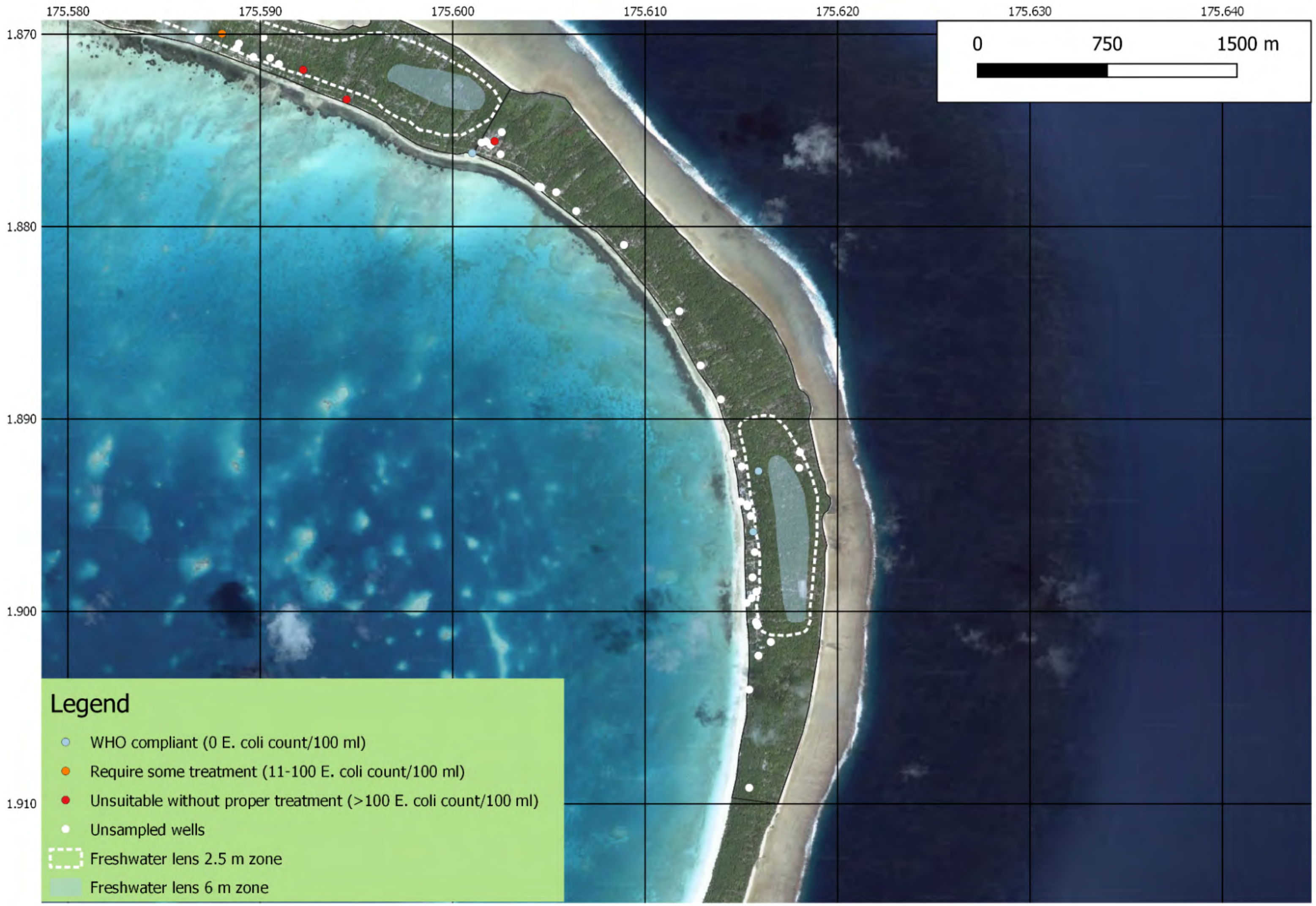

Figure A1.5b: Freshwater lens extent and groundwater E.coli contamination status for Aiaki village

ANNEX 1.6 – TABOARORAE VILLAGE

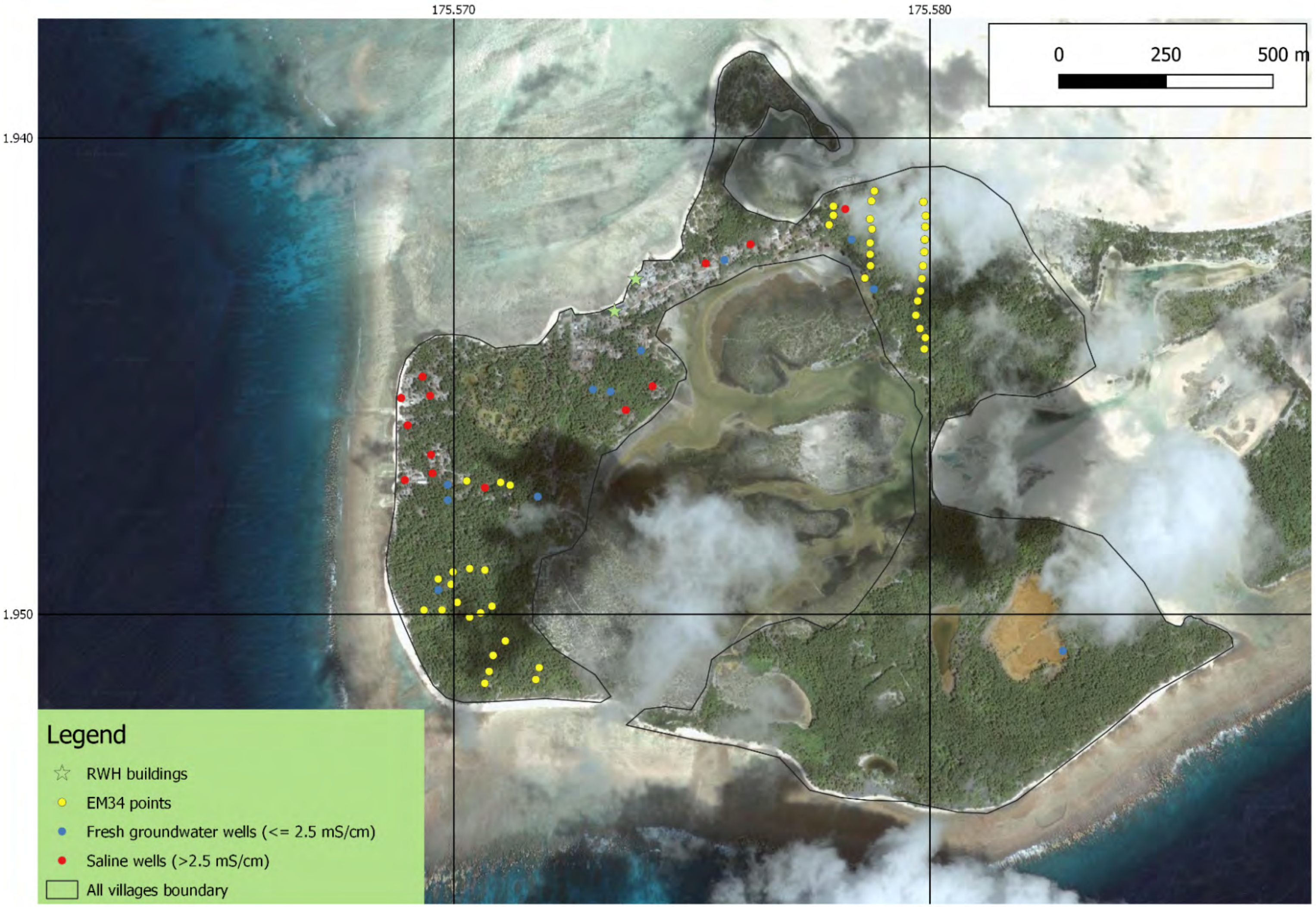

Figure A1.6a: Water resources assessment field map for Taboarorae village

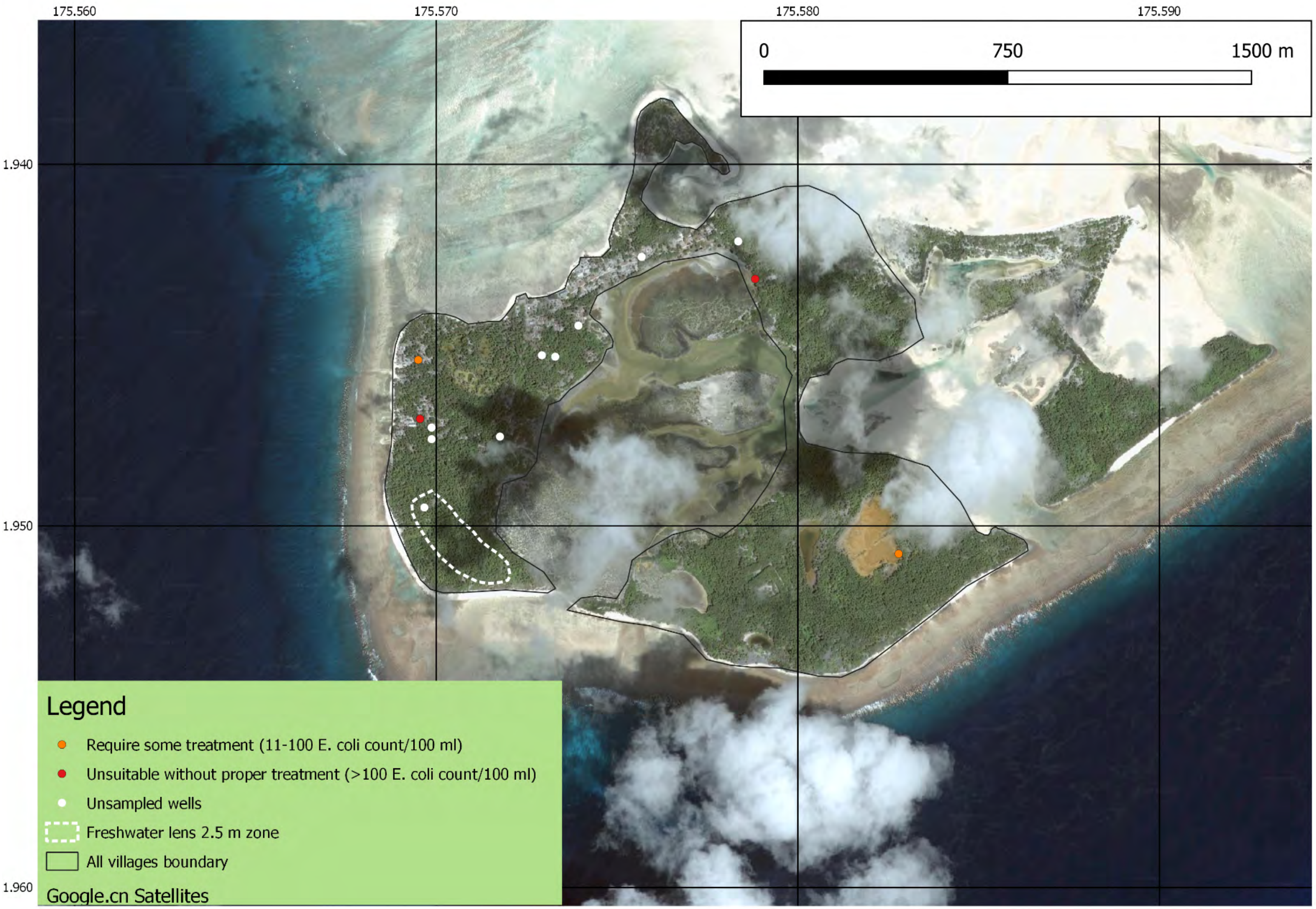

Figure A1.6b: Freshwater lens extent and groundwater E.coli contamination status for Taboarorae village

ANNEX 2 – Rainfall data

This annex contains the historical rainfall data from Tarawa, Beru, Onotoa and Arorae.

Table A2. 1. Tarawa rainfall (1946–2019)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1946	0.0	78.0	0.0	0.0	0.0	0.0	0.0	0.0	38.1	132.1	241.0	235.0
1947	0.0	78.0	110.0	94.0	253.2	208.0	81.5	57.4	20.6	62.7	121.2	275.1
1948	538.7	237.5	457.7	405.6	211.6	225.8	153.4	119.1	28.2	32.5	134.9	383.3
1949	763.0	205.0	280.7	405.4	70.4	71.1	373.9	3.0	57.9	8.9	39.9	32.0
1950	14.5	4.3	3.8	17.0	7.9	12.2	15.0	76.2	30.5	45.5	69.1	101.3
1951	228.6	56.9	60.2	227.6	192.5	292.4	259.8	473.5	296.4	88.9	53.8	411.5
1952	473.2	211.6	196.6	109.2	135.4	157.2	39.6	63.0	48.8	25.4	67.3	340.9
1953	333.5	454.9	246.1	525.0	337.6	143.0	116.1	179.6	256.0	123.7	43.2	410.7
1954	396.5	288.5	196.9	97.8	35.6	0.5	80.8	93.2	99.7	5.8	36.6	20.1
1955	62.0	22.1	78.5	64.3	39.4	97.5	51.6	73.4	128.3	9.1	4.1	15.5
1956	216.7	67.8	11.2	53.1	45.0	84.6	181.4	95.0	61.0	56.4	37.1	82.3
1957	131.8	118.9	215.9	186.9	230.9	260.4	289.6	140.5	222.8	324.1	479.8	394.5
1958	148.1	432.1	723.6	292.1	164.6	165.4	351.8	174.2	88.9	13.2	213.4	205.7
1959	396.5	391.2	221.5	142.0	227.3	100.3	78.5	64.0	34.5	24.1	165.9	91.4
1960	453.4	241.8	186.9	166.4	165.9	134.9	101.6	63.8	27.7	24.9	5.8	254.5
1961	245.4	244.3	157.7	167.1	208.5	142.2	135.9	157.0	41.7	42.7	69.3	21.1
1962	69.9	40.1	112.8	142.5	91.7	54.9	162.8	129.0	123.7	41.1	42.4	139.7
1963	176.5	49.8	121.7	78.2	39.4	66.3	234.7	166.4	143.3	389.6	352.0	292.9
1964	417.8	377.4	192.3	39.6	3.6	58.2	29.0	46.7	28.7	1.5	64.5	64.3
1965	136.4	541.5	288.3	134.9	108.5	154.7	361.7	241.6	238.0	403.3	181.1	236.5
1966	824.2	368.6	283.2	211.8	94.5	73.9	316.1	65.5	127.5	86.9	151.1	111.5
1967	251.5	69.1	94.7	173.0	10.7	85.3	103.9	84.8	81.8	56.1	63.5	258.3
1968	245.9	133.9	15.5	0.3	3.6	14.2	38.4	29.2	180.1	72.9	75.2	181.4
1969	309.4	348.0	483.6	344.7	162.6	215.4	171.5	24.6	115.6	44.5	42.8	250.7
1970	326.4	282.2	368.0	310.6	82.0	80.3	66.8	101.3	1.5	3.3	3.8	13.7
1971	25.0	44.0	4.0	78.0	60.0	98.0	97.0	41.0	41.0	100.0	69.0	76.0
1972	176.0	53.0	270.0	78.0	421.0	373.0	336.0	507.0	361.0	291.0	154.0	432.0
1973	709.0	273.0	117.0	148.0	62.0	42.0	1.0	13.0	2.0	20.0	3.0	17.0
1974	2.0	43.0	1.0	12.0	112.0	67.0	167.0	50.0	62.0	60.0	37.0	97.0
1975	306.0	298.0	301.0	290.0	106.0	191.0	101.0	6.0	27.0	5.0	1.0	44.0
1976	138.0	44.0	135.0	216.0	337.0	342.0	271.0	354.0	199.0	92.0	161.0	491.0
1977	635.0	296.0	402.0	204.0	170.0	86.0	254.0	163.0	306.0	135.0	477.0	192.0
1978	179.6	303.3	454.7	160.6	49.7	57.4	13.1	27.1	33.3	0.0	39.9	158.0
1979	277.4	317.0	481.7	89.2	143.8	175.8	63.6	82.0	68.4	188.7	162.8	315.9
1980	430.0	124.0	357.0	487.0	250.0	241.0	125.0	181.0	121.0	77.0	213.0	200.0
1981	190.0	244.0	363.0	260.0	254.0	275.0	20.0	6.0	56.0	20.0	73.0	384.0
1982	34.0	164.0	48.0	195.0	247.0	120.0	507.0	421.0	202.0	228.0	245.0	205.8
1983	22.0	170.0	68.0	120.0	375.0	282.0	394.0	111.0	59.0	149.0	69.0	79.0
1984	110.0	54.0	33.0	148.0	122.0	97.0	37.0	114.0	39.0	101.0	19.0	125.0
1985	32.0	44.0	80.0	22.0	85.0	70.0	67.0	36.0	52.0	40.0	49.0	167.0
1986	248.0	63.0	37.0	108.0	24.0	142.0	238.0	104.0	347.0	247.0	312.0	453.0
1987	449.0	492.0	241.0	493.0	285.0	353.0	411.0	330.0	150.2	250.3	129.6	259.0
1988	411.9	378.3	169.8	92.0	211.4	53.3	17.9	9.1	6.6	17.8	1.0	20.6
1989	5.5	7.0	0.0	54.6	0.0	0.0	19.4	0.0	0.0	63.0	0.0	0.0
1990	643.3	187.0	476.5	467.7	143.8	173.3	171.1	271.4	337.0	19.1	308.3	406.9
1991	502.9	162.1	113.7	99.5	178.4	349.2	226.8	441.1	311.2	253.3	455.0	310.6
1992	203.6	300.6	332.7	553.4	292.0	101.9	117.0	106.2	81.6	70.3	128.4	509.6
1993	388.8	308.3	617.4	468.9	578.3	344.2	272.0	271.5	205.5	432.6	100.2	368.4
1994	269.0	138.0	126.2	161.4	87.2	156.1	133.2	262.1	313.3	284.3	224.7	365.6
1995	348.3	229.1	187.4	142.3	52.2	59.4	23.2	165.4	12.6	44.3	6.7	25.7
1996	33.1	92.7	65.5	67.5	184.6	69.2	102.0	18.0	65.0	179.7	28.7	41.9

1997	213.3	425.5	290.5	410.5	353.7	330.4	266.3	321.7	144.9	302.3	167.0	217.7
1998	158.2	18.2	22.4	46.2	134.6	50.5	37.3	4.0	0.9	3.3	4.7	70.9
1999	3.8	7.0	96.3	109.3	138.3	64.5	50.4	38.0	42.8	21.4	5.3	9.5
2000	9.9	27.5	47.6	75.1	57.5	84.7	154.1	102.6	73.7	108.8	65.5	94.2
2001	99.3	98.4	199.5	280.6	141.2	80.2	237.4	219.9	84.3	25.9	119.9	423.2
2002	497.8	405.6	302.9	219.1	97.8	316.2	150.8	474.0	375.8	490.9	387.7	336.6
2003	504.3	270.3	270.9	234.9	116.2	126.5	165.1	85.0	116.9	76.7	135.8	91.2
2004	156.9	184.0	171.0	427.8	225.9	290.1	202.4	230.7	176.7	123.9	29.4	272.6
2005	301.9	236.9	407.1	228.8	114.6	78.5	211.9	185.1	141.4	92.2	50.6	138.6
2006	21.1	49.7	71.0	149.0	59.1	221.6	143.3	219.9	142.0	505.7	210.4	509.5
2007	425.9	454.0	326.9	49.0	141.4	88.3	97.5	43.9	17.3	23.3	40.6	13.5
2008	13.5	1.0	19.4	41.3	160.0	187.2	118.3	54.7	12.0	47.5	122.1	149.9
2009	131.7	102.7	134.2	29.2	165.5	223.7	226.0	246.6	266.2	241.3	243.7	554.6
2010	486.3	208.8	346.6	518.6	216.7	122.0	35.3	19.0	14.8	10.7	40.2	6.2
2011	10.1	7.1	9.9	152.8	66.2	150.5	129.6	128.9	282.5	26.1	23.5	23.9
2012	115.8	4.6	122.8	137.2	149.5	162.1	316.4	262.2	238.0	136.8	70.1	131.2
2013	113.0	250.0	128.6	310.0	47.3	68.5	49.4	25.1	112.1	165.8	9.4	139.8
2014	237.5	179.9	310.9	407.7	180.3	323.1	208.1	146.5	87.3	128.9	38.6	313.5
2015	229.4	287.1	434.2	301.2	439.6	382.1	171.9	233.1	358.5	250.1	261.4	272.0
2016	521.7	707.0	638.9	409.9	152.1	123.3	60.4	56.2	20.9	31.8	16.2	120.6
2017	53.4	35.4	124.3	55.0	85.1	78.4	228.8	189.9	59.1	28.1	128.6	145.4
2018	37.4	26.4	7.1	29.2	41.7	107.2	83.9	142.2	168.5	24.4	65.3	384.1
2019	335.3	200.4	811.6	875.1								

Table A2. 2. Beru rainfall (1945–2019 with gaps)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1945	48	7	9	62	54	99	57	60	63	72	22	108
1946	112	39	128	213	252	211	311	264	46	84	89	241
1947	452	65	4	13	12	29	44	11	9	40	80	94
1948	850	262	60	184	193	109	130	20	38	20	80	270
1949	729	139	136	11	62	43	31	32	12	25	3	3
1950	1	0	2	2	0	8	28	68	34	31	32	41
1951	43	7	33	105	199	144	383	280	113	57	35	161
1952	350	26	73	114	105	56	94	82	69	91	25	70
1953	176	157	101	140	129	119	162	152	162	30	19	216
1954	99	6	14	8	12	9	23	47	47	5	0	38
1955	122	0	45	35	15	12	24	65	36	9	4	27
1956	53	7	18	19	54	21	153	31	11	16	60	4
1957	28	46	44	22	151	161	255	85	179	216	383	291
1958	338	197	315	582	246	66	117	28	22	33	281	273
1959	314	405	194	65	100	52	72	30	10	19	30	9
1960	216	31	19	86	53	7	93	33	57	19	11	126
1961	106	112	155	84	139	181	108	87	55	61	140	0
1962	0	0	20	42	24	25	112	78	26	38	1	5
1963	15	3	27	21	6	113	76	192	48	77	352	360
1964	519	535	24	0	6	23	42	93	7	2	27	81
1965	27	188	89	105	119	141	287	370	293	384	307	49
1966	648	333	152	231	60	30	234	58	57	54	63	65
1967	98	0	48	0	92	53	32	41	22	8	53	169
1968	240	11	0	30	4	2	34	23	6	86	3	182
1969	342	299	426	276	10	46	40	29	66	61	40	302
1970	278	58	137	201	43	132	76	43	13	2	5	5
1971	6	5	1	35	77	50	52	94	7	28	11	61
1972	132	42	16	132	366	277	245	231	436	292	345	571
1973	651	474	242	22	35	13	7	83	33	2	1	19
1974	0	0	0	22	229	31	20	85	25	18	15	276
1975	332	52	136	69	29	115	30	8	23	6	3	5

1976	91	16	23	50	191	346	357	344	144	118	30	170
1977	207	121	165	352	49	29	155	131	95	58	90	411
1978	358	324	320	50	35	75	43	48	1	11	16	153
1979	267	259	66	11	93	104	42	28	29	122	84	153
1980	100	96	132	63	72	76	15	104	54	108	65	157
1981	62	30	150	295	62	132	36	30	81	16	0	125
1982	4	10	12	84	64	168	351	460	176	337	182	546
1983	78	168	108	146	284	244	385	105	101	0	43	61
1984	6	8	11	92	87	40	140	28	47	37	35	24
1985	55	10	92	0	34	50	21	44	20	33	129	72
1986	30	7	8	8	16	65	148	101	194	229	132	368
1987	356	248	517	362	340	182	279	160	151	84	76	349
1988	267	138	185	71	206	28	49	65	20	11	13	6
1989	0	0	2	62	33	92	18	11	24	14	30	87
1990	483	288	242	188	97	72		171	180	62	121	419
1991	419	32	26	16	7	98	66	214	165	113	329	210
1992	278	145	173	184	318	213	232	55	35	47	167	406
1993	198	196	150		236	96			197	203	2	354
1994	81	7	19	267	77		55	79	203		139	373
1995												
1996												
1997												
1998												
1999												
2000												
2001	0.0	0.0	0.0	26.0	30.4	77.7	188.1	92.5	33.1	0.6	74.6	490.0
2002	176.8	286.3	394.3	111.9	120.1	230.6	78.4	459.5	231.9	96.6	569.9	247.2
2003	608.1	529.0	395.5	135.9	66.5	5.8		62.6	229.9	72.6	94.3	113.5
2004												
2005												
2006												
2007												
2008												
2009												
2010	261.0	211.0	273.3	211.1	95.1	18.8	19.9	17.0	6.9	18.9	0.0	68.4
2011	3.1	2.2	19.0	54.6	65.6	75.5	92.7	133.7	0.0	0.0	0.0	0.0
2012	6.4	10.0	55.3	111.0	215.8	82.9	400.0	57.4	47.4	69.0	57.2	115.1
2013	40.5	50.1	52.5	51.4	36.7	148.8	17.3	9.0	83.7	66.2	47.3	107.3
2014	9.4	9.0	262.2	379.6	94.8	187.1	44.5	22.1	27.7	8.4	0.5	71.2
2015	157.2	149.8	82.1	124.9	0.0	183.3	135.8	31.4	94.8	67.7	208.0	318.4
2016	213.7	400.2	470.6	597.9	229.8	57.2	7.2	68.4	22.0	13.6	0.0	10.8
2017	95.5	3.6	6.2	153.8	48.8	36.5	155.9	90.1	13.6	14.7	38.4	11.2
2018	22.3	0.0	44.8	5.5	14.9	61.6	32.2	104.0	19.4	18.9	62.1	201.5
2019	398.1	332.7	468.7									

Table A2. 3. Onotoa Island rainfall (1932–2003 with gaps)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1932							49.7	51.3	57.1	4.8	12.6	0
1933	257.5	13.9	21.5	119.3	61.7	150.1						
1934	2.7	8.1	23.6	30.4	55.3	119.6	83	54.6	53.5	6	48	38.6
1935												
1936												
1937	135.6	326.3	87.3	25.9	9.1	21	104.3	92.2	35.3	49	82.2	9.3
1938	29.9	1	39.1	3.3	36.8	44.9	47.4	46.2	87.3	71.3	57.6	19
1938	30.0	1.0	39.1	3.3	36.8	45.0	47.5	46.2	87.4	71.4	57.7	19.1
1939												
1940												

1941												
1942												
1943												
1944	315.0	4.8	69.3	69.9	0.0	116.3	86.4	78.5	58.7	19.3	154.9	0.0
1945	30.5	0.0	7.4	26.7	73.2	218.7	142.5	65.8	27.4	14.7	88.9	0.0
1946	62.5	70.6	99.8	245.9	176.3	318.3	211.6	208.5	150.9	91.7	48.8	476.5
1947	407.9	5.8	13.5	14.2	31.0	84.3	12.4	32.0	4.3	0.0	81.5	87.9
1948	289.6	521.0	218.9	348.5	202.4	137.7	58.9	38.9	24.1	36.3	84.8	566.2
1949	644.4	123.2	99.1	22.6	95.5	38.1	59.4	24.9	24.6	23.1	5.8	6.1
1950	0.0	0.0	0.0	0.0	0.0	0.0	45.7	70.1	20.3	0.0	10.9	19.6
1951	193.5	12.7	69.6	62.7	304.5	199.4	316.7	237.5				
1952												
1953	304.5	153.7	130.8	118.4	120.1	128.8	102.6	120.7	147.1	0.0	50.5	351.5
1954	119.9	6.1	12.7	0.0	34.3	0.0	22.1	47.2	42.4	0.0	11.7	20.6
1955	205.5	9.7	10.9	48.3	4.8	74.9	20.1	28.7	42.9	3.3	4.1	56.6
1956	13.5	4.3	23.6	12.7	37.1	16.8	198.4	22.6	0.0	30.2	17.8	13.0
1957	35.8	134.9	10.2	105.4	158.5	95.3	195.1	160.0	113.0	278.1	474.2	70.9
1958	382.5	154.2	397.5	215.4	103.9	0.0	24.6	35.3	21.3	18.8	301.5	317.5
1559	310.4	368.6	245.1	70.6	77.0	26.7	127.3	22.4	4.1	35.3	39.9	32.5
1960	191.3	35.6	18.3	117.1	89.2	0.0	125.2	27.4	102.1	51.1	110.7	46.2
1961	280.4	125.2	258.8	117.1	65.5	108.0	64.0	150.4	27.9	120.1	14.0	12.7
1962	8.6	0.0	5.6	34.5	20.3	64.8	138.4	31.8	53.3	0.0	0.0	0.0
1963		0.0	0.0	194.3	91.4	33.0	102.4	195.6	11.2	57.2	453.4	378.5
1964	408.9	132.1	124.5	0.0	0.0	47.0	25.4	74.2	T	0.0	0.0	233.7
1965	74.4	76.2	39.4	35.6	135.6	269.7	494.3	254.0	214.1	104.6	215.6	181.4
1966	791.2	404.1	134.6	156.7	8.6	81.3	187.5	60.2	18.3	33.3		162.3
1967	170.2	0.0	0.0	31.0	55.1	44.5	34.3	15.5	25.7	28.7	55.9	353.8
1968	270.8	26.9	4.1	4.1	0.0	10.9	70.6	37.1	17.5	115.8	4.1	109.0
1969	422.7	180.1	302.5	239.8	31.0	136.9	88.4	113.0	35.6	54.6	54.6	109.2
1970	160.0	55.0	7.0	4.0	0.0	30.0	48.0	7.0	0.0	0.0	0.0	0.0
1971	38.0	0.0	0.0	17.0	82.0	39.0	40.0	18.0	23.0	50.0	25.0	247.0
1972	202.0	41.0	0.0	104.0	492.0	221.0	263.0	170.0	302.0	387.0	281.0	386.0
1973	452.0	274.0	203.0	66.0	67.0	89.0	0.0	49.0	8.0	11.0	11.0	10.0
1974	0.0	0.0	0.0	44.0	71.0	28.0	65.0	59.0	15.0	0.0	0.0	275.0
1975	402.0	87.0	105.0	31.0	42.0	121.0	31.0		0.0			
1976	104.0	18.0	60.0	77.0	176.0	209.0	317.0	233.0	173.0	96.0	94.0	239.0
1977	315.0	97.0	379.0	368.0	47.0	64.0	93.0	198.0	121.0	13.0	245.0	447.0
1978	299.0	331.0	220.0	78.0	60.0	12.0	44.0	38.0	31.0	6.0	5.0	121.0
1979	262.0	455.0	139.0	6.0	125.0	105.0	59.0	53.0	53.0	141.0	53.0	211.0
1980	263.0	116.0	203.0	126.0	79.0	26.0	47.0	168.0	100.0	9.0		66.0
1981	34.0	243.0	340.0	221.0	51.0	114.0	97.0	19.0	82.0			
1982						223.0	135.0	309.0	129.0	243.0	122.0	208.0
1983									110.0	3.0	184.0	0.0
1984	0.0	0.0	8.0	90.0	22.0	0.0	79.0	45.0	36.0	176.0	43.0	79.0
1985	148.0	0.0		10.0	57.0	197.0		41.0	24.0	10.0	108.0	111.0
1986	84.0	74.0	31.0	48.0	25.0	53.0	290.0	101.0	178.0	317.0	281.0	762.0
1987	625.0	647.0	381.0	527.0	161.0	314.0	413.0					
1988												
1989												
1990												
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999	0.0	6.0			79.0	166.0			33.0	2.0	20.0	2.0
2000	19.0			12.0			97.0	49.0	33.0	16.0	5.0	

2001		23.0	18.0				138.0	128.0		0.0	79.0	
2002		370.0	228.0	111.0	147.0	214.0	180.0	361.0	258.0			
2003		283.0	304.0	194.0								

Table A2. 4. Arorae monthly rainfall (1950–2004)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1950	0	0	7	38	30	63	64	29	38	0	0	21
1951	280	44	65	250	288	102	319	222	179	73	36	246
1952	499	35	135	197	160	86	95	212	46	54	44	162
1953	260	168	84	127	481	134	299	99	240	83	53	388
1954	19	9	15	28	67	25	33	130	79	8	15	24
1955	269	8	14	25	61	47	28	38	16	20	1	43
1956	0	22	53	38	22	34	84	46	13	15	62	58
1957	36	94	13	191	120	82	225	175	41	188	347	333
1958	590	214	283	464	165	97	94	59	17	32	174	265
1959	411	453	222	183	60	138	55	29	20	65	64	64
1960	113	8	3	59	96	78	275	75	119	91	38	58
1961	136	25	232	84	196	139	71	237	68	124	59	27
1962	1	4	5	39	45	15	116	56	47	17	15	15
1963	10	16	13	57	14	84	109	112	72	99	254	348
1964	425	460	17	28	44	29	16	93	36	27	0	180
1965	49	199	104	119	38	158	339	298	301	372	306	141
1966	831	428	281	265	245	75	187	102	39	29	17	118
1967	44	2	8	97	54	49	91	56	68	11	108	358
1968	104	65	11	43	18	30	120	34	51	56	14	55
1969	298	191	208	77	70	94	112	88	146	43	36	127
1970	0	35	88	241	153	171	51	43	60	10	10	23
1971	38	5	5	101	101	25	54	25	22	4	242	132
1972	262	33	37	236	364	240	270	168	475	345	273	397
1973	385	391	179	188	74	101	22	150	26	7	1	121
1974	0	0	5	135	129	123	150	72	19	4	16	281
1975	305	80	49	99	8	65	27	20	801	1	1	1
1976	61	13	116	170	133	212	306	219	274	81	29	435
1977	357	212	294	468	138	130	135	144	259	89	392	438
1978	260	585	356	124	44	25	42	108	19	79	9	400
1979	496	331	144	108	111	112	95	22	77	99	111	403
1980	204	45	394	190	208	93	141	120	115	61	178	127
1981	183	199	313	269	100	164	236	143	134	44	5	150
1982	17	78	62	143	96	62	325	231	161	315	240	458
1983	454	304	255	362	278	266	418	110	355	32	68	76
1984	0	28	53	128	54	71	178	196	73	143	62	111
1985	170	10	241	15	49	109	88	55	109	31	33	105
1986	25	55	22	101	25	159	164	139	245	331	279	449
1987	451	701	250	344	447	272	400	355	280	281	182	661
1988	469	459	127	97	111	0	77	99	31	5	11	52
1989	2	0	12		28	18	52	75	22	10	33	244
1990	405	370	296	202	185	170	73	0	255	17	171	147
1991	148	196	196	97	3	29	61	200	158	81	294	423
1992	295	282	216	356	243	153	150	88	36	24	175	242

1993	195	270	156	433	429	299	337	224	102	167	75	302
1994	63	151	51	365	184	94	62	218	459	147	324	549
1995	0	170	85	42	105	74	97	10	9	37	41	0
1996	26	0	25	63	156	88	131	147	66	22	50	193
1997	164	5	354	157	253	233	195	309	110	129	204	357
1998	159	281	312	374	408	173	0	0	88	69	3	19
1999	0	5	19	0	0	0	0	0	101	0	0	0
2000	0	0	0	0	164	48	126	148	70	11	70	0
2001	12	14	57	80	93	201	177	315	164	37	150	770
2002	117	522	324	124	158	494	173	492	421	329	291	348
2003	489	265	290	278	106	50.4	62	31	0	45	3	0
2004	316	15	175	88	24							

ANNEX 3: Diver Data

ANNEX A3.1. TEKAWA COMMUNITY WELL

Date Time	Pressure[cm]	Temperature[°C]	2:Spec.cond.[mS/cm]
8/03/2019 14:12	1082.383	28.767	0.729
8/03/2019 14:18	1083.9	28.68	0.71
8/03/2019 14:24	1084.6	28.67	0.728
8/03/2019 14:30	1085.767	28.673	0.732
8/03/2019 14:36	1086.117	28.673	0.732
8/03/2019 14:42	1086.642	28.677	0.731
8/03/2019 14:48	1086.817	28.677	0.73
8/03/2019 14:54	1086.642	28.673	0.729
8/03/2019 15:00	1086.933	28.677	0.729
8/03/2019 15:06	1086.933	28.677	0.729
8/03/2019 15:12	1086.992	28.673	0.726
8/03/2019 15:18	1087.283	28.67	0.724
8/03/2019 15:24	1087.458	28.67	0.723
8/03/2019 15:30	1087.283	28.667	0.722
8/03/2019 15:36	1087.633	28.67	0.722
8/03/2019 15:42	1087.808	28.67	0.722
8/03/2019 15:48	1087.808	28.667	0.722
8/03/2019 15:54	1088.158	28.667	0.722
8/03/2019 16:00	1088.158	28.667	0.722
8/03/2019 16:06	1088.333	28.667	0.722
8/03/2019 16:12	1088.45	28.667	0.722
8/03/2019 16:18	1088.625	28.667	0.723
8/03/2019 16:24	1088.8	28.667	0.723
8/03/2019 16:30	1089.15	28.667	0.723
8/03/2019 16:36	1089.15	28.667	0.723
8/03/2019 16:42	1089.5	28.663	0.724
8/03/2019 16:48	1089.15	28.663	0.724
8/03/2019 16:54	1086.292	28.663	0.724
8/03/2019 17:00	1086.117	28.667	0.723
8/03/2019 17:06	1088.45	28.677	0.717
8/03/2019 17:12	1089.325	28.68	0.721
8/03/2019 17:18	1088.625	28.68	0.723
8/03/2019 17:24	1089.675	28.68	0.721
8/03/2019 17:30	1090.317	28.683	0.722
8/03/2019 17:36	1091.017	28.687	0.733
8/03/2019 17:42	1091.192	28.687	0.735
8/03/2019 17:48	1088.975	28.687	0.735
8/03/2019 17:54	1089.675	28.693	0.72
8/03/2019 18:00	1090.667	28.687	0.73
8/03/2019 18:06	1088.158	28.69	0.732
8/03/2019 18:12	1087.983	28.697	0.734
8/03/2019 18:18	1089.325	28.703	0.74
8/03/2019 18:24	1091.192	28.71	0.729
8/03/2019 18:30	1092.008	28.71	0.734
8/03/2019 18:36	1092.533	28.707	0.737
8/03/2019 18:42	1093.058	28.71	0.738
8/03/2019 18:48	1093.233	28.713	0.739
8/03/2019 18:54	1092.008	28.713	0.737
8/03/2019 19:00	1092.883	28.71	0.739
8/03/2019 19:06	1093.7	28.71	0.74
8/03/2019 19:12	1094.225	28.707	0.741
8/03/2019 19:18	1094.75	28.713	0.741
8/03/2019 19:24	1094.925	28.713	0.742
8/03/2019 19:30	1095.042	28.71	0.743

8/03/2019 19:36	1095.217	28.71	0.743
8/03/2019 19:42	1095.392	28.71	0.743
8/03/2019 19:48	1095.567	28.71	0.744
8/03/2019 19:54	1095.917	28.71	0.744
8/03/2019 20:00	1095.567	28.703	0.744
8/03/2019 20:06	1092.358	28.707	0.744
8/03/2019 20:12	1092.533	28.707	0.744
8/03/2019 20:18	1094.75	28.713	0.74
8/03/2019 20:24	1095.742	28.713	0.745
8/03/2019 20:30	1096.092	28.71	0.746
8/03/2019 20:36	1096.617	28.713	0.747
8/03/2019 20:42	1096.617	28.717	0.748
8/03/2019 20:48	1096.733	28.713	0.748
8/03/2019 20:54	1096.908	28.713	0.748
8/03/2019 21:00	1096.733	28.71	0.749
8/03/2019 21:06	1096.908	28.707	0.749
8/03/2019 21:12	1096.267	28.71	0.75
8/03/2019 21:18	1096.267	28.71	0.75
8/03/2019 21:24	1096.908	28.707	0.75
8/03/2019 21:30	1097.083	28.707	0.75
8/03/2019 21:36	1097.258	28.707	0.75
8/03/2019 21:42	1097.258	28.703	0.751
8/03/2019 21:48	1097.258	28.703	0.751
8/03/2019 21:54	1097.083	28.703	0.751
8/03/2019 22:00	1096.908	28.7	0.751
8/03/2019 22:06	1096.908	28.7	0.751
8/03/2019 22:12	1096.733	28.697	0.751
8/03/2019 22:18	1096.617	28.697	0.751
8/03/2019 22:24	1096.267	28.697	0.752
8/03/2019 22:30	1096.442	28.697	0.752
8/03/2019 22:36	1095.917	28.693	0.752
8/03/2019 22:42	1095.567	28.693	0.752
8/03/2019 22:48	1095.567	28.69	0.752
8/03/2019 22:54	1095.567	28.687	0.752
8/03/2019 23:00	1095.042	28.69	0.752
8/03/2019 23:06	1094.925	28.69	0.752
8/03/2019 23:12	1094.75	28.683	0.752
8/03/2019 23:18	1094.575	28.683	0.752
8/03/2019 23:24	1094.4	28.687	0.752
8/03/2019 23:30	1094.05	28.683	0.752
8/03/2019 23:36	1094.05	28.68	0.752
8/03/2019 23:42	1093.7	28.677	0.752
8/03/2019 23:48	1093.7	28.677	0.753
8/03/2019 23:54	1093.525	28.677	0.753
9/03/2019 0:00	1093.408	28.677	0.753
9/03/2019 0:06	1093.058	28.673	0.753
9/03/2019 0:12	1092.883	28.673	0.753
9/03/2019 0:18	1092.708	28.673	0.753
9/03/2019 0:24	1092.533	28.673	0.753
9/03/2019 0:30	1092.183	28.673	0.753
9/03/2019 0:36	1092.183	28.673	0.753
9/03/2019 0:42	1092.008	28.67	0.753
9/03/2019 0:48	1091.833	28.67	0.753
9/03/2019 0:54	1091.542	28.67	0.753
9/03/2019 1:00	1091.367	28.67	0.753
9/03/2019 1:06	1091.017	28.667	0.753
9/03/2019 1:12	1090.667	28.667	0.753
9/03/2019 1:18	1090.492	28.663	0.754
9/03/2019 1:24	1090.142	28.663	0.754
9/03/2019 1:30	1090.317	28.663	0.754

9/03/2019 1:36	1090.142	28.663	0.754
9/03/2019 1:42	1090.025	28.663	0.754
9/03/2019 1:48	1089.967	28.66	0.754
9/03/2019 1:54	1089.85	28.66	0.754
9/03/2019 2:00	1089.675	28.66	0.754
9/03/2019 2:06	1089.5	28.66	0.754
9/03/2019 2:12	1088.975	28.657	0.754
9/03/2019 2:18	1088.975	28.657	0.754
9/03/2019 2:24	1088.975	28.653	0.754
9/03/2019 2:30	1088.8	28.653	0.754
9/03/2019 2:36	1088.625	28.65	0.754
9/03/2019 2:42	1088.333	28.65	0.754
9/03/2019 2:48	1088.45	28.653	0.755
9/03/2019 2:54	1088.333	28.65	0.755
9/03/2019 3:00	1088.158	28.647	0.755
9/03/2019 3:06	1088.158	28.65	0.755
9/03/2019 3:12	1087.983	28.647	0.755
9/03/2019 3:18	1087.983	28.65	0.755
9/03/2019 3:24	1087.983	28.647	0.755
9/03/2019 3:30	1087.983	28.647	0.755
9/03/2019 3:36	1088.333	28.643	0.755
9/03/2019 3:42	1088.158	28.643	0.755
9/03/2019 3:48	1088.158	28.637	0.755
9/03/2019 3:54	1088.158	28.637	0.755
9/03/2019 4:00	1087.983	28.64	0.755
9/03/2019 4:06	1088.45	28.637	0.755
9/03/2019 4:12	1088.333	28.633	0.755
9/03/2019 4:18	1088.333	28.633	0.755
9/03/2019 4:24	1088.625	28.63	0.756
9/03/2019 4:30	1088.975	28.63	0.756
9/03/2019 4:36	1089.15	28.63	0.756
9/03/2019 4:42	1089.325	28.63	0.756
9/03/2019 4:48	1089.5	28.63	0.756
9/03/2019 4:54	1089.85	28.627	0.756
9/03/2019 5:00	1089.967	28.627	0.756
9/03/2019 5:06	1090.025	28.63	0.756
9/03/2019 5:12	1090.142	28.623	0.756
9/03/2019 5:18	1090.492	28.627	0.756
9/03/2019 5:24	1090.842	28.627	0.756
9/03/2019 5:30	1091.017	28.627	0.756
9/03/2019 5:36	1091.017	28.623	0.756
9/03/2019 5:42	1091.542	28.62	0.757
9/03/2019 5:48	1091.658	28.62	0.757
9/03/2019 5:54	1091.833	28.62	0.757
9/03/2019 6:00	1092.008	28.62	0.757
9/03/2019 6:06	1092.183	28.62	0.757
9/03/2019 6:12	1091.833	28.62	0.757
9/03/2019 6:18	1090.492	28.62	0.756
9/03/2019 6:24	1091.658	28.617	0.756
9/03/2019 6:30	1092.358	28.62	0.756
9/03/2019 6:36	1092.883	28.62	0.757
9/03/2019 6:42	1093.233	28.62	0.757
9/03/2019 6:48	1093.35	28.62	0.757
9/03/2019 6:54	1093.7	28.62	0.757
9/03/2019 7:00	1093.875	28.62	0.757
9/03/2019 7:06	1093.875	28.617	0.757
9/03/2019 7:12	1094.05	28.617	0.757
9/03/2019 7:18	1094.05	28.613	0.758
9/03/2019 7:24	1094.4	28.613	0.758
9/03/2019 7:30	1093.525	28.613	0.758

9/03/2019 7:36	1093.7	28.613	0.758
9/03/2019 7:42	1091.833	28.617	0.758
9/03/2019 7:48	1091.192	28.633	0.749
9/03/2019 7:54	1093.408	28.63	0.746
9/03/2019 8:00	1094.4	28.63	0.753
9/03/2019 8:06	1093.7	28.63	0.755
9/03/2019 8:12	1094.225	28.633	0.757
9/03/2019 8:18	1094.225	28.633	0.758
9/03/2019 8:24	1091.717	28.64	0.758
9/03/2019 8:30	1091.367	28.647	0.759
9/03/2019 8:36	1091.542	28.653	0.76
9/03/2019 8:42	1090.317	28.667	0.76
9/03/2019 8:48	1090.492	28.677	0.765
9/03/2019 8:54	1089.85	28.687	0.767
9/03/2019 9:00	1089.15	28.693	0.769
9/03/2019 9:06	1088.45	28.7	0.771
9/03/2019 9:12	1087.458	28.713	0.774
9/03/2019 9:18	1086.642	28.727	0.776
9/03/2019 9:24	1087.108	28.73	0.775
9/03/2019 9:30	1088.45	28.74	0.777
9/03/2019 9:36	1090.667	28.743	0.776
9/03/2019 9:42	1092.008	28.743	0.774
9/03/2019 9:48	1093.525	28.743	0.771
9/03/2019 9:54	1094.225	28.743	0.771
9/03/2019 10:00	1094.75	28.747	0.771
9/03/2019 10:06	1094.575	28.743	0.771
9/03/2019 10:12	1094.575	28.74	0.772
9/03/2019 10:18	1094.4	28.74	0.773
9/03/2019 10:24	1094.4	28.74	0.773
9/03/2019 10:30	1091.717	28.733	0.773
9/03/2019 10:36	1088.45	28.733	0.771
9/03/2019 10:42	1088.158	28.74	0.772
9/03/2019 10:48	1089.675	28.743	0.773
9/03/2019 10:54	1091.367	28.75	0.769
9/03/2019 11:00	1091.833	28.75	0.772
9/03/2019 11:06	1092.183	28.75	0.773
9/03/2019 11:12	1092.008	28.75	0.773
9/03/2019 11:18	1092.183	28.74	0.774
9/03/2019 11:24	1091.833	28.743	0.773
9/03/2019 11:30	1091.717	28.743	0.772
9/03/2019 11:36	1091.658	28.74	0.771
9/03/2019 11:42	1091.542	28.74	0.771
9/03/2019 11:48	1091.367	28.737	0.771
9/03/2019 11:54	1091.192	28.737	0.771
9/03/2019 12:00	1090.667	28.733	0.771
9/03/2019 12:06	1087.983	28.73	0.771
9/03/2019 12:12	1085.242	28.737	0.771
9/03/2019 12:18	1084.6	28.743	0.771
9/03/2019 12:24	1084.075	28.753	0.77
9/03/2019 12:30	1085.767	28.763	0.771
9/03/2019 12:36	1087.633	28.753	0.768
9/03/2019 12:42	1088.158	28.753	0.768
9/03/2019 12:48	1088.333	28.75	0.768
9/03/2019 12:54	1088.333	28.75	0.767
9/03/2019 13:00	1088.45	28.753	0.767
9/03/2019 13:06	1088.333	28.753	0.767
9/03/2019 13:12	1087.983	28.753	0.768
9/03/2019 13:18	1087.808	28.747	0.767
9/03/2019 13:24	1087.808	28.747	0.766
9/03/2019 13:30	1087.458	28.743	0.766

9/03/2019 13:36	1087.283	28.743	0.766
9/03/2019 13:42	1087.108	28.743	0.766
9/03/2019 13:48	1087.283	28.74	0.766
9/03/2019 13:54	1087.108	28.743	0.766
9/03/2019 14:00	1087.108	28.74	0.766
9/03/2019 14:06	1087.108	28.74	0.766
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9/03/2019 14:18	1086.758	28.737	0.766
9/03/2019 14:24	1086.758	28.74	0.766
9/03/2019 14:30	1086.642	28.737	0.766
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9/03/2019 14:42	1086.292	28.733	0.766
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9/03/2019 15:18	1086.292	28.73	0.766
9/03/2019 15:24	1086.117	28.73	0.767
9/03/2019 15:30	1086.117	28.727	0.767
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9/03/2019 18:24	1090.492	28.737	0.765
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9/03/2019 18:42	1088.45	28.74	0.766
9/03/2019 18:48	1086.933	28.74	0.767
9/03/2019 18:54	1085.767	28.743	0.768
9/03/2019 19:00	1084.95	28.75	0.769
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9/03/2019 19:12	1087.633	28.763	0.771
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9/03/2019 19:24	1091.192	28.767	0.775
9/03/2019 19:30	1091.833	28.767	0.775

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9/03/2019 19:48	1092.708	28.77	0.776
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9/03/2019 21:36	1090.142	28.753	0.776
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9/03/2019 22:18	1094.925	28.763	0.776
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10/03/2019 8:48	1092.708	28.77	0.786
10/03/2019 8:54	1093.233	28.773	0.786
10/03/2019 9:00	1093.525	28.77	0.786
10/03/2019 9:06	1093.875	28.77	0.786
10/03/2019 9:12	1093.233	28.767	0.787
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10/03/2019 12:18	1089.967	28.763	0.783
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10/03/2019 15:24	1084.6	28.757	0.783
10/03/2019 15:30	1084.6	28.757	0.783
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10/03/2019 15:42	1084.775	28.757	0.783
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10/03/2019 19:30	1085.592	28.803	0.779

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10/03/2019 19:42	1089.5	28.813	0.782
10/03/2019 19:48	1089.967	28.817	0.783
10/03/2019 19:54	1090.492	28.813	0.784
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10/03/2019 20:36	1092.183	28.803	0.785
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10/03/2019 23:24	1091.542	28.79	0.78
10/03/2019 23:30	1091.542	28.79	0.78
10/03/2019 23:36	1091.192	28.79	0.781
10/03/2019 23:42	1091.192	28.79	0.781
10/03/2019 23:48	1090.667	28.787	0.781
10/03/2019 23:54	1090.667	28.79	0.781
11/03/2019 0:00	1090.317	28.787	0.781
11/03/2019 0:06	1090.317	28.787	0.782
11/03/2019 0:12	1090.025	28.787	0.782
11/03/2019 0:18	1089.85	28.787	0.782
11/03/2019 0:24	1089.5	28.783	0.781
11/03/2019 0:30	1089.325	28.783	0.781
11/03/2019 0:36	1089.15	28.783	0.781
11/03/2019 0:42	1088.975	28.78	0.781
11/03/2019 0:48	1088.8	28.78	0.781
11/03/2019 0:54	1088.45	28.78	0.781
11/03/2019 1:00	1088.625	28.78	0.781
11/03/2019 1:06	1088.333	28.78	0.781
11/03/2019 1:12	1087.983	28.777	0.781
11/03/2019 1:18	1087.983	28.78	0.781
11/03/2019 1:24	1087.458	28.777	0.781
11/03/2019 1:30	1087.458	28.78	0.781

11/03/2019 1:36	1087.283	28.773	0.781
11/03/2019 1:42	1086.933	28.773	0.781
11/03/2019 1:48	1086.758	28.773	0.781
11/03/2019 1:54	1086.758	28.773	0.781
11/03/2019 2:00	1086.642	28.773	0.781
11/03/2019 2:06	1086.467	28.77	0.781
11/03/2019 2:12	1086.292	28.773	0.781
11/03/2019 2:18	1085.942	28.77	0.781
11/03/2019 2:24	1085.592	28.77	0.781
11/03/2019 2:30	1085.417	28.77	0.781
11/03/2019 2:36	1085.242	28.77	0.782
11/03/2019 2:42	1085.125	28.767	0.782
11/03/2019 2:48	1084.95	28.767	0.782
11/03/2019 2:54	1084.775	28.77	0.782
11/03/2019 3:00	1084.775	28.763	0.782
11/03/2019 3:06	1084.425	28.767	0.782
11/03/2019 3:12	1084.6	28.763	0.782
11/03/2019 3:18	1084.425	28.763	0.782
11/03/2019 3:24	1084.425	28.763	0.782
11/03/2019 3:30	1084.25	28.76	0.782
11/03/2019 3:36	1084.425	28.757	0.782
11/03/2019 3:42	1084.075	28.76	0.782
11/03/2019 3:48	1084.075	28.76	0.782
11/03/2019 3:54	1083.9	28.76	0.782
11/03/2019 4:00	1084.25	28.757	0.782
11/03/2019 4:06	1084.075	28.753	0.782
11/03/2019 4:12	1084.25	28.757	0.783
11/03/2019 4:18	1084.25	28.757	0.783
11/03/2019 4:24	1084.25	28.753	0.783
11/03/2019 4:30	1084.075	28.75	0.783
11/03/2019 4:36	1084.075	28.75	0.783
11/03/2019 4:42	1084.425	28.753	0.783
11/03/2019 4:48	1084.25	28.75	0.783
11/03/2019 4:54	1084.425	28.75	0.783
11/03/2019 5:00	1084.6	28.75	0.783
11/03/2019 5:06	1084.775	28.75	0.783
11/03/2019 5:12	1084.95	28.75	0.783
11/03/2019 5:18	1085.125	28.743	0.783
11/03/2019 5:24	1085.592	28.747	0.783
11/03/2019 5:30	1085.417	28.743	0.783
11/03/2019 5:36	1085.767	28.747	0.783
11/03/2019 5:42	1085.942	28.743	0.783
11/03/2019 5:48	1086.467	28.74	0.783
11/03/2019 5:54	1086.642	28.74	0.783
11/03/2019 6:00	1086.758	28.74	0.783
11/03/2019 6:06	1086.933	28.743	0.783
11/03/2019 6:12	1087.458	28.737	0.783
11/03/2019 6:18	1086.117	28.74	0.783
11/03/2019 6:24	1084.075	28.743	0.783
11/03/2019 6:30	1085.242	28.75	0.777
11/03/2019 6:36	1086.467	28.747	0.778
11/03/2019 6:42	1087.283	28.747	0.78
11/03/2019 6:48	1087.633	28.747	0.781
11/03/2019 6:54	1087.808	28.743	0.782
11/03/2019 7:00	1088.158	28.743	0.782
11/03/2019 7:06	1088.333	28.743	0.783
11/03/2019 7:12	1088.45	28.743	0.783
11/03/2019 7:18	1088.8	28.74	0.783
11/03/2019 7:24	1088.8	28.743	0.784
11/03/2019 7:30	1089.325	28.74	0.783

11/03/2019 7:36	1089.675	28.74	0.784
11/03/2019 7:42	1089.85	28.737	0.784
11/03/2019 7:48	1087.983	28.737	0.783
11/03/2019 7:54	1085.942	28.74	0.783
11/03/2019 8:00	1084.775	28.747	0.784
11/03/2019 8:06	1086.117	28.747	0.785
11/03/2019 8:12	1088.333	28.757	0.785
11/03/2019 8:18	1088.8	28.757	0.786
11/03/2019 8:24	1089.5	28.76	0.786
11/03/2019 8:30	1090.2	28.76	0.787
11/03/2019 8:36	1090.025	28.76	0.787
11/03/2019 8:42	1087.808	28.757	0.787
11/03/2019 8:48	1086.933	28.757	0.788
11/03/2019 8:54	1088.625	28.763	0.788
11/03/2019 9:00	1090.025	28.767	0.788
11/03/2019 9:06	1090.667	28.763	0.789
11/03/2019 9:12	1090.842	28.77	0.789
11/03/2019 9:18	1091.017	28.767	0.79
11/03/2019 9:24	1091.192	28.77	0.791
11/03/2019 9:30	1091.367	28.767	0.792
11/03/2019 9:36	1091.658	28.763	0.792
11/03/2019 9:42	1091.833	28.763	0.792
11/03/2019 9:48	1091.717	28.76	0.792
11/03/2019 9:54	1091.892	28.76	0.792
11/03/2019 10:00	1092.008	28.763	0.792
11/03/2019 10:06	1091.717	28.76	0.791
11/03/2019 10:12	1091.717	28.76	0.791
11/03/2019 10:18	1092.008	28.757	0.792
11/03/2019 10:24	1091.833	28.757	0.792
11/03/2019 10:30	1091.717	28.757	0.792
11/03/2019 10:36	1091.658	28.753	0.792
11/03/2019 10:42	1091.542	28.757	0.792
11/03/2019 10:48	1091.542	28.753	0.792
11/03/2019 10:54	1091.367	28.753	0.792
11/03/2019 11:00	1091.017	28.75	0.791
11/03/2019 11:06	1090.842	28.75	0.792
11/03/2019 11:12	1091.017	28.753	0.792
11/03/2019 11:18	1090.667	28.753	0.792
11/03/2019 11:24	1090.492	28.753	0.792
11/03/2019 11:30	1090.142	28.75	0.792
11/03/2019 11:36	1090.025	28.75	0.792
11/03/2019 11:42	1089.967	28.747	0.792
11/03/2019 11:48	1089.675	28.75	0.792
11/03/2019 11:54	1089.675	28.747	0.792
11/03/2019 12:00	1089.5	28.747	0.792
11/03/2019 12:06	1088.8	28.747	0.792
11/03/2019 12:12	1088.625	28.747	0.792
11/03/2019 12:18	1088.333	28.75	0.792
11/03/2019 12:24	1087.808	28.743	0.792
11/03/2019 12:30	1087.808	28.747	0.792
11/03/2019 12:36	1087.633	28.747	0.792
11/03/2019 12:42	1087.458	28.747	0.792
11/03/2019 12:48	1086.933	28.743	0.792
11/03/2019 12:54	1086.817	28.743	0.792
11/03/2019 13:00	1086.758	28.747	0.792
11/03/2019 13:06	1086.467	28.747	0.792
11/03/2019 13:12	1086.292	28.743	0.792
11/03/2019 13:18	1086.117	28.747	0.792
11/03/2019 13:24	1085.767	28.743	0.792
11/03/2019 13:30	1085.767	28.747	0.792

11/03/2019 13:36	1085.417	28.743	0.792
11/03/2019 13:42	1085.125	28.743	0.792
11/03/2019 13:48	1085.242	28.747	0.792
11/03/2019 13:54	1084.95	28.747	0.792
11/03/2019 14:00	1084.6	28.743	0.792
11/03/2019 14:06	1084.425	28.743	0.792
11/03/2019 14:12	1084.425	28.74	0.792
11/03/2019 14:18	1084.25	28.74	0.792
11/03/2019 14:24	1084.075	28.743	0.792
11/03/2019 14:30	1083.725	28.743	0.792
11/03/2019 14:36	1083.55	28.743	0.792
11/03/2019 14:42	1083.433	28.743	0.792
11/03/2019 14:48	1083.55	28.747	0.792
11/03/2019 14:54	1083.258	28.743	0.792
11/03/2019 15:00	1083.375	28.747	0.792
11/03/2019 15:06	1083.083	28.743	0.792
11/03/2019 15:12	1082.908	28.743	0.792
11/03/2019 15:18	1083.083	28.743	0.792
11/03/2019 15:24	1083.083	28.747	0.792
11/03/2019 15:30	1082.908	28.743	0.792
11/03/2019 15:36	1082.733	28.743	0.792
11/03/2019 15:42	1082.908	28.747	0.792
11/03/2019 15:48	1082.908	28.747	0.792
11/03/2019 15:54	1082.908	28.747	0.792
11/03/2019 16:00	1082.733	28.747	0.792
11/03/2019 16:06	1082.908	28.747	0.793
11/03/2019 16:12	1082.733	28.743	0.793
11/03/2019 16:18	1081.217	28.747	0.793
11/03/2019 16:24	1080.05	28.75	0.793
11/03/2019 16:30	1080.867	28.75	0.793
11/03/2019 16:36	1082.033	28.75	0.792
11/03/2019 16:42	1082.733	28.753	0.792
11/03/2019 16:48	1082.908	28.753	0.792
11/03/2019 16:54	1083.258	28.753	0.792
11/03/2019 17:00	1083.258	28.753	0.792
11/03/2019 17:06	1082.383	28.753	0.792
11/03/2019 17:12	1079.7	28.757	0.792
11/03/2019 17:18	1078.008	28.76	0.791
11/03/2019 17:24	1077.483	28.767	0.792
11/03/2019 17:30	1079	28.777	0.792
11/03/2019 17:36	1081.217	28.79	0.785
11/03/2019 17:42	1082.558	28.783	0.789
11/03/2019 17:48	1083.725	28.78	0.789
11/03/2019 17:54	1084.075	28.783	0.789
11/03/2019 18:00	1084.6	28.783	0.789
11/03/2019 18:06	1084.425	28.783	0.79
11/03/2019 18:12	1084.95	28.783	0.79
11/03/2019 18:18	1085.242	28.787	0.79
11/03/2019 18:24	1085.592	28.787	0.791
11/03/2019 18:30	1085.767	28.787	0.791
11/03/2019 18:36	1085.592	28.787	0.791
11/03/2019 18:42	1082.208	28.78	0.792
11/03/2019 18:48	1080.692	28.78	0.791
11/03/2019 18:54	1080.342	28.787	0.792
11/03/2019 19:00	1080.692	28.793	0.795
11/03/2019 19:06	1081.567	28.807	0.798
11/03/2019 19:12	1081.392	28.807	0.799
11/03/2019 19:18	1083.258	28.813	0.798
11/03/2019 19:24	1085.125	28.81	0.795
11/03/2019 19:30	1086.467	28.81	0.795

11/03/2019 19:36	1086.117	28.813	0.791
11/03/2019 19:42	1087.283	28.813	0.792
11/03/2019 19:48	1087.808	28.813	0.794
11/03/2019 19:54	1088.158	28.81	0.795
11/03/2019 20:00	1086.117	28.81	0.794
11/03/2019 20:06	1087.108	28.81	0.793
11/03/2019 20:12	1088.158	28.81	0.794
11/03/2019 20:18	1088.8	28.81	0.794
11/03/2019 20:24	1089.325	28.813	0.795
11/03/2019 20:30	1089.5	28.81	0.796
11/03/2019 20:36	1089.675	28.81	0.796
11/03/2019 20:42	1089.675	28.81	0.796
11/03/2019 20:48	1089.967	28.807	0.796
11/03/2019 20:54	1090.025	28.803	0.796

ANNEX A3.2. Mwea's well Buariki

Date/time	Pressure[cm]	Temperature[°C]	2:Spec.cond.[mS/cm]
5/03/2019 17:00	1051.992	28.647	1.18
5/03/2019 17:06	1053.508	28.65	1.216
5/03/2019 17:12	1054.208	28.65	1.228
5/03/2019 17:18	1054.908	28.653	1.252
5/03/2019 17:24	1055.55	28.653	1.26
5/03/2019 17:30	1056.25	28.653	1.268
5/03/2019 17:36	1056.717	28.66	1.276
5/03/2019 17:42	1057.125	28.66	1.28
5/03/2019 17:48	1058.058	28.66	1.284
5/03/2019 17:54	1058.525	28.66	1.292
5/03/2019 18:00	1059.167	28.663	1.3
5/03/2019 18:06	1060.042	28.663	1.308
5/03/2019 18:12	1060.333	28.667	1.312
5/03/2019 18:18	1060.975	28.67	1.32
5/03/2019 18:24	1061.208	28.667	1.324
5/03/2019 18:30	1062.083	28.67	1.332
5/03/2019 18:36	1062.783	28.67	1.336
5/03/2019 18:42	1062.783	28.673	1.34
5/03/2019 18:48	1063.192	28.67	1.344
5/03/2019 18:54	1063.192	28.67	1.348
5/03/2019 19:00	1063.425	28.67	1.352
5/03/2019 19:06	1063.425	28.67	1.352
5/03/2019 19:12	1063.658	28.67	1.356
5/03/2019 19:18	1063.483	28.673	1.356
5/03/2019 19:24	1063.892	28.67	1.356
5/03/2019 19:30	1063.658	28.67	1.356
5/03/2019 19:36	1063.483	28.667	1.356
5/03/2019 19:42	1063.25	28.667	1.352
5/03/2019 19:48	1063.192	28.67	1.348
5/03/2019 19:54	1062.55	28.663	1.348
5/03/2019 20:00	1062.083	28.663	1.34
5/03/2019 20:06	1061.617	28.663	1.336
5/03/2019 20:12	1061.208	28.663	1.332
5/03/2019 20:18	1060.333	28.66	1.324
5/03/2019 20:24	1059.4	28.663	1.312
5/03/2019 20:30	1058.292	28.66	1.304
5/03/2019 20:36	1057.592	28.657	1.296
5/03/2019 20:42	1056.892	28.657	1.288
5/03/2019 20:48	1056.25	28.657	1.272

5/03/2019 20:54	1055.783	28.65	1.26
5/03/2019 21:00	1054.908	28.653	1.252
5/03/2019 21:06	1054.442	28.65	1.24
5/03/2019 21:12	1053.567	28.643	1.224
5/03/2019 21:18	1052.867	28.64	1.208
5/03/2019 21:24	1052.167	28.633	1.192
5/03/2019 21:30	1051.233	28.627	1.172
5/03/2019 21:36	1050.358	28.62	1.16
5/03/2019 21:42	1049.25	28.61	1.14
5/03/2019 21:48	1048.783	28.6	1.124
5/03/2019 21:54	1047.908	28.597	1.116
5/03/2019 22:00	1047.208	28.58	1.092
5/03/2019 22:06	1046.333	28.583	1.076
5/03/2019 22:12	1045.633	28.577	1.072
5/03/2019 22:18	1044.933	28.577	1.068
5/03/2019 22:24	1044.467	28.557	1.068
5/03/2019 22:30	1043.825	28.55	1.056
5/03/2019 22:36	1043.125	28.537	1.048
5/03/2019 22:42	1042.25	28.52	1.028
5/03/2019 22:48	1041.842	28.517	1.012
5/03/2019 22:54	1041.142	28.51	1.004
5/03/2019 23:00	1040.5	28.503	1.004
5/03/2019 23:06	1039.8	28.503	1
5/03/2019 23:12	1039.333	28.507	1
5/03/2019 23:18	1039.1	28.507	1
5/03/2019 23:24	1038.4	28.513	0.996
5/03/2019 23:30	1037.933	28.513	0.996
5/03/2019 23:36	1037.292	28.513	0.996
5/03/2019 23:42	1036.417	28.52	0.996
5/03/2019 23:48	1035.95	28.517	0.996
5/03/2019 23:54	1035.542	28.523	0.996
6/03/2019 0:00	1034.842	28.527	0.996
6/03/2019 0:06	1034.783	28.53	0.996
6/03/2019 0:12	1034.142	28.533	0.992
6/03/2019 0:18	1033.5	28.547	0.992
6/03/2019 0:24	1033.442	28.55	0.992
6/03/2019 0:30	1032.567	28.553	0.984
6/03/2019 0:36	1032.158	28.553	0.964
6/03/2019 0:42	1031.867	28.563	0.94
6/03/2019 0:48	1031.458	28.56	0.92
6/03/2019 0:54	1030.992	28.573	0.9
6/03/2019 1:00	1030.992	28.577	0.884
6/03/2019 1:06	1030.583	28.573	0.468
6/03/2019 1:12	1030.117	28.58	0.412
6/03/2019 1:18	1030.117	28.587	0.388
6/03/2019 1:24	1030.117	28.59	0.4
6/03/2019 1:30	1030.117	28.597	0.448
6/03/2019 1:36	1030.35	28.603	0.524
6/03/2019 1:42	1030.35	28.61	0.636
6/03/2019 1:48	1030.583	28.61	0.812
6/03/2019 1:54	1030.758	28.61	0.96
6/03/2019 2:00	1031.167	28.613	0.96
6/03/2019 2:06	1031.4	28.613	0.968
6/03/2019 2:12	1031.692	28.61	0.98
6/03/2019 2:18	1032.1	28.607	0.984
6/03/2019 2:24	1032.158	28.603	0.988
6/03/2019 2:30	1032.742	28.6	0.988
6/03/2019 2:36	1033.442	28.593	0.988
6/03/2019 2:42	1034.142	28.593	0.988
6/03/2019 2:48	1034.375	28.587	0.988

6/03/2019 2:54	1035.308	28.587	0.988
6/03/2019 3:00	1035.95	28.58	0.988
6/03/2019 3:06	1037.058	28.577	0.988
6/03/2019 3:12	1037.525	28.573	0.988
6/03/2019 3:18	1038.867	28.577	0.988
6/03/2019 3:24	1039.742	28.577	0.988
6/03/2019 3:30	1040.267	28.583	1
6/03/2019 3:36	1041.375	28.58	1.02
6/03/2019 3:42	1042.25	28.587	1.036
6/03/2019 3:48	1043.592	28.593	1.048
6/03/2019 3:54	1044.467	28.593	1.052
6/03/2019 4:00	1045.225	28.597	1.068
6/03/2019 4:06	1046.567	28.603	1.1
6/03/2019 4:12	1048.083	28.607	1.132
6/03/2019 4:18	1049.483	28.61	1.164
6/03/2019 4:24	1050.592	28.617	1.192
6/03/2019 4:30	1051.758	28.623	1.228
6/03/2019 4:36	1053.508	28.633	1.24
6/03/2019 4:42	1054.85	28.64	1.256
6/03/2019 4:48	1055.55	28.643	1.276
6/03/2019 4:54	1056.483	28.653	1.288
6/03/2019 5:00	1056.95	28.653	1.296
6/03/2019 5:06	1058	28.663	1.304
6/03/2019 5:12	1058.933	28.667	1.308
6/03/2019 5:18	1060.042	28.67	1.32
6/03/2019 5:24	1060.333	28.673	1.328
6/03/2019 5:30	1061.617	28.677	1.34
6/03/2019 5:36	1062.317	28.683	1.348
6/03/2019 5:42	1063.425	28.69	1.356
6/03/2019 5:48	1064.358	28.693	1.364
6/03/2019 5:54	1065.7	28.693	1.372
6/03/2019 6:00	1066.867	28.693	1.384
6/03/2019 6:06	1067.975	28.693	1.392
6/03/2019 6:12	1068.85	28.693	1.404
6/03/2019 6:18	1069.783	28.693	1.416
6/03/2019 6:24	1070.892	28.7	1.432
6/03/2019 6:30	1071.767	28.697	1.44
6/03/2019 6:36	1072.7	28.703	1.448
6/03/2019 6:42	1073.167	28.7	1.456
6/03/2019 6:48	1073.808	28.7	1.464
6/03/2019 6:54	1074.042	28.7	1.468
6/03/2019 7:00	1074.742	28.697	1.472
6/03/2019 7:06	1075.15	28.697	1.476
6/03/2019 7:12	1075.383	28.703	1.476
6/03/2019 7:18	1075.617	28.7	1.476
6/03/2019 7:24	1075.617	28.7	1.476
6/03/2019 7:30	1075.617	28.697	1.472
6/03/2019 7:36	1075.15	28.697	1.468
6/03/2019 7:42	1074.508	28.693	1.464
6/03/2019 7:48	1074.042	28.693	1.46
6/03/2019 7:54	1073.575	28.697	1.456
6/03/2019 8:00	1073.108	28.69	1.448
6/03/2019 8:06	1072.467	28.693	1.436
6/03/2019 8:12	1072	28.69	1.428
6/03/2019 8:18	1070.892	28.693	1.416
6/03/2019 8:24	1070.192	28.69	1.408
6/03/2019 8:30	1069.317	28.687	1.4
6/03/2019 8:36	1069.083	28.69	1.392
6/03/2019 8:42	1067.975	28.687	1.384
6/03/2019 8:48	1067.275	28.68	1.376

6/03/2019 8:54	1066.633	28.687	1.368
6/03/2019 9:00	1065.933	28.687	1.356
6/03/2019 9:06	1065.467	28.683	1.348
6/03/2019 9:12	1064.592	28.683	1.344
6/03/2019 9:18	1063.658	28.68	1.336
6/03/2019 9:24	1062.783	28.68	1.332
6/03/2019 9:30	1062.083	28.677	1.324
6/03/2019 9:36	1061.383	28.677	1.316
6/03/2019 9:42	1060.742	28.677	1.312
6/03/2019 9:48	1059.867	28.68	1.308
6/03/2019 9:54	1059.167	28.677	1.3
6/03/2019 10:00	1058.058	28.673	1.288
6/03/2019 10:06	1057.825	28.67	1.28
6/03/2019 10:12	1057.125	28.677	1.276
6/03/2019 10:18	1056.25	28.67	1.276
6/03/2019 10:24	1055.142	28.647	1.252
6/03/2019 10:30	1054.442	28.637	1.224
6/03/2019 10:36	1053.742	28.63	1.212
6/03/2019 10:42	1053.275	28.62	1.208
6/03/2019 10:48	1052.633	28.607	1.2
6/03/2019 10:54	1052.167	28.57	1.176
6/03/2019 11:00	1051.467	28.513	1.12
6/03/2019 11:06	1051.058	28.503	1.096
6/03/2019 11:12	1050.825	28.48	1.084
6/03/2019 11:18	1050.183	28.47	1.08
6/03/2019 11:24	1049.717	28.463	1.08
6/03/2019 11:30	1049.017	28.477	1.092
6/03/2019 11:36	1048.375	28.477	1.092
6/03/2019 11:42	1047.442	28.49	1.104
6/03/2019 11:48	1047.033	28.433	1.084
6/03/2019 11:54	1046.567	28.37	1.056
6/03/2019 12:00	1045.867	28.35	1.044
6/03/2019 12:06	1045.458	28.343	1.044
6/03/2019 12:12	1044.758	28.337	1.036
6/03/2019 12:18	1044.058	28.327	1.032
6/03/2019 12:24	1043.825	28.323	1.032
6/03/2019 12:30	1043.358	28.323	1.032
6/03/2019 12:36	1042.717	28.317	1.028
6/03/2019 12:42	1042.075	28.313	1.028
6/03/2019 12:48	1041.55	28.317	1.032
6/03/2019 12:54	1041.375	28.32	1.032
6/03/2019 13:00	1040.675	28.32	1.028
6/03/2019 13:06	1040.442	28.317	1.028
6/03/2019 13:12	1040.208	28.317	1.028
6/03/2019 13:18	1039.333	28.32	1.028
6/03/2019 13:24	1039.333	28.317	1.032
6/03/2019 13:30	1039.1	28.32	1.032
6/03/2019 13:36	1039.1	28.32	1.032
6/03/2019 13:42	1038.692	28.32	1.032
6/03/2019 13:48	1038.867	28.31	1.032
6/03/2019 13:54	1038.867	28.313	1.036
6/03/2019 14:00	1038.692	28.313	1.036
6/03/2019 14:06	1039.333	28.31	1.036
6/03/2019 14:12	1039.333	28.31	1.04
6/03/2019 14:18	1039.333	28.31	1.04
6/03/2019 14:24	1039.742	28.303	1.04
6/03/2019 14:30	1039.975	28.303	1.04
6/03/2019 14:36	1040.675	28.297	1.044
6/03/2019 14:42	1041.083	28.297	1.044
6/03/2019 14:48	1041.783	28.297	1.044

6/03/2019 14:54	1042.075	28.293	1.048
6/03/2019 15:00	1042.25	28.287	1.048
6/03/2019 15:06	1042.95	28.287	1.048
6/03/2019 15:12	1043.65	28.283	1.052
6/03/2019 15:18	1044.058	28.28	1.052
6/03/2019 15:24	1045.225	28.283	1.052
6/03/2019 15:30	1045.867	28.277	1.056
6/03/2019 15:36	1046.567	28.27	1.056
6/03/2019 15:42	1047.675	28.263	1.056
6/03/2019 15:48	1048.783	28.263	1.056
6/03/2019 15:54	1049.892	28.26	1.06
6/03/2019 16:00	1050.825	28.257	1.06
6/03/2019 16:06	1052.4	28.267	1.064
6/03/2019 16:12	1053.333	28.27	1.068
6/03/2019 16:18	1054.617	28.267	1.068
6/03/2019 16:24	1055.55	28.257	1.068
6/03/2019 16:30	1056.95	28.257	1.072
6/03/2019 16:36	1058.233	28.267	1.076
6/03/2019 16:42	1059.4	28.297	1.088
6/03/2019 16:48	1059.633	28.27	1.104
6/03/2019 16:54	1060.975	28.3	1.124
6/03/2019 17:00	1062.083	28.33	1.164
6/03/2019 17:06	1063.192	28.353	1.208
6/03/2019 17:12	1064.358	28.363	1.216
6/03/2019 17:18	1066.167	28.38	1.252
6/03/2019 17:24	1068.15	28.387	1.264
6/03/2019 17:30	1070.658	28.427	1.26
6/03/2019 17:36	1073.4	28.49	1.28
6/03/2019 17:42	1076.783	28.54	1.332
6/03/2019 17:48	1080.575	28.597	1.372
6/03/2019 17:54	1085.067	28.633	1.436
6/03/2019 18:00	1089.383	28.68	1.488
6/03/2019 18:06	1093.233	28.667	1.48
6/03/2019 18:12	1096.15	28.657	1.488
6/03/2019 18:18	1097.725	28.597	1.44
6/03/2019 18:24	1099.067	28.617	1.448
6/03/2019 18:30	1100.408	28.627	1.464
6/03/2019 18:36	1100.875	28.603	1.456
6/03/2019 18:42	1101.342	28.6	1.448
6/03/2019 18:48	1101.575	28.59	1.44
6/03/2019 18:54	1101.983	28.547	1.408
6/03/2019 19:00	1102.217	28.537	1.396
6/03/2019 19:06	1101.983	28.533	1.388
6/03/2019 19:12	1101.75	28.523	1.384
6/03/2019 19:18	1101.575	28.523	1.384
6/03/2019 19:24	1101.108	28.52	1.384
6/03/2019 19:30	1101.108	28.487	1.38
6/03/2019 19:36	1100.642	28.453	1.372
6/03/2019 19:42	1100.408	28.423	1.344
6/03/2019 19:48	1099.533	28.393	1.312
6/03/2019 19:54	1099.067	28.373	1.284
6/03/2019 20:00	1098.192	28.283	1.244
6/03/2019 20:06	1097.725	28.267	1.224
6/03/2019 20:12	1096.792	28.273	1.22
6/03/2019 20:18	1095.917	28.27	1.224
6/03/2019 20:24	1095.45	28.26	1.22
6/03/2019 20:30	1094.808	28.253	1.22
6/03/2019 20:36	1093.408	28.257	1.22
6/03/2019 20:42	1092.533	28.257	1.22
6/03/2019 20:48	1091.833	28.253	1.22

6/03/2019 20:54	1090.258	28.257	1.22
6/03/2019 21:00	1089.383	28.267	1.224
6/03/2019 21:06	1088.042	28.25	1.224
6/03/2019 21:12	1086.875	28.263	1.224
6/03/2019 21:18	1085.767	28.26	1.224
6/03/2019 21:24	1084.192	28.25	1.224
6/03/2019 21:30	1083.258	28.253	1.224
6/03/2019 21:36	1082.15	28.253	1.224
6/03/2019 21:42	1080.808	28.253	1.224
6/03/2019 21:48	1079.233	28.25	1.224
6/03/2019 21:54	1078.3	28.247	1.224
6/03/2019 22:00	1076.783	28.25	1.224
6/03/2019 22:06	1075.617	28.237	1.224
6/03/2019 22:12	1074.508	28.247	1.224
6/03/2019 22:18	1073.575	28.247	1.224
6/03/2019 22:24	1072.233	28.243	1.224
6/03/2019 22:30	1071.358	28.247	1.224
6/03/2019 22:36	1070.25	28.243	1.224
6/03/2019 22:42	1069.083	28.243	1.224
6/03/2019 22:48	1068.442	28.237	1.224
6/03/2019 22:54	1067.508	28.237	1.224
6/03/2019 23:00	1066.633	28.237	1.224
6/03/2019 23:06	1065.7	28.237	1.22
6/03/2019 23:12	1064.825	28.23	1.22
6/03/2019 23:18	1063.892	28.23	1.22
6/03/2019 23:24	1062.783	28.23	1.22
6/03/2019 23:30	1061.675	28.227	1.22
6/03/2019 23:36	1060.742	28.23	1.22
6/03/2019 23:42	1059.867	28.227	1.22
6/03/2019 23:48	1058.7	28.223	1.22
6/03/2019 23:54	1057.825	28.227	1.22
7/03/2019 0:00	1056.95	28.227	1.22
7/03/2019 0:06	1056.25	28.223	1.22
7/03/2019 0:12	1055.375	28.227	1.22
7/03/2019 0:18	1054.442	28.23	1.216
7/03/2019 0:24	1053.742	28.23	1.216
7/03/2019 0:30	1053.1	28.233	1.216
7/03/2019 0:36	1052.167	28.233	1.216
7/03/2019 0:42	1051.525	28.233	1.216
7/03/2019 0:48	1051.058	28.23	1.216
7/03/2019 0:54	1050.417	28.237	1.216
7/03/2019 1:00	1049.717	28.237	1.216
7/03/2019 1:06	1049.25	28.243	1.216
7/03/2019 1:12	1049.25	28.247	1.212
7/03/2019 1:18	1048.608	28.243	1.216
7/03/2019 1:24	1048.375	28.243	1.216
7/03/2019 1:30	1048.608	28.243	1.216
7/03/2019 1:36	1048.55	28.247	1.216
7/03/2019 1:42	1048.142	28.257	1.216
7/03/2019 1:48	1047.908	28.257	1.216
7/03/2019 1:54	1047.675	28.267	1.216
7/03/2019 2:00	1046.975	28.297	1.212
7/03/2019 2:06	1046.742	28.317	1.216
7/03/2019 2:12	1047.208	28.323	1.204
7/03/2019 2:18	1047.442	28.333	1.208
7/03/2019 2:24	1047.675	28.343	1.196
7/03/2019 2:30	1048.608	28.363	1.184
7/03/2019 2:36	1049.717	28.37	1.184
7/03/2019 2:42	1050.825	28.38	1.184
7/03/2019 2:48	1051.292	28.37	1.188

7/03/2019 2:54	1052.633	28.373	1.192
7/03/2019 3:00	1053.333	28.377	1.192
7/03/2019 3:06	1053.975	28.39	1.2
7/03/2019 3:12	1055.317	28.393	1.204
7/03/2019 3:18	1055.783	28.397	1.208
7/03/2019 3:24	1056.717	28.403	1.212
7/03/2019 3:30	1057.592	28.397	1.216
7/03/2019 3:36	1058.525	28.397	1.22
7/03/2019 3:42	1059.633	28.4	1.22
7/03/2019 3:48	1060.508	28.397	1.224
7/03/2019 3:54	1061.675	28.403	1.224
7/03/2019 4:00	1062.55	28.397	1.228
7/03/2019 4:06	1064.125	28.393	1.232
7/03/2019 4:12	1065.292	28.407	1.236
7/03/2019 4:18	1066.633	28.403	1.24
7/03/2019 4:24	1067.975	28.407	1.244
7/03/2019 4:30	1069.317	28.4	1.248
7/03/2019 4:36	1071.358	28.393	1.252
7/03/2019 4:42	1072.7	28.397	1.256
7/03/2019 4:48	1074.742	28.393	1.256
7/03/2019 4:54	1076.55	28.39	1.256
7/03/2019 5:00	1078.358	28.383	1.256
7/03/2019 5:06	1080.342	28.383	1.256
7/03/2019 5:12	1082.383	28.383	1.256
7/03/2019 5:18	1084.192	28.38	1.252
7/03/2019 5:24	1086	28.38	1.252
7/03/2019 5:30	1087.108	28.377	1.252
7/03/2019 5:36	1088.45	28.37	1.252
7/03/2019 5:42	1089.617	28.37	1.252
7/03/2019 5:48	1090.725	28.363	1.252
7/03/2019 5:54	1092.067	28.367	1.248
7/03/2019 6:00	1092.767	28.37	1.248
7/03/2019 6:06	1093.642	28.367	1.244
7/03/2019 6:12	1094.342	28.367	1.244
7/03/2019 6:18	1094.808	28.363	1.244
7/03/2019 6:24	1095.042	28.37	1.244
7/03/2019 6:30	1095.683	28.363	1.24
7/03/2019 6:36	1095.917	28.367	1.24
7/03/2019 6:42	1096.15	28.367	1.24
7/03/2019 6:48	1096.15	28.37	1.24
7/03/2019 6:54	1096.383	28.367	1.24
7/03/2019 7:00	1096.15	28.367	1.24
7/03/2019 7:06	1096.15	28.37	1.24
7/03/2019 7:12	1095.917	28.37	1.24
7/03/2019 7:18	1095.45	28.37	1.24
7/03/2019 7:24	1095.217	28.37	1.24
7/03/2019 7:30	1094.808	28.37	1.24
7/03/2019 7:36	1094.575	28.373	1.24
7/03/2019 7:42	1093.642	28.37	1.24
7/03/2019 7:48	1093.233	28.373	1.24
7/03/2019 7:54	1092.3	28.37	1.24
7/03/2019 8:00	1091.6	28.367	1.24
7/03/2019 8:06	1090.958	28.363	1.24
7/03/2019 8:12	1089.85	28.357	1.24
7/03/2019 8:18	1088.917	28.333	1.236
7/03/2019 8:24	1088.217	28.323	1.232
7/03/2019 8:30	1087.342	28.317	1.228
7/03/2019 8:36	1085.767	28.307	1.224
7/03/2019 8:42	1085.067	28.303	1.216
7/03/2019 8:48	1083.725	28.3	1.216

7/03/2019 8:54	1082.85	28.297	1.212
7/03/2019 9:00	1081.742	28.293	1.212
7/03/2019 9:06	1080.342	28.293	1.212
7/03/2019 9:12	1079.467	28.29	1.208
7/03/2019 9:18	1078.125	28.283	1.208
7/03/2019 9:24	1076.958	28.277	1.208
7/03/2019 9:30	1076.083	28.283	1.208
7/03/2019 9:36	1074.975	28.273	1.204
7/03/2019 9:42	1073.808	28.27	1.204
7/03/2019 9:48	1072.7	28.27	1.204
7/03/2019 9:54	1072	28.26	1.2
7/03/2019 10:00	1070.658	28.25	1.196
7/03/2019 10:06	1069.783	28.243	1.192
7/03/2019 10:12	1068.617	28.243	1.188
7/03/2019 10:18	1067.742	28.243	1.188
7/03/2019 10:24	1066.867	28.243	1.188
7/03/2019 10:30	1065.933	28.24	1.184
7/03/2019 10:36	1064.825	28.237	1.184
7/03/2019 10:42	1063.658	28.233	1.184
7/03/2019 10:48	1062.55	28.22	1.184
7/03/2019 10:54	1061.208	28.17	1.148
7/03/2019 11:00	1060.508	28.107	1.036
7/03/2019 11:06	1059.167	28.047	0.96
7/03/2019 11:12	1058.292	28.023	0.936
7/03/2019 11:18	1057.125	28.017	0.936
7/03/2019 11:24	1056.425	28.007	0.936
7/03/2019 11:30	1055.083	28.007	0.932
7/03/2019 11:36	1053.975	28.007	0.932
7/03/2019 11:42	1053.1	27.997	0.932
7/03/2019 11:48	1051.758	28	0.928
7/03/2019 11:54	1050.592	28.003	0.928
7/03/2019 12:00	1049.892	28.007	0.928
7/03/2019 12:06	1049.017	28.007	0.928
7/03/2019 12:12	1048.142	28.01	0.928
7/03/2019 12:18	1047.442	28.007	0.928
7/03/2019 12:24	1046.567	28.003	0.928
7/03/2019 12:30	1046.1	28.013	0.928
7/03/2019 12:36	1045.633	28.02	0.928
7/03/2019 12:42	1044.933	28.02	0.924
7/03/2019 12:48	1044.292	28.02	0.928
7/03/2019 12:54	1043.417	28.027	0.924
7/03/2019 13:00	1042.717	28.03	0.928
7/03/2019 13:06	1042.483	28.03	0.928
7/03/2019 13:12	1041.608	28.037	0.924
7/03/2019 13:18	1041.375	28.04	0.924
7/03/2019 13:24	1040.908	28.043	0.924
7/03/2019 13:30	1040.5	28.047	0.924
7/03/2019 13:36	1040.267	28.047	0.924
7/03/2019 13:42	1039.8	28.06	0.924
7/03/2019 13:48	1039.8	28.05	0.924
7/03/2019 13:54	1039.567	28.06	0.924
7/03/2019 14:00	1039.1	28.067	0.924
7/03/2019 14:06	1039.508	28.063	0.924
7/03/2019 14:12	1039.1	28.067	0.924
7/03/2019 14:18	1039.1	28.067	0.924
7/03/2019 14:24	1039.1	28.073	0.924
7/03/2019 14:30	1039.1	28.073	0.924
7/03/2019 14:36	1039.333	28.073	0.924
7/03/2019 14:42	1039.742	28.077	0.924
7/03/2019 14:48	1039.8	28.073	0.924

7/03/2019 14:54	1040.033	28.08	0.924
7/03/2019 15:00	1040.267	28.073	0.924
7/03/2019 15:06	1041.083	28.077	0.924
7/03/2019 15:12	1041.375	28.073	0.924
7/03/2019 15:18	1041.842	28.073	0.924
7/03/2019 15:24	1042.25	28.067	0.924
7/03/2019 15:30	1043.125	28.063	0.924
7/03/2019 15:36	1043.825	28.063	0.924
7/03/2019 15:42	1044.467	28.063	0.924
7/03/2019 15:48	1045.225	28.06	0.924
7/03/2019 15:54	1046.1	28.057	0.924
7/03/2019 16:00	1046.567	28.06	0.92
7/03/2019 16:06	1047.442	28.053	0.92
7/03/2019 16:12	1048.608	28.05	0.92
7/03/2019 16:18	1049.483	28.057	0.92
7/03/2019 16:24	1050.592	28.05	0.92
7/03/2019 16:30	1051.758	28.05	0.92
7/03/2019 16:36	1052.633	28.05	0.92
7/03/2019 16:42	1053.975	28.05	0.92
7/03/2019 16:48	1055.142	28.043	0.92
7/03/2019 16:54	1056.25	28.043	0.916
7/03/2019 17:00	1056.95	28.043	0.916
7/03/2019 17:06	1058.058	28.05	0.916
7/03/2019 17:12	1058.933	28.063	0.928
7/03/2019 17:18	1059.633	28.05	0.928
7/03/2019 17:24	1060.742	28.043	0.924
7/03/2019 17:30	1061.675	28.043	0.924
7/03/2019 17:36	1062.783	28.04	0.924
7/03/2019 17:42	1063.892	28.01	0.916
7/03/2019 17:48	1065.058	28.01	0.912
7/03/2019 17:54	1066.167	28.073	0.94
7/03/2019 18:00	1067.508	28.09	0.968
7/03/2019 18:06	1068.85	28.12	1.004
7/03/2019 18:12	1069.317	28.173	1.08
7/03/2019 18:18	1070.892	28.227	1.148
7/03/2019 18:24	1072	28.223	1.176
7/03/2019 18:30	1073.4	28.217	1.184
7/03/2019 18:36	1074.742	28.203	1.184
7/03/2019 18:42	1075.85	28.197	1.18
7/03/2019 18:48	1076.783	28.193	1.18
7/03/2019 18:54	1077.658	28.193	1.18
7/03/2019 19:00	1078.533	28.193	1.18
7/03/2019 19:06	1079.467	28.2	1.18
7/03/2019 19:12	1079.933	28.187	1.184
7/03/2019 19:18	1080.575	28.19	1.184
7/03/2019 19:24	1080.808	28.183	1.184
7/03/2019 19:30	1080.808	28.187	1.184
7/03/2019 19:36	1081.042	28.18	1.184
7/03/2019 19:42	1081.275	28.183	1.184
7/03/2019 19:48	1081.042	28.18	1.184
7/03/2019 19:54	1079.933	28.18	1.184
7/03/2019 20:00	1079.233	28.19	1.184
7/03/2019 20:06	1078.767	28.207	1.184
7/03/2019 20:12	1078.533	28.2	1.184
7/03/2019 20:18	1078.3	28.197	1.184
7/03/2019 20:24	1077.892	28.203	1.184
7/03/2019 20:30	1077.192	28.197	1.184
7/03/2019 20:36	1076.317	28.2	1.184
7/03/2019 20:42	1075.85	28.203	1.188
7/03/2019 20:48	1074.742	28.187	1.184

7/03/2019 20:54	1074.275	28.147	1.092
7/03/2019 21:00	1072.933	28.113	1.044
7/03/2019 21:06	1072	28.067	1.008
7/03/2019 21:12	1071.592	28.05	0.992
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7/03/2019 21:24	1069.783	28.03	0.968
7/03/2019 21:30	1068.85	28.037	0.964
7/03/2019 21:36	1068.15	28.013	0.956
7/03/2019 21:42	1067.275	28.02	0.956
7/03/2019 21:48	1066.167	28.023	0.956
7/03/2019 21:54	1065.467	28.007	0.952
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7/03/2019 22:06	1063.25	28.003	0.944
7/03/2019 22:12	1062.55	28.007	0.944
7/03/2019 22:18	1061.617	28.007	0.94
7/03/2019 22:24	1060.333	28.003	0.94
7/03/2019 22:30	1059.867	28.01	0.94
7/03/2019 22:36	1058.7	28.01	0.936
7/03/2019 22:42	1057.358	28.01	0.936
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7/03/2019 22:54	1055.375	28.017	0.936
7/03/2019 23:00	1054.442	28.017	0.936
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8/03/2019 0:18	1042.717	28.053	0.932
8/03/2019 0:24	1042.075	28.053	0.932
8/03/2019 0:30	1041.608	28.06	0.932
8/03/2019 0:36	1041.083	28.063	0.932
8/03/2019 0:42	1040.267	28.073	0.932
8/03/2019 0:48	1039.567	28.073	0.932
8/03/2019 0:54	1039.1	28.08	0.932
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8/03/2019 1:18	1037.117	28.1	0.932
8/03/2019 1:24	1036.65	28.103	0.932
8/03/2019 1:30	1036.183	28.11	0.932
8/03/2019 1:36	1035.95	28.12	0.932
8/03/2019 1:42	1035.717	28.13	0.936
8/03/2019 1:48	1035.308	28.143	0.932
8/03/2019 1:54	1035.25	28.147	0.932
8/03/2019 2:00	1034.842	28.157	0.932
8/03/2019 2:06	1034.842	28.163	0.932
8/03/2019 2:12	1034.842	28.167	0.932
8/03/2019 2:18	1034.842	28.17	0.932
8/03/2019 2:24	1035.017	28.183	0.928
8/03/2019 2:30	1034.842	28.187	0.924
8/03/2019 2:36	1034.842	28.193	0.924
8/03/2019 2:42	1035.483	28.197	0.92
8/03/2019 2:48	1035.483	28.197	0.924

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8/03/2019 3:00	1036.358	28.197	0.928
8/03/2019 3:06	1036.417	28.187	0.932
8/03/2019 3:12	1036.883	28.193	0.932
8/03/2019 3:18	1037.525	28.187	0.936
8/03/2019 3:24	1038.167	28.183	0.936
8/03/2019 3:30	1038.692	28.187	0.936
8/03/2019 3:36	1039.567	28.18	0.936
8/03/2019 3:42	1040.267	28.173	0.936
8/03/2019 3:48	1040.908	28.17	0.936
8/03/2019 3:54	1042.017	28.177	0.936
8/03/2019 4:00	1042.717	28.167	0.936
8/03/2019 4:06	1043.417	28.17	0.936
8/03/2019 4:12	1044.525	28.16	0.936
8/03/2019 4:18	1045.458	28.157	0.936
8/03/2019 4:24	1046.333	28.153	0.936
8/03/2019 4:30	1047.675	28.157	0.936
8/03/2019 4:36	1048.783	28.15	0.936
8/03/2019 4:42	1050.183	28.153	0.936
8/03/2019 4:48	1051.292	28.157	0.936
8/03/2019 4:54	1052.4	28.15	0.936
8/03/2019 5:00	1053.742	28.157	0.936
8/03/2019 5:06	1055.142	28.153	0.936
8/03/2019 5:12	1056.25	28.157	0.936
8/03/2019 5:18	1057.125	28.15	0.936
8/03/2019 5:24	1058.292	28.153	0.936
8/03/2019 5:30	1059.167	28.157	0.936
8/03/2019 5:36	1060.333	28.16	0.936
8/03/2019 5:42	1061.442	28.163	0.936
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8/03/2019 5:54	1063.658	28.163	0.936
8/03/2019 6:00	1065.058	28.163	0.94
8/03/2019 6:06	1066.4	28.18	0.94
8/03/2019 6:12	1067.742	28.187	0.944
8/03/2019 6:18	1068.442	28.2	0.944
8/03/2019 6:24	1069.725	28.253	0.96
8/03/2019 6:30	1070.425	28.28	0.976
8/03/2019 6:36	1072	28.267	0.968
8/03/2019 6:42	1073.808	28.26	0.968
8/03/2019 6:48	1075.208	28.27	0.996
8/03/2019 6:54	1076.783	28.283	1.008
8/03/2019 7:00	1078.125	28.273	1.008
8/03/2019 7:06	1079	28.3	1.032
8/03/2019 7:12	1080.575	28.323	1.068
8/03/2019 7:18	1081.275	28.337	1.108
8/03/2019 7:24	1081.917	28.34	1.136
8/03/2019 7:30	1082.383	28.35	1.156
8/03/2019 7:36	1083.083	28.353	1.168
8/03/2019 7:42	1083.258	28.353	1.176
8/03/2019 7:48	1083.492	28.353	1.184
8/03/2019 7:54	1083.492	28.353	1.184
8/03/2019 8:00	1083.492	28.353	1.18
8/03/2019 8:06	1083.258	28.353	1.172
8/03/2019 8:12	1082.85	28.343	1.164
8/03/2019 8:18	1082.383	28.337	1.152
8/03/2019 8:24	1082.15	28.323	1.124
8/03/2019 8:30	1081.683	28.31	1.088
8/03/2019 8:36	1080.808	28.29	1.044
8/03/2019 8:42	1079.933	28.283	1.02
8/03/2019 8:48	1079.233	28.263	1.004

8/03/2019 8:54	1078.358	28.263	0.992
8/03/2019 9:00	1077.658	28.253	0.988
8/03/2019 9:06	1076.55	28.25	0.984
8/03/2019 9:12	1076.083	28.253	0.984
8/03/2019 9:18	1074.975	28.25	0.984
8/03/2019 9:24	1074.275	28.247	0.98
8/03/2019 9:30	1073.167	28.243	0.98
8/03/2019 9:36	1072.7	28.24	0.98
8/03/2019 9:42	1071.358	28.243	0.976
8/03/2019 9:48	1070.892	28.24	0.976
8/03/2019 9:54	1069.958	28.247	0.972
8/03/2019 10:00	1068.617	28.243	0.972
8/03/2019 10:06	1068.15	28.247	0.972
8/03/2019 10:12	1067.275	28.24	0.972
8/03/2019 10:18	1066.342	28.247	0.968
8/03/2019 10:24	1065.233	28.253	0.968
8/03/2019 10:30	1064.358	28.247	0.968
8/03/2019 10:36	1063.425	28.247	0.968
8/03/2019 10:42	1061.908	28.243	0.968
8/03/2019 10:48	1060.975	28.233	0.968
8/03/2019 10:54	1060.1	28.233	0.964
8/03/2019 11:00	1059.167	28.227	0.964
8/03/2019 11:06	1058.292	28.227	0.96
8/03/2019 11:12	1057.125	28.23	0.956
8/03/2019 11:18	1056.017	28.227	0.956
8/03/2019 11:24	1054.908	28.223	0.956
8/03/2019 11:30	1053.742	28.223	0.952
8/03/2019 11:36	1052.633	28.217	0.952
8/03/2019 11:42	1051.525	28.217	0.952
8/03/2019 11:48	1050.417	28.217	0.952
8/03/2019 11:54	1049.483	28.213	0.952
8/03/2019 12:00	1048.375	28.213	0.948
8/03/2019 12:06	1047.675	28.21	0.948
8/03/2019 12:12	1047.033	28.21	0.948
8/03/2019 12:18	1046.1	28.213	0.948
8/03/2019 12:24	1045.633	28.21	0.948
8/03/2019 12:30	1044.758	28.213	0.948
8/03/2019 12:36	1043.825	28.21	0.948
8/03/2019 12:42	1043.183	28.213	0.948
8/03/2019 12:48	1042.483	28.207	0.948
8/03/2019 12:54	1041.608	28.21	0.944
8/03/2019 13:00	1041.142	28.21	0.944
8/03/2019 13:06	1040.5	28.207	0.944
8/03/2019 13:12	1039.8	28.207	0.944
8/03/2019 13:18	1039.333	28.21	0.944
8/03/2019 13:24	1038.867	28.213	0.944
8/03/2019 13:30	1038.692	28.217	0.944
8/03/2019 13:36	1037.992	28.217	0.944
8/03/2019 13:42	1037.758	28.22	0.944
8/03/2019 13:48	1037.292	28.223	0.94
8/03/2019 13:54	1036.883	28.217	0.936
8/03/2019 14:00	1036.183	28.213	0.928
8/03/2019 14:06	1035.95	28.21	0.912
8/03/2019 14:12	1035.95	28.207	0.892
8/03/2019 14:18	1035.717	28.207	0.888
8/03/2019 14:24	1035.542	28.187	0.88
8/03/2019 14:30	1035.483	28.183	0.868
8/03/2019 14:36	1035.075	28.173	0.86
8/03/2019 14:42	1035.075	28.17	0.856
8/03/2019 14:48	1035.075	28.167	0.856

8/03/2019 14:54	1035.075	28.16	0.852
8/03/2019 15:00	1035.308	28.163	0.852
8/03/2019 15:06	1035.542	28.167	0.852
8/03/2019 15:12	1035.542	28.167	0.856
8/03/2019 15:18	1035.95	28.177	0.864
8/03/2019 15:24	1036.592	28.19	0.876
8/03/2019 15:30	1036.825	28.197	0.888
8/03/2019 15:36	1037.117	28.207	0.9
8/03/2019 15:42	1037.525	28.207	0.912
8/03/2019 15:48	1038.225	28.213	0.92
8/03/2019 15:54	1038.458	28.213	0.928
8/03/2019 16:00	1039.1	28.217	0.932
8/03/2019 16:06	1039.567	28.22	0.936
8/03/2019 16:12	1040.5	28.213	0.936
8/03/2019 16:18	1041.142	28.21	0.936
8/03/2019 16:24	1042.075	28.207	0.936
8/03/2019 16:30	1042.717	28.207	0.936
8/03/2019 16:36	1043.65	28.2	0.936
8/03/2019 16:42	1044.758	28.2	0.936
8/03/2019 16:48	1045.633	28.2	0.936
8/03/2019 16:54	1046.742	28.197	0.936
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8/03/2019 17:06	1049.25	28.197	0.936
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8/03/2019 17:24	1052.633	28.187	0.936
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8/03/2019 17:42	1056.25	28.18	0.932
8/03/2019 17:48	1057.358	28.18	0.932
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8/03/2019 18:00	1059.167	28.177	0.932
8/03/2019 18:06	1059.633	28.173	0.932
8/03/2019 18:12	1060.508	28.17	0.932
8/03/2019 18:18	1061.908	28.167	0.928
8/03/2019 18:24	1062.783	28.153	0.928
8/03/2019 18:30	1064.125	28.147	0.924
8/03/2019 18:36	1064.825	28.15	0.924
8/03/2019 18:42	1065.933	28.15	0.924
8/03/2019 18:48	1066.867	28.143	0.924
8/03/2019 18:54	1067.975	28.14	0.924
8/03/2019 19:00	1069.317	28.147	0.924
8/03/2019 19:06	1069.958	28.147	0.924
8/03/2019 19:12	1071.125	28.153	0.924
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8/03/2019 19:24	1072.467	28.183	0.956
8/03/2019 19:30	1073.167	28.2	0.952
8/03/2019 19:36	1074.042	28.22	0.98
8/03/2019 19:42	1074.975	28.213	0.984
8/03/2019 19:48	1075.617	28.217	0.984
8/03/2019 19:54	1076.317	28.22	0.984
8/03/2019 20:00	1076.55	28.22	0.992
8/03/2019 20:06	1076.958	28.213	0.988
8/03/2019 20:12	1077.192	28.21	0.988
8/03/2019 20:18	1077.192	28.207	0.984
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8/03/2019 20:30	1077.192	28.18	0.968
8/03/2019 20:36	1077.192	28.177	0.964
8/03/2019 20:42	1076.55	28.163	0.96
8/03/2019 20:48	1075.85	28.167	0.96

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8/03/2019 21:36	1069.958	28.14	0.948
8/03/2019 21:42	1069.083	28.143	0.944
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8/03/2019 21:54	1067.742	28.147	0.94
8/03/2019 22:00	1066.808	28.147	0.94
8/03/2019 22:06	1065.933	28.143	0.94
8/03/2019 22:12	1065.058	28.143	0.94
8/03/2019 22:18	1064.358	28.147	0.94
8/03/2019 22:24	1063.425	28.14	0.94
8/03/2019 22:30	1062.317	28.147	0.94
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8/03/2019 22:48	1059.4	28.15	0.94
8/03/2019 22:54	1058.7	28.147	0.94
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8/03/2019 23:06	1056.483	28.153	0.936
8/03/2019 23:12	1055.375	28.153	0.936
8/03/2019 23:18	1054.208	28.157	0.936
8/03/2019 23:24	1053.333	28.16	0.936
8/03/2019 23:30	1052.167	28.157	0.936
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8/03/2019 23:42	1050.183	28.163	0.936
8/03/2019 23:48	1049.25	28.167	0.936
8/03/2019 23:54	1048.142	28.17	0.936
9/03/2019 0:00	1047.208	28.17	0.936
9/03/2019 0:06	1046.333	28.17	0.936
9/03/2019 0:12	1045.867	28.17	0.936
9/03/2019 0:18	1044.933	28.177	0.936
9/03/2019 0:24	1044.058	28.18	0.936
9/03/2019 0:30	1043.417	28.18	0.936
9/03/2019 0:36	1042.717	28.183	0.94
9/03/2019 0:42	1042.25	28.183	0.94
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9/03/2019 0:54	1040.675	28.183	0.94
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9/03/2019 1:06	1039.1	28.193	0.94
9/03/2019 1:12	1038.633	28.197	0.936
9/03/2019 1:18	1038.225	28.207	0.936
9/03/2019 1:24	1037.525	28.2	0.936
9/03/2019 1:30	1037.117	28.207	0.936
9/03/2019 1:36	1036.65	28.207	0.936
9/03/2019 1:42	1036.417	28.217	0.936
9/03/2019 1:48	1035.95	28.22	0.94
9/03/2019 1:54	1035.542	28.223	0.94
9/03/2019 2:00	1035.308	28.23	0.94
9/03/2019 2:06	1035.075	28.233	0.94
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9/03/2019 2:18	1034.375	28.25	0.936
9/03/2019 2:24	1034.375	28.25	0.936
9/03/2019 2:30	1034.375	28.26	0.94
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9/03/2019 2:42	1033.908	28.27	0.94
9/03/2019 2:48	1033.908	28.277	0.94

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9/03/2019 3:00	1033.908	28.28	0.94
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9/03/2019 3:18	1034.375	28.283	0.94
9/03/2019 3:24	1035.075	28.283	0.94
9/03/2019 3:30	1035.542	28.283	0.94
9/03/2019 3:36	1035.717	28.283	0.94
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9/03/2019 3:54	1037.292	28.277	0.94
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9/03/2019 4:24	1040.908	28.263	0.94
9/03/2019 4:30	1041.608	28.263	0.94
9/03/2019 4:36	1042.483	28.26	0.94
9/03/2019 4:42	1043.358	28.26	0.94
9/03/2019 4:48	1044.467	28.26	0.94
9/03/2019 4:54	1045.633	28.26	0.94
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9/03/2019 5:18	1049.483	28.257	0.94
9/03/2019 5:24	1050.825	28.253	0.94
9/03/2019 5:30	1052.167	28.253	0.94
9/03/2019 5:36	1051.758	28.263	0.94
9/03/2019 5:42	1052.167	28.283	0.94
9/03/2019 5:48	1053.1	28.29	0.944
9/03/2019 5:54	1054.908	28.283	0.94
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9/03/2019 6:18	1059.4	28.28	0.944
9/03/2019 6:24	1060.333	28.28	0.944
9/03/2019 6:30	1061.442	28.277	0.944
9/03/2019 6:36	1062.317	28.28	0.944
9/03/2019 6:42	1063.658	28.28	0.944
9/03/2019 6:48	1064.592	28.287	0.944
9/03/2019 6:54	1065.7	28.283	0.944
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9/03/2019 7:12	1069.317	28.337	0.968
9/03/2019 7:18	1070.658	28.333	0.976
9/03/2019 7:24	1071.358	28.34	0.984
9/03/2019 7:30	1072.233	28.347	0.984
9/03/2019 7:36	1073.167	28.357	0.984
9/03/2019 7:42	1074.275	28.353	0.988
9/03/2019 7:48	1075.15	28.36	0.992
9/03/2019 7:54	1075.85	28.367	0.992
9/03/2019 8:00	1076.492	28.353	0.992
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9/03/2019 8:18	1077.658	28.36	1
9/03/2019 8:24	1077.658	28.363	1
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9/03/2019 8:48	1077.192	28.367	1

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9/03/2019 10:24	1065.933	28.323	0.968
9/03/2019 10:30	1065.058	28.327	0.968
9/03/2019 10:36	1064.358	28.327	0.964
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9/03/2019 10:48	1062.317	28.32	0.964
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9/03/2019 11:24	1057.125	28.303	0.952
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9/03/2019 11:48	1052.867	28.307	0.948
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9/03/2019 12:12	1048.783	28.293	0.948
9/03/2019 12:18	1047.908	28.29	0.948
9/03/2019 12:24	1046.8	28.283	0.944
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9/03/2019 12:54	1042.95	28.283	0.944
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9/03/2019 14:06	1036.358	28.267	0.94
9/03/2019 14:12	1035.95	28.273	0.94
9/03/2019 14:18	1035.308	28.27	0.94
9/03/2019 14:24	1034.842	28.27	0.94
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9/03/2019 14:42	1034.142	28.28	0.928
9/03/2019 14:48	1033.908	28.277	0.924

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9/03/2019 15:06	1033.733	28.277	0.912
9/03/2019 15:12	1033.733	28.277	0.908
9/03/2019 15:18	1033.908	28.273	0.912
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9/03/2019 15:30	1034.142	28.273	0.924
9/03/2019 15:36	1034.783	28.267	0.928
9/03/2019 15:42	1034.55	28.267	0.932
9/03/2019 15:48	1034.608	28.263	0.936
9/03/2019 15:54	1035.075	28.257	0.936
9/03/2019 16:00	1035.717	28.253	0.936
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9/03/2019 16:12	1036.417	28.25	0.936
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9/03/2019 16:24	1037.933	28.247	0.936
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9/03/2019 16:42	1039.975	28.24	0.936
9/03/2019 16:48	1040.908	28.24	0.936
9/03/2019 16:54	1041.55	28.24	0.936
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9/03/2019 17:06	1043.125	28.24	0.936
9/03/2019 17:12	1043.825	28.227	0.936
9/03/2019 17:18	1044.758	28.23	0.936
9/03/2019 17:24	1045.867	28.233	0.936
9/03/2019 17:30	1046.567	28.223	0.936
9/03/2019 17:36	1047.442	28.223	0.936
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9/03/2019 17:48	1049.717	28.22	0.936
9/03/2019 17:54	1051.058	28.217	0.936
9/03/2019 18:00	1052.167	28.223	0.936
9/03/2019 18:06	1053.333	28.21	0.936
9/03/2019 18:12	1054.442	28.213	0.936
9/03/2019 18:18	1055.55	28.213	0.936
9/03/2019 18:24	1056.717	28.213	0.936
9/03/2019 18:30	1058	28.203	0.936
9/03/2019 18:36	1058.7	28.21	0.936
9/03/2019 18:42	1059.867	28.207	0.936
9/03/2019 18:48	1060.333	28.2	0.94
9/03/2019 18:54	1060.975	28.2	0.94
9/03/2019 19:00	1062.083	28.197	0.94
9/03/2019 19:06	1063.192	28.197	0.94
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9/03/2019 20:18	1072.233	28.217	0.964
9/03/2019 20:24	1072.7	28.22	0.972
9/03/2019 20:30	1073.167	28.217	0.964
9/03/2019 20:36	1073.575	28.233	0.976
9/03/2019 20:42	1073.808	28.227	0.98
9/03/2019 20:48	1074.042	28.22	0.972

9/03/2019 20:54	1074.042	28.22	0.972
9/03/2019 21:00	1074.042	28.21	0.968
9/03/2019 21:06	1074.042	28.203	0.964
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9/03/2019 21:36	1071.592	28.227	0.976
9/03/2019 21:42	1070.892	28.217	0.972
9/03/2019 21:48	1070.25	28.21	0.968
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9/03/2019 22:00	1068.85	28.21	0.964
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9/03/2019 22:36	1064.358	28.21	0.956
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10/03/2019 1:00	1043.183	28.243	0.952
10/03/2019 1:06	1042.483	28.243	0.952
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10/03/2019 3:06	1034.142	28.357	0.948
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10/03/2019 4:06	1036.358	28.353	0.948
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10/03/2019 8:36	1071.592	28.407	1.012
10/03/2019 8:42	1072.467	28.417	1.028
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10/03/2019 9:06	1073.575	28.42	1.056
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10/03/2019 9:18	1073.4	28.407	1.048
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10/03/2019 9:30	1073.167	28.403	1.036
10/03/2019 9:36	1072.7	28.403	1.032
10/03/2019 9:42	1072.467	28.39	1.028
10/03/2019 9:48	1071.825	28.383	1.024
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10/03/2019 10:06	1070.425	28.353	0.996
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10/03/2019 10:54	1063.892	28.3	0.964
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10/03/2019 11:12	1061.675	28.287	0.956
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10/03/2019 11:48	1056.017	28.277	0.956
10/03/2019 11:54	1055.375	28.27	0.956
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10/03/2019 13:00	1046.1	28.26	0.956
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10/03/2019 13:12	1044.467	28.26	0.956
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10/03/2019 14:30	1037.525	28.247	0.956
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10/03/2019 14:48	1036.183	28.243	0.956

10/03/2019 14:54	1035.95	28.24	0.956
10/03/2019 15:00	1035.308	28.237	0.956
10/03/2019 15:06	1035.25	28.24	0.956
10/03/2019 15:12	1035.25	28.24	0.956
10/03/2019 15:18	1035.25	28.24	0.956
10/03/2019 15:24	1035.25	28.24	0.956
10/03/2019 15:30	1035.017	28.24	0.956
10/03/2019 15:36	1035.017	28.24	0.956
10/03/2019 15:42	1034.842	28.243	0.956
10/03/2019 15:48	1034.783	28.24	0.956
10/03/2019 15:54	1035.075	28.237	0.956
10/03/2019 16:00	1034.842	28.237	0.956
10/03/2019 16:06	1035.075	28.227	0.956
10/03/2019 16:12	1035.542	28.23	0.956
10/03/2019 16:18	1035.717	28.223	0.956
10/03/2019 16:24	1036.417	28.223	0.956
10/03/2019 16:30	1036.65	28.217	0.956
10/03/2019 16:36	1037.117	28.213	0.956
10/03/2019 16:42	1037.525	28.21	0.956
10/03/2019 16:48	1037.992	28.21	0.956
10/03/2019 16:54	1038.458	28.207	0.956
10/03/2019 17:00	1039.1	28.21	0.956
10/03/2019 17:06	1039.975	28.203	0.956
10/03/2019 17:12	1040.5	28.2	0.956
10/03/2019 17:18	1041.142	28.207	0.956
10/03/2019 17:24	1042.25	28.197	0.956
10/03/2019 17:30	1042.95	28.2	0.96
10/03/2019 17:36	1043.65	28.193	0.96
10/03/2019 17:42	1044.525	28.193	0.96
10/03/2019 17:48	1045.458	28.187	0.96
10/03/2019 17:54	1046.333	28.187	0.96
10/03/2019 18:00	1047.442	28.187	0.96
10/03/2019 18:06	1048.55	28.183	0.96
10/03/2019 18:12	1049.483	28.183	0.96
10/03/2019 18:18	1050.417	28.187	0.96
10/03/2019 18:24	1051.292	28.18	0.96
10/03/2019 18:30	1052.4	28.18	0.96
10/03/2019 18:36	1053.567	28.18	0.96
10/03/2019 18:42	1054.675	28.187	0.96
10/03/2019 18:48	1055.55	28.173	0.96
10/03/2019 18:54	1056.483	28.167	0.96
10/03/2019 19:00	1057.592	28.16	0.96
10/03/2019 19:06	1058.525	28.157	0.96
10/03/2019 19:12	1059.167	28.157	0.96
10/03/2019 19:18	1059.867	28.163	0.964
10/03/2019 19:24	1060.508	28.17	0.964
10/03/2019 19:30	1060.975	28.173	0.964
10/03/2019 19:36	1062.317	28.17	0.968
10/03/2019 19:42	1063.017	28.167	0.972
10/03/2019 19:48	1063.892	28.183	0.98
10/03/2019 19:54	1064.767	28.197	0.996
10/03/2019 20:00	1065.292	28.187	0.992
10/03/2019 20:06	1066.167	28.217	0.992
10/03/2019 20:12	1067.042	28.18	0.996
10/03/2019 20:18	1067.975	28.177	0.988
10/03/2019 20:24	1068.442	28.18	0.984
10/03/2019 20:30	1069.317	28.183	0.984
10/03/2019 20:36	1069.783	28.217	1
10/03/2019 20:42	1069.783	28.277	1.048
10/03/2019 20:48	1070.658	28.29	1.064

10/03/2019 20:54	1070.892	28.277	1.06
10/03/2019 21:00	1071.358	28.28	1.056
10/03/2019 21:06	1071.767	28.267	1.052
10/03/2019 21:12	1072.233	28.26	1.048
10/03/2019 21:18	1072.233	28.237	1.04
10/03/2019 21:24	1072.467	28.247	1.032
10/03/2019 21:30	1072.233	28.233	1.032
10/03/2019 21:36	1072.233	28.227	1.024
10/03/2019 21:42	1072.233	28.227	1.024
10/03/2019 21:48	1071.825	28.223	1.02
10/03/2019 21:54	1071.592	28.217	1.02
10/03/2019 22:00	1071.125	28.213	1.012
10/03/2019 22:06	1070.658	28.207	1.008
10/03/2019 22:12	1070.25	28.2	1.004
10/03/2019 22:18	1069.783	28.2	1
10/03/2019 22:24	1069.317	28.193	1
10/03/2019 22:30	1068.208	28.187	0.996
10/03/2019 22:36	1067.508	28.187	0.992
10/03/2019 22:42	1066.633	28.193	0.992
10/03/2019 22:48	1065.933	28.187	0.988
10/03/2019 22:54	1065.467	28.19	0.988
10/03/2019 23:00	1064.592	28.187	0.988
10/03/2019 23:06	1064.125	28.19	0.984
10/03/2019 23:12	1063.192	28.19	0.984
10/03/2019 23:18	1062.55	28.19	0.984
10/03/2019 23:24	1061.617	28.19	0.984
10/03/2019 23:30	1060.742	28.193	0.984
10/03/2019 23:36	1060.1	28.193	0.98
10/03/2019 23:42	1059.575	28.197	0.98
10/03/2019 23:48	1058.7	28.197	0.98
10/03/2019 23:54	1058.233	28.197	0.98
11/03/2019 0:00	1056.95	28.2	0.98
11/03/2019 0:06	1056.017	28.203	0.98
11/03/2019 0:12	1055.317	28.203	0.98
11/03/2019 0:18	1054.208	28.203	0.98
11/03/2019 0:24	1053.275	28.203	0.98
11/03/2019 0:30	1052.4	28.207	0.98
11/03/2019 0:36	1051.292	28.207	0.98
11/03/2019 0:42	1050.417	28.21	0.98
11/03/2019 0:48	1049.483	28.207	0.98
11/03/2019 0:54	1048.783	28.213	0.98
11/03/2019 1:00	1047.908	28.217	0.98
11/03/2019 1:06	1047.208	28.217	0.98
11/03/2019 1:12	1046.567	28.223	0.98
11/03/2019 1:18	1045.867	28.223	0.98
11/03/2019 1:24	1044.992	28.227	0.98
11/03/2019 1:30	1044.525	28.227	0.98
11/03/2019 1:36	1044.058	28.23	0.98
11/03/2019 1:42	1043.417	28.233	0.98
11/03/2019 1:48	1042.95	28.237	0.98
11/03/2019 1:54	1042.075	28.237	0.98
11/03/2019 2:00	1041.783	28.24	0.98
11/03/2019 2:06	1041.317	28.247	0.98
11/03/2019 2:12	1040.5	28.243	0.98
11/03/2019 2:18	1040.033	28.25	0.98
11/03/2019 2:24	1039.8	28.25	0.98
11/03/2019 2:30	1039.1	28.257	0.98
11/03/2019 2:36	1038.867	28.257	0.98
11/03/2019 2:42	1038.4	28.26	0.98
11/03/2019 2:48	1037.992	28.263	0.98

11/03/2019 2:54	1037.758	28.27	0.98
11/03/2019 3:00	1037.7	28.267	0.98
11/03/2019 3:06	1037.292	28.277	0.98
11/03/2019 3:12	1037.292	28.277	0.98
11/03/2019 3:18	1037.117	28.28	0.98
11/03/2019 3:24	1036.883	28.283	0.98
11/03/2019 3:30	1036.883	28.287	0.98
11/03/2019 3:36	1036.65	28.287	0.98
11/03/2019 3:42	1036.65	28.293	0.98
11/03/2019 3:48	1036.65	28.3	0.98
11/03/2019 3:54	1037.058	28.297	0.98
11/03/2019 4:00	1036.883	28.3	0.98
11/03/2019 4:06	1037.292	28.297	0.98
11/03/2019 4:12	1037.117	28.293	0.98
11/03/2019 4:18	1037.525	28.3	0.98
11/03/2019 4:24	1037.7	28.297	0.98
11/03/2019 4:30	1038.4	28.297	0.98
11/03/2019 4:36	1038.458	28.293	0.98
11/03/2019 4:42	1039.1	28.297	0.98
11/03/2019 4:48	1039.508	28.297	0.98
11/03/2019 4:54	1039.8	28.293	0.98
11/03/2019 5:00	1040.5	28.293	0.98
11/03/2019 5:06	1041.142	28.293	0.98
11/03/2019 5:12	1041.375	28.29	0.98
11/03/2019 5:18	1042.25	28.29	0.98
11/03/2019 5:24	1042.95	28.283	0.98
11/03/2019 5:30	1043.65	28.29	0.98
11/03/2019 5:36	1044.058	28.29	0.98
11/03/2019 5:42	1044.758	28.29	0.98
11/03/2019 5:48	1045.633	28.293	0.98
11/03/2019 5:54	1046.333	28.29	0.98
11/03/2019 6:00	1047.033	28.293	0.98
11/03/2019 6:06	1047.908	28.29	0.98
11/03/2019 6:12	1048.783	28.29	0.98
11/03/2019 6:18	1049.95	28.29	0.98
11/03/2019 6:24	1050.825	28.29	0.98
11/03/2019 6:30	1051.992	28.29	0.98
11/03/2019 6:36	1052.4	28.29	0.98
11/03/2019 6:42	1052.867	28.297	0.98
11/03/2019 6:48	1052.867	28.31	0.98
11/03/2019 6:54	1053.742	28.31	0.98
11/03/2019 7:00	1054.908	28.313	0.98
11/03/2019 7:06	1056.25	28.323	0.98
11/03/2019 7:12	1057.358	28.317	0.98
11/03/2019 7:18	1058.058	28.32	0.984
11/03/2019 7:24	1059.167	28.323	0.984
11/03/2019 7:30	1060.1	28.327	0.984
11/03/2019 7:36	1060.508	28.33	0.984
11/03/2019 7:42	1060.975	28.34	0.988
11/03/2019 7:48	1062.083	28.347	0.992
11/03/2019 7:54	1062.783	28.35	0.996
11/03/2019 8:00	1063.483	28.343	0.996
11/03/2019 8:06	1064.125	28.333	0.996
11/03/2019 8:12	1064.825	28.337	0.996
11/03/2019 8:18	1065.7	28.34	0.996
11/03/2019 8:24	1066.167	28.333	0.996

ANNEX A3.3. KUC Manneaba community well, Buariki

DATE TIME	Pressure[cm]	Temperature[°C]	2:Spec.cond.[mS/cm]
5/03/2019 17:24	1103.033	28.37	1.232
5/03/2019 17:30	1103.208	28.307	1.231
5/03/2019 17:36	1103.325	28.3	1.224
5/03/2019 17:42	1103.325	28.3	1.218
5/03/2019 17:48	1103.325	28.297	1.218
5/03/2019 17:54	1103.325	28.297	1.199
5/03/2019 18:00	1102.858	28.297	1.19
5/03/2019 18:06	1102.567	28.3	1.187
5/03/2019 18:12	1102.1	28.303	1.185
5/03/2019 18:18	1101.633	28.3	1.185
5/03/2019 18:24	1101.05	28.3	1.184
5/03/2019 18:30	1100.292	28.297	1.183
5/03/2019 18:36	1099.533	28.3	1.179
5/03/2019 18:42	1098.483	28.3	1.178
5/03/2019 18:48	1097.55	28.3	1.176
5/03/2019 18:54	1096.383	28.3	1.175
5/03/2019 19:00	1095.333	28.3	1.173
5/03/2019 19:06	1094.283	28.303	1.17
5/03/2019 19:12	1092.592	28.307	1.168
5/03/2019 19:18	1091.425	28.303	1.164
5/03/2019 19:24	1089.792	28.303	1.16
5/03/2019 19:30	1087.983	28.307	1.156
5/03/2019 19:36	1086.467	28.307	1.153
5/03/2019 19:42	1084.658	28.307	1.15
5/03/2019 19:48	1083.025	28.31	1.148
5/03/2019 19:54	1081.508	28.31	1.146
5/03/2019 20:00	1079.7	28.31	1.144
5/03/2019 20:06	1078.533	28.313	1.141
5/03/2019 20:12	1076.842	28.313	1.139
5/03/2019 20:18	1075.208	28.313	1.137
5/03/2019 20:24	1073.4	28.317	1.135
5/03/2019 20:30	1071.942	28.317	1.134
5/03/2019 20:36	1070.425	28.317	1.131
5/03/2019 20:42	1069.083	28.317	1.129
5/03/2019 20:48	1067.742	28.317	1.127
5/03/2019 20:54	1066.517	28.317	1.124
5/03/2019 21:00	1065.467	28.32	1.122
5/03/2019 21:06	1064.592	28.32	1.119
5/03/2019 21:12	1064.125	28.32	1.117
5/03/2019 21:18	1063.367	28.32	1.115
5/03/2019 21:24	1062.492	28.323	1.114
5/03/2019 21:30	1062.025	28.32	1.121
5/03/2019 21:36	1061.267	28.327	1.118
5/03/2019 21:42	1060.508	28.323	1.113
5/03/2019 21:48	1060.042	28.32	1.106
5/03/2019 21:54	1059.342	28.317	1.1
5/03/2019 22:00	1058.583	28.31	1.092
5/03/2019 22:06	1058	28.3	1.082
5/03/2019 22:12	1057.358	28.29	1.071
5/03/2019 22:18	1056.892	28.273	1.062
5/03/2019 22:24	1056.308	28.26	1.039
5/03/2019 22:30	1056.017	28.237	1.025
5/03/2019 22:36	1055.608	28.22	1.01
5/03/2019 22:42	1055.142	28.2	0.975
5/03/2019 22:48	1054.675	28.183	0.958
5/03/2019 22:54	1053.917	28.18	0.957
5/03/2019 23:00	1053.625	28.173	0.957

5/03/2019 23:06	1053.042	28.163	0.957
5/03/2019 23:12	1052.75	28.16	0.956
5/03/2019 23:18	1052.108	28.16	0.957
5/03/2019 23:24	1051.525	28.153	0.957
5/03/2019 23:30	1050.942	28.147	0.957
5/03/2019 23:36	1050.475	28.143	0.958
5/03/2019 23:42	1049.892	28.14	0.958
5/03/2019 23:48	1049.25	28.133	0.958
5/03/2019 23:54	1048.842	28.13	0.958
6/03/2019 0:00	1048.2	28.127	0.964
6/03/2019 0:06	1047.908	28.123	0.964
6/03/2019 0:12	1047.325	28.117	0.964
6/03/2019 0:18	1046.858	28.117	0.964
6/03/2019 0:24	1046.392	28.113	0.964
6/03/2019 0:30	1045.983	28.103	0.964
6/03/2019 0:36	1045.692	28.097	0.964
6/03/2019 0:42	1045.225	28.1	0.964
6/03/2019 0:48	1045.05	28.097	0.964
6/03/2019 0:54	1044.758	28.093	0.965
6/03/2019 1:00	1044.758	28.083	0.966
6/03/2019 1:06	1044.35	28.083	0.967
6/03/2019 1:12	1044.175	28.08	0.967
6/03/2019 1:18	1044.175	28.077	0.967
6/03/2019 1:24	1044	28.07	0.967
6/03/2019 1:30	1043.883	28.073	0.968
6/03/2019 1:36	1044.175	28.063	0.969
6/03/2019 1:42	1044.175	28.06	0.969
6/03/2019 1:48	1044.35	28.063	0.969
6/03/2019 1:54	1044.642	28.06	0.969
6/03/2019 2:00	1045.05	28.05	0.97
6/03/2019 2:06	1045.517	28.05	0.97
6/03/2019 2:12	1045.983	28.053	0.97
6/03/2019 2:18	1046.392	28.05	0.971
6/03/2019 2:24	1047.033	28.047	0.971
6/03/2019 2:30	1047.617	28.043	0.972
6/03/2019 2:36	1048.258	28.043	0.972
6/03/2019 2:42	1048.958	28.033	0.973
6/03/2019 2:48	1049.717	28.03	0.974
6/03/2019 2:54	1050.183	28.023	0.975
6/03/2019 3:00	1051.233	28.02	0.975
6/03/2019 3:06	1052.108	28.017	0.976
6/03/2019 3:12	1053.158	28.017	0.977
6/03/2019 3:18	1054.5	28.013	0.978
6/03/2019 3:24	1055.725	28.047	0.998
6/03/2019 3:30	1057.533	28.09	1.062
6/03/2019 3:36	1059.633	28.097	1.074
6/03/2019 3:42	1063.075	28.097	1.077
6/03/2019 3:48	1067.158	28.103	1.08
6/03/2019 3:54	1070.425	28.12	1.103
6/03/2019 4:00	1073.108	28.14	1.128
6/03/2019 4:06	1075.792	28.147	1.136
6/03/2019 4:12	1077.892	28.147	1.142
6/03/2019 4:18	1080.458	28.15	1.145
6/03/2019 4:24	1082.558	28.16	1.15
6/03/2019 4:30	1084.658	28.167	1.158
6/03/2019 4:36	1086.292	28.167	1.179
6/03/2019 4:42	1088.1	28.173	1.192
6/03/2019 4:48	1089.617	28.173	1.198
6/03/2019 4:54	1090.958	28.177	1.203
6/03/2019 5:00	1092.183	28.177	1.207

6/03/2019 5:06	1093.058	28.18	1.209
6/03/2019 5:12	1093.992	28.18	1.211
6/03/2019 5:18	1094.75	28.18	1.212
6/03/2019 5:24	1095.333	28.18	1.212
6/03/2019 5:30	1095.742	28.177	1.213
6/03/2019 5:36	1096.092	28.177	1.212
6/03/2019 5:42	1096.5	28.173	1.212
6/03/2019 5:48	1096.5	28.177	1.212
6/03/2019 5:54	1096.675	28.173	1.212
6/03/2019 6:00	1096.383	28.17	1.212
6/03/2019 6:06	1096.5	28.173	1.212
6/03/2019 6:12	1096.208	28.177	1.213
6/03/2019 6:18	1095.917	28.173	1.216
6/03/2019 6:24	1095.742	28.173	1.218
6/03/2019 6:30	1095.333	28.167	1.217
6/03/2019 6:36	1094.692	28.167	1.216
6/03/2019 6:42	1093.992	28.163	1.213
6/03/2019 6:48	1093.35	28.16	1.21
6/03/2019 6:54	1092.3	28.157	1.207
6/03/2019 7:00	1091.425	28.153	1.204
6/03/2019 7:06	1090.375	28.153	1.201
6/03/2019 7:12	1089.15	28.15	1.2
6/03/2019 7:18	1088.1	28.143	1.198
6/03/2019 7:24	1086.933	28.143	1.196
6/03/2019 7:30	1085.417	28.14	1.195
6/03/2019 7:36	1084.075	28.14	1.192
6/03/2019 7:42	1082.733	28.137	1.19
6/03/2019 7:48	1081.392	28.133	1.187
6/03/2019 7:54	1079.875	28.13	1.185
6/03/2019 8:00	1078.358	28.123	1.182
6/03/2019 8:06	1077.017	28.12	1.179
6/03/2019 8:12	1075.5	28.117	1.174
6/03/2019 8:18	1074.158	28.113	1.168
6/03/2019 8:24	1072.817	28.107	1.164
6/03/2019 8:30	1071.3	28.1	1.156
6/03/2019 8:36	1070.133	28.097	1.15
6/03/2019 8:42	1069.083	28.087	1.147
6/03/2019 8:48	1067.742	28.09	1.143
6/03/2019 8:54	1066.808	28.087	1.143
6/03/2019 9:00	1065.758	28.08	1.142
6/03/2019 9:06	1065	28.073	1.141
6/03/2019 9:12	1064.242	28.073	1.139
6/03/2019 9:18	1063.542	28.073	1.137
6/03/2019 9:24	1062.783	28.07	1.135
6/03/2019 9:30	1062.025	28.063	1.134
6/03/2019 9:36	1061.442	28.06	1.13
6/03/2019 9:42	1060.683	28.057	1.126
6/03/2019 9:48	1060.217	28.047	1.124
6/03/2019 9:54	1059.633	28.037	1.118
6/03/2019 10:00	1058.875	28.023	1.096
6/03/2019 10:06	1058.292	28.007	1.068
6/03/2019 10:12	1057.533	28.003	1.06
6/03/2019 10:18	1057.067	28	1.059
6/03/2019 10:24	1056.483	27.997	1.057
6/03/2019 10:30	1055.842	28.003	1.054
6/03/2019 10:36	1055.433	28.003	1.053
6/03/2019 10:42	1054.85	27.997	1.052
6/03/2019 10:48	1054.5	27.983	1.051
6/03/2019 10:54	1054.092	27.963	1.035
6/03/2019 11:00	1053.625	27.97	1.034

6/03/2019 11:06	1053.158	27.943	0.996
6/03/2019 11:12	1052.692	27.943	0.997
6/03/2019 11:18	1051.817	27.937	0.987
6/03/2019 11:24	1051.408	27.937	0.983
6/03/2019 11:30	1051.233	27.933	0.98
6/03/2019 11:36	1050.475	27.927	0.981
6/03/2019 11:42	1049.892	27.923	0.98
6/03/2019 11:48	1049.425	27.93	0.98
6/03/2019 11:54	1048.958	27.937	0.979
6/03/2019 12:00	1048.55	27.93	0.98
6/03/2019 12:06	1047.908	27.937	0.98
6/03/2019 12:12	1047.442	27.94	0.98
6/03/2019 12:18	1046.917	27.947	0.98
6/03/2019 12:24	1046.567	27.95	0.98
6/03/2019 12:30	1046.1	27.957	0.98
6/03/2019 12:36	1045.692	27.96	0.981
6/03/2019 12:42	1045.4	27.967	0.981
6/03/2019 12:48	1045.05	27.97	0.981
6/03/2019 12:54	1044.758	27.973	0.981
6/03/2019 13:00	1044.467	27.977	0.982
6/03/2019 13:06	1044.292	27.977	0.982
6/03/2019 13:12	1044.175	27.977	0.982
6/03/2019 13:18	1043.883	27.98	0.983
6/03/2019 13:24	1044.175	27.983	0.983
6/03/2019 13:30	1044.467	27.99	0.982
6/03/2019 13:36	1044.642	27.997	0.982
6/03/2019 13:42	1044.817	28.007	0.983
6/03/2019 13:48	1045.225	28.01	0.983
6/03/2019 13:54	1045.692	28.013	0.984
6/03/2019 14:00	1046.1	28.013	0.984
6/03/2019 14:06	1046.567	28.02	0.984
6/03/2019 14:12	1047.208	28.027	0.985
6/03/2019 14:18	1047.442	28.03	0.985
6/03/2019 14:24	1048.375	28.037	0.985
6/03/2019 14:30	1049.133	28.043	0.987
6/03/2019 14:36	1050.008	28.05	1.01
6/03/2019 14:42	1050.65	28.057	1.028
6/03/2019 14:48	1051.7	28.063	1.037
6/03/2019 14:54	1052.867	28.077	1.045
6/03/2019 15:00	1054.208	28.083	1.05
6/03/2019 15:06	1055.9	28.103	1.068
6/03/2019 15:12	1057.533	28.127	1.12
6/03/2019 15:18	1060.1	28.14	1.13
6/03/2019 15:24	1063.075	28.127	1.134
6/03/2019 15:30	1068.033	28.15	1.135
6/03/2019 15:36	1071.767	28.153	1.135
6/03/2019 15:42	1075.092	28.153	1.136
6/03/2019 15:48	1077.775	28.153	1.136
6/03/2019 15:54	1080.633	28.153	1.137
6/03/2019 16:00	1083.317	28.157	1.138
6/03/2019 16:06	1086	28.157	1.138
6/03/2019 16:12	1088.567	28.157	1.139
6/03/2019 16:18	1090.842	28.16	1.14
6/03/2019 16:24	1093.058	28.157	1.14
6/03/2019 16:30	1095.042	28.16	1.141
6/03/2019 16:36	1096.85	28.16	1.141
6/03/2019 16:42	1098.308	28.16	1.142
6/03/2019 16:48	1099.825	28.16	1.142
6/03/2019 16:54	1100.875	28.16	1.143
6/03/2019 17:00	1102.275	28.16	1.143

6/03/2019 17:06	1103.208	28.16	1.144
6/03/2019 17:12	1104.083	28.163	1.144
6/03/2019 17:18	1104.9	28.16	1.144
6/03/2019 17:24	1105.775	28.16	1.145
6/03/2019 17:30	1106.417	28.16	1.145
6/03/2019 17:36	1107.175	28.16	1.145
6/03/2019 17:42	1107.642	28.163	1.145
6/03/2019 17:48	1108.108	28.16	1.146
6/03/2019 17:54	1108.225	28.163	1.146
6/03/2019 18:00	1108.4	28.163	1.146
6/03/2019 18:06	1108.4	28.163	1.146
6/03/2019 18:12	1108.4	28.163	1.147
6/03/2019 18:18	1108.225	28.163	1.146
6/03/2019 18:24	1107.933	28.163	1.146
6/03/2019 18:30	1107.642	28.163	1.146
6/03/2019 18:36	1107	28.163	1.147
6/03/2019 18:42	1106.417	28.167	1.146
6/03/2019 18:48	1105.775	28.163	1.147
6/03/2019 18:54	1105.192	28.167	1.147
6/03/2019 19:00	1104.258	28.167	1.147
6/03/2019 19:06	1103.325	28.167	1.146
6/03/2019 19:12	1102.275	28.163	1.147
6/03/2019 19:18	1101.342	28.163	1.147
6/03/2019 19:24	1100.292	28.163	1.146
6/03/2019 19:30	1099.358	28.157	1.146
6/03/2019 19:36	1098.192	28.153	1.145
6/03/2019 19:42	1096.792	28.15	1.144
6/03/2019 19:48	1095.042	28.143	1.142
6/03/2019 19:54	1093.058	28.137	1.142
6/03/2019 20:00	1091.133	28.127	1.141
6/03/2019 20:06	1089.325	28.127	1.139
6/03/2019 20:12	1087.517	28.12	1.138
6/03/2019 20:18	1085.708	28.117	1.137
6/03/2019 20:24	1083.9	28.11	1.137
6/03/2019 20:30	1082.267	28.11	1.136
6/03/2019 20:36	1080.458	28.107	1.135
6/03/2019 20:42	1078.825	28.103	1.134
6/03/2019 20:48	1077.192	28.093	1.133
6/03/2019 20:54	1075.5	28.09	1.132
6/03/2019 21:00	1074.042	28.083	1.133
6/03/2019 21:06	1072.525	28.08	1.132
6/03/2019 21:12	1071.592	28.037	1.104
6/03/2019 21:18	1070.425	27.99	1.087
6/03/2019 21:24	1070.25	27.953	1.075
6/03/2019 21:30	1069.492	27.923	1.064
6/03/2019 21:36	1068.325	27.913	1.059
6/03/2019 21:42	1067.1	27.883	1.056
6/03/2019 21:48	1066.225	27.86	1.049
6/03/2019 21:54	1065.467	27.843	1.046
6/03/2019 22:00	1064.883	27.84	1.042
6/03/2019 22:06	1064.125	27.833	1.041
6/03/2019 22:12	1063.367	27.82	1.039
6/03/2019 22:18	1062.783	27.81	1.036
6/03/2019 22:24	1062.317	27.8	1.032
6/03/2019 22:30	1061.733	27.783	1.028
6/03/2019 22:36	1061.733	27.763	1.021
6/03/2019 22:42	1060.975	27.74	1.014
6/03/2019 22:48	1060.683	27.71	1.007
6/03/2019 22:54	1059.925	27.693	1.002
6/03/2019 23:00	1059.342	27.673	0.998

6/03/2019 23:06	1059.167	27.657	0.994
6/03/2019 23:12	1058.875	27.637	0.989
6/03/2019 23:18	1058.292	27.623	0.985
6/03/2019 23:24	1057.708	27.617	0.984
6/03/2019 23:30	1057.067	27.617	0.984
6/03/2019 23:36	1056.483	27.61	0.983
6/03/2019 23:42	1055.9	27.603	0.981
6/03/2019 23:48	1055.433	27.6	0.98
6/03/2019 23:54	1055.142	27.597	0.978
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7/03/2019 0:06	1054.675	27.593	0.977
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7/03/2019 0:18	1054.208	27.583	0.976
7/03/2019 0:24	1053.917	27.58	0.976
7/03/2019 0:30	1053.625	27.573	0.975
7/03/2019 0:36	1053.508	27.567	0.975
7/03/2019 0:42	1053.158	27.563	0.976
7/03/2019 0:48	1052.75	27.56	0.975
7/03/2019 0:54	1052.75	27.553	0.974
7/03/2019 1:00	1052.458	27.543	0.972
7/03/2019 1:06	1052.108	27.537	0.971
7/03/2019 1:12	1051.992	27.533	0.97
7/03/2019 1:18	1051.7	27.527	0.97
7/03/2019 1:24	1051.7	27.523	0.969
7/03/2019 1:30	1051.525	27.517	0.969
7/03/2019 1:36	1051.525	27.517	0.969
7/03/2019 1:42	1051.7	27.51	0.97
7/03/2019 1:48	1051.7	27.507	0.97
7/03/2019 1:54	1051.817	27.5	0.97
7/03/2019 2:00	1052.283	27.497	0.97
7/03/2019 2:06	1052.75	27.493	0.97
7/03/2019 2:12	1052.867	27.49	0.97
7/03/2019 2:18	1053.508	27.49	0.97
7/03/2019 2:24	1054.208	27.483	0.97
7/03/2019 2:30	1055.258	27.483	0.97
7/03/2019 2:36	1056.775	27.48	0.971
7/03/2019 2:42	1058.292	27.48	0.971
7/03/2019 2:48	1059.808	27.483	0.972
7/03/2019 2:54	1061.267	27.483	0.973
7/03/2019 3:00	1062.958	27.493	0.979
7/03/2019 3:06	1064.708	27.5	0.985
7/03/2019 3:12	1067.392	27.497	0.987
7/03/2019 3:18	1069.842	27.507	0.99
7/03/2019 3:24	1072.525	27.51	0.993
7/03/2019 3:30	1075.383	27.51	0.994
7/03/2019 3:36	1078.067	27.523	0.995
7/03/2019 3:42	1080.633	27.533	0.998
7/03/2019 3:48	1083.492	27.537	1.002
7/03/2019 3:54	1085.708	27.537	1.003
7/03/2019 4:00	1088.1	27.547	1.005
7/03/2019 4:06	1090.083	27.553	1.007
7/03/2019 4:12	1092.008	27.567	1.009
7/03/2019 4:18	1093.7	27.57	1.012
7/03/2019 4:24	1095.742	27.577	1.014
7/03/2019 4:30	1097.433	27.577	1.016
7/03/2019 4:36	1098.775	27.577	1.016
7/03/2019 4:42	1100	27.573	1.017
7/03/2019 4:48	1101.342	27.57	1.016
7/03/2019 4:54	1102.742	27.567	1.015
7/03/2019 5:00	1104.433	27.567	1.014

7/03/2019 5:06	1105.95	27.567	1.013
7/03/2019 5:12	1108.4	27.56	1.015
7/03/2019 5:18	1112.542	27.59	1.039
7/03/2019 5:24	1117.15	27.55	1.034
7/03/2019 5:30	1121	27.21	0.877
7/03/2019 5:36	1123.45	27.097	0.829
7/03/2019 5:42	1126.367	27	0.804
7/03/2019 5:48	1129.575	26.817	0.753
7/03/2019 5:54	1130.917	26.723	0.729
7/03/2019 6:00	1132.025	26.643	0.714
7/03/2019 6:06	1132.492	26.553	0.684
7/03/2019 6:12	1132.9	26.513	0.679
7/03/2019 6:18	1133.075	26.457	0.659
7/03/2019 6:24	1133.25	26.423	0.652
7/03/2019 6:30	1133.542	26.383	0.64
7/03/2019 6:36	1133.367	26.34	0.632
7/03/2019 6:42	1133.367	26.26	0.615
7/03/2019 6:48	1133.367	26.2	0.586
7/03/2019 6:54	1133.25	26.157	0.582
7/03/2019 7:00	1133.25	26.123	0.561
7/03/2019 7:06	1132.9	26.073	0.55
7/03/2019 7:12	1132.608	26.043	0.546
7/03/2019 7:18	1132.317	25.983	0.53
7/03/2019 7:24	1131.85	25.95	0.514
7/03/2019 7:30	1131.383	25.89	0.5
7/03/2019 7:36	1130.917	25.847	0.482
7/03/2019 7:42	1129.575	25.793	0.462
7/03/2019 7:48	1129.692	25.713	0.439
7/03/2019 7:54	1128.933	25.673	0.432
7/03/2019 8:00	1128.467	25.613	0.413
7/03/2019 8:06	1127.883	25.573	0.401
7/03/2019 8:12	1127.067	25.53	0.385
7/03/2019 8:18	1126.658	25.47	0.361
7/03/2019 8:24	1125.725	25.45	0.356
7/03/2019 8:30	1124.617	25.397	0.349
7/03/2019 8:36	1122.983	25.38	0.335
7/03/2019 8:42	1120.183	25.353	0.329
7/03/2019 8:48	1115.458	25.357	0.326
7/03/2019 8:54	1111.025	25.363	0.324
7/03/2019 9:00	1107	25.37	0.324
7/03/2019 9:06	1103.5	25.383	0.326
7/03/2019 9:12	1100.117	25.39	0.327
7/03/2019 9:18	1096.85	25.39	0.327
7/03/2019 9:24	1093.7	25.397	0.326
7/03/2019 9:30	1091.25	25.4	0.326
7/03/2019 9:36	1089.15	25.407	0.326
7/03/2019 9:42	1086.933	25.413	0.327
7/03/2019 9:48	1085.008	25.42	0.326
7/03/2019 9:54	1083.2	25.427	0.327
7/03/2019 10:00	1081.508	25.433	0.327
7/03/2019 10:06	1079.467	25.437	0.327
7/03/2019 10:12	1077.658	25.443	0.327
7/03/2019 10:18	1076.142	25.45	0.327
7/03/2019 10:24	1074.508	25.457	0.327
7/03/2019 10:30	1072.875	25.463	0.327
7/03/2019 10:36	1071.65	25.467	0.327
7/03/2019 10:42	1070.308	25.473	0.326
7/03/2019 10:48	1068.208	25.483	0.327
7/03/2019 10:54	1067.45	25.49	0.326
7/03/2019 11:00	1066.692	25.5	0.327

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7/03/2019 11:12	1064.767	25.51	0.327
7/03/2019 11:18	1063.833	25.517	0.327
7/03/2019 11:24	1062.958	25.523	0.327
7/03/2019 11:30	1062.375	25.527	0.327
7/03/2019 11:36	1061.617	25.533	0.327
7/03/2019 11:42	1060.858	25.537	0.327
7/03/2019 11:48	1060.1	25.543	0.327
7/03/2019 11:54	1059.633	25.547	0.327
7/03/2019 12:00	1059.225	25.553	0.327
7/03/2019 12:06	1058.875	25.56	0.327
7/03/2019 12:12	1058.758	25.563	0.327
7/03/2019 12:18	1058.467	25.567	0.327
7/03/2019 12:24	1058.175	25.573	0.327
7/03/2019 12:30	1058.175	25.577	0.327
7/03/2019 12:36	1058.175	25.583	0.327
7/03/2019 12:42	1058	25.587	0.327
7/03/2019 12:48	1058.175	25.59	0.327
7/03/2019 12:54	1058.175	25.593	0.327
7/03/2019 13:00	1058.467	25.6	0.327
7/03/2019 13:06	1058.758	25.603	0.328
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7/03/2019 13:18	1059.517	25.61	0.328
7/03/2019 13:24	1059.925	25.613	0.328
7/03/2019 13:30	1060.683	25.617	0.328
7/03/2019 13:36	1061.617	25.617	0.328
7/03/2019 13:42	1062.375	25.62	0.328
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7/03/2019 13:54	1064.475	25.62	0.329
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7/03/2019 14:06	1067.275	25.623	0.329
7/03/2019 14:12	1068.792	25.627	0.329
7/03/2019 14:18	1070.017	25.627	0.329
7/03/2019 14:24	1071.65	25.627	0.329
7/03/2019 14:30	1073.283	25.627	0.33
7/03/2019 14:36	1075.092	25.63	0.329
7/03/2019 14:42	1076.725	25.64	0.33
7/03/2019 14:48	1078.358	25.65	0.331
7/03/2019 14:54	1080.167	25.657	0.332
7/03/2019 15:00	1081.975	25.66	0.335
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7/03/2019 15:12	1085.592	25.667	0.341
7/03/2019 15:18	1087.517	25.673	0.343
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7/03/2019 15:30	1090.958	25.68	0.346
7/03/2019 15:36	1092.942	25.69	0.348
7/03/2019 15:42	1094.4	25.697	0.351
7/03/2019 15:48	1096.383	25.703	0.354
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7/03/2019 16:00	1099.533	25.713	0.36
7/03/2019 16:06	1101.225	25.713	0.362
7/03/2019 16:12	1102.858	25.717	0.364
7/03/2019 16:18	1104.55	25.72	0.366
7/03/2019 16:24	1106.242	25.727	0.368
7/03/2019 16:30	1107.642	25.733	0.37
7/03/2019 16:36	1109.333	25.737	0.372
7/03/2019 16:42	1110.675	25.74	0.374
7/03/2019 16:48	1112.075	25.747	0.376
7/03/2019 16:54	1113.3	25.75	0.378
7/03/2019 17:00	1114.525	25.757	0.38

7/03/2019 17:06	1115.633	25.757	0.382
7/03/2019 17:12	1116.508	25.763	0.385
7/03/2019 17:18	1117.442	25.77	0.386
7/03/2019 17:24	1117.908	25.777	0.388
7/03/2019 17:30	1118.55	25.783	0.39
7/03/2019 17:36	1119.133	25.79	0.392
7/03/2019 17:42	1119.6	25.793	0.394
7/03/2019 17:48	1119.892	25.797	0.396
7/03/2019 17:54	1120.183	25.8	0.397
7/03/2019 18:00	1120.825	25.803	0.399
7/03/2019 18:06	1120.65	25.807	0.401
7/03/2019 18:12	1120.825	25.81	0.402
7/03/2019 18:18	1120.942	25.813	0.403
7/03/2019 18:24	1120.825	25.817	0.404
7/03/2019 18:30	1120.825	25.82	0.405
7/03/2019 18:36	1120.358	25.823	0.406
7/03/2019 18:42	1120.358	25.83	0.407
7/03/2019 18:48	1119.892	25.833	0.407
7/03/2019 18:54	1119.425	25.84	0.408
7/03/2019 19:00	1119.133	25.847	0.409
7/03/2019 19:06	1118.667	25.853	0.41
7/03/2019 19:12	1117.733	25.86	0.411
7/03/2019 19:18	1116.975	25.867	0.412
7/03/2019 19:24	1116.042	25.873	0.414
7/03/2019 19:30	1115.458	25.88	0.415
7/03/2019 19:36	1114.058	25.887	0.415
7/03/2019 19:42	1113.183	25.893	0.416
7/03/2019 19:48	1111.783	25.9	0.417
7/03/2019 19:54	1110.675	25.91	0.417
7/03/2019 20:00	1109.333	25.917	0.418
7/03/2019 20:06	1107.817	25.927	0.419
7/03/2019 20:12	1106.242	25.933	0.42
7/03/2019 20:18	1104.725	25.94	0.42
7/03/2019 20:24	1102.858	25.947	0.421
7/03/2019 20:30	1101.342	25.957	0.422
7/03/2019 20:36	1099.358	25.963	0.422
7/03/2019 20:42	1097.55	25.973	0.423
7/03/2019 20:48	1095.8	25.98	0.423
7/03/2019 20:54	1093.992	25.99	0.423
7/03/2019 21:00	1091.892	26.003	0.423
7/03/2019 21:06	1090.083	26.01	0.424
7/03/2019 21:12	1088.158	26.02	0.424
7/03/2019 21:18	1086.175	26.03	0.425
7/03/2019 21:24	1084.367	26.04	0.425
7/03/2019 21:30	1082.558	26.05	0.425
7/03/2019 21:36	1080.75	26.06	0.425
7/03/2019 21:42	1079	26.07	0.426
7/03/2019 21:48	1077.017	26.08	0.426
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9/03/2019 9:18	1087.4	27.047	0.589
9/03/2019 9:24	1085.592	27.053	0.588
9/03/2019 9:30	1083.783	27.06	0.587
9/03/2019 9:36	1081.975	27.067	0.586
9/03/2019 9:42	1080.342	27.073	0.586
9/03/2019 9:48	1078.825	27.08	0.585
9/03/2019 9:54	1077.017	27.09	0.584
9/03/2019 10:00	1075.383	27.093	0.578
9/03/2019 10:06	1073.692	27.103	0.572
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9/03/2019 10:18	1070.6	27.117	0.567
9/03/2019 10:24	1068.908	27.127	0.566
9/03/2019 10:30	1067.275	27.137	0.565
9/03/2019 10:36	1066.05	27.147	0.565
9/03/2019 10:42	1065	27.163	0.564
9/03/2019 10:48	1064.125	27.18	0.564
9/03/2019 10:54	1063.075	27.197	0.564
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9/03/2019 16:36	1068.033	27.383	0.565
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9/03/2019 17:24	1088.567	27.34	0.648
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9/03/2019 17:36	1092.65	27.333	0.651
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9/03/2019 17:48	1096.208	27.323	0.654
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9/03/2019 18:42	1106.242	27.3	0.678
9/03/2019 18:48	1106.883	27.3	0.68
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9/03/2019 21:18	1090.958	27.347	0.674
9/03/2019 21:24	1089.325	27.35	0.672
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9/03/2019 21:36	1086	27.36	0.666
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9/03/2019 22:24	1072.817	27.397	0.661
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9/03/2019 22:36	1069.958	27.403	0.659
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9/03/2019 22:48	1067.158	27.41	0.654
9/03/2019 22:54	1066.05	27.42	0.651
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9/03/2019 23:48	1058.117	27.497	0.604
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10/03/2019 5:42	1083.783	27.35	0.677
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10/03/2019 6:42	1100.758	27.337	0.737
10/03/2019 6:48	1101.808	27.337	0.74
10/03/2019 6:54	1102.742	27.337	0.742
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10/03/2019 12:18	1056.95	27.733	0.628
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10/03/2019 12:36	1055.258	27.767	0.625
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10/03/2019 17:18	1069.55	27.733	0.663
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10/03/2019 17:48	1081.975	27.713	0.782
10/03/2019 17:54	1083.9	27.71	0.784
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10/03/2019 18:12	1089.908	27.693	0.786
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10/03/2019 18:48	1098.775	27.673	0.795
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10/03/2019 19:00	1100.875	27.67	0.799
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10/03/2019 19:18	1102.858	27.663	0.804
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10/03/2019 19:36	1104.258	27.66	0.808
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10/03/2019 20:18	1104.433	27.66	0.812
10/03/2019 20:24	1104.083	27.66	0.812
10/03/2019 20:30	1103.325	27.663	0.812
10/03/2019 20:36	1102.858	27.66	0.812
10/03/2019 20:42	1102.1	27.663	0.812
10/03/2019 20:48	1101.517	27.667	0.811
10/03/2019 20:54	1100.583	27.667	0.81
10/03/2019 21:00	1099.65	27.667	0.81
10/03/2019 21:06	1098.892	27.67	0.809
10/03/2019 21:12	1097.55	27.673	0.807
10/03/2019 21:18	1096.383	27.673	0.806
10/03/2019 21:24	1094.867	27.677	0.805
10/03/2019 21:30	1093.525	27.68	0.805
10/03/2019 21:36	1092.008	27.683	0.804
10/03/2019 21:42	1090.375	27.683	0.803
10/03/2019 21:48	1089.033	27.69	0.802
10/03/2019 21:54	1087.517	27.69	0.802
10/03/2019 22:00	1086.175	27.697	0.801
10/03/2019 22:06	1084.367	27.7	0.801
10/03/2019 22:12	1083.025	27.703	0.801
10/03/2019 22:18	1081.508	27.703	0.8
10/03/2019 22:24	1079.875	27.703	0.8
10/03/2019 22:30	1078.358	27.703	0.799
10/03/2019 22:36	1076.842	27.703	0.798
10/03/2019 22:42	1075.383	27.703	0.797
10/03/2019 22:48	1073.575	27.7	0.796
10/03/2019 22:54	1072.35	27.697	0.795
10/03/2019 23:00	1070.717	27.693	0.793

10/03/2019 23:06	1069.492	27.693	0.792
10/03/2019 23:12	1068.325	27.69	0.788
10/03/2019 23:18	1067.158	27.68	0.781
10/03/2019 23:24	1066.108	27.677	0.759
10/03/2019 23:30	1065.175	27.667	0.695
10/03/2019 23:36	1064.242	27.653	0.658
10/03/2019 23:42	1063.367	27.65	0.652
10/03/2019 23:48	1062.608	27.647	0.65
10/03/2019 23:54	1061.733	27.65	0.65
11/03/2019 0:00	1060.858	27.647	0.65
11/03/2019 0:06	1060.1	27.64	0.65
11/03/2019 0:12	1059.458	27.64	0.65
11/03/2019 0:18	1059.05	27.64	0.65
11/03/2019 0:24	1058.408	27.633	0.65
11/03/2019 0:30	1057.825	27.633	0.65
11/03/2019 0:36	1057.067	27.63	0.649
11/03/2019 0:42	1056.658	27.627	0.649
11/03/2019 0:48	1056.308	27.62	0.649
11/03/2019 0:54	1056.017	27.62	0.649
11/03/2019 1:00	1055.725	27.613	0.649
11/03/2019 1:06	1055.433	27.613	0.65
11/03/2019 1:12	1055.142	27.607	0.65
11/03/2019 1:18	1054.558	27.607	0.65
11/03/2019 1:24	1054.092	27.603	0.65
11/03/2019 1:30	1053.625	27.603	0.65
11/03/2019 1:36	1053.333	27.6	0.65
11/03/2019 1:42	1053.042	27.593	0.65
11/03/2019 1:48	1052.575	27.59	0.65
11/03/2019 1:54	1052.283	27.58	0.65
11/03/2019 2:00	1051.817	27.58	0.65
11/03/2019 2:06	1051.525	27.58	0.65
11/03/2019 2:12	1051.233	27.573	0.65
11/03/2019 2:18	1050.767	27.567	0.65
11/03/2019 2:24	1050.475	27.567	0.65
11/03/2019 2:30	1050.008	27.563	0.65
11/03/2019 2:36	1049.717	27.563	0.65
11/03/2019 2:42	1049.308	27.56	0.65
11/03/2019 2:48	1048.958	27.557	0.65
11/03/2019 2:54	1048.667	27.557	0.651
11/03/2019 3:00	1048.375	27.55	0.651
11/03/2019 3:06	1048.258	27.55	0.651
11/03/2019 3:12	1048.083	27.547	0.651
11/03/2019 3:18	1048.258	27.543	0.651
11/03/2019 3:24	1048.375	27.54	0.651
11/03/2019 3:30	1048.375	27.537	0.651
11/03/2019 3:36	1048.492	27.537	0.651
11/03/2019 3:42	1048.55	27.53	0.651
11/03/2019 3:48	1048.842	27.53	0.651
11/03/2019 3:54	1049.308	27.53	0.651
11/03/2019 4:00	1049.425	27.523	0.651
11/03/2019 4:06	1049.892	27.52	0.651
11/03/2019 4:12	1050.183	27.517	0.651
11/03/2019 4:18	1050.65	27.52	0.651
11/03/2019 4:24	1051.233	27.517	0.651
11/03/2019 4:30	1051.817	27.51	0.652
11/03/2019 4:36	1052.575	27.51	0.652
11/03/2019 4:42	1053.042	27.5	0.652
11/03/2019 4:48	1054.092	27.497	0.652
11/03/2019 4:54	1055.142	27.497	0.652
11/03/2019 5:00	1056.483	27.49	0.652

11/03/2019 5:06	1057.825	27.487	0.653
11/03/2019 5:12	1059.342	27.483	0.653
11/03/2019 5:18	1060.8	27.48	0.653
11/03/2019 5:24	1062.958	27.47	0.653
11/03/2019 5:30	1065.35	27.5	0.693
11/03/2019 5:36	1068.792	27.53	0.752
11/03/2019 5:42	1071.767	27.537	0.763
11/03/2019 5:48	1074.8	27.547	0.767
11/03/2019 5:54	1077.192	27.553	0.77
11/03/2019 6:00	1079.408	27.55	0.772
11/03/2019 6:06	1081.683	27.547	0.773
11/03/2019 6:12	1083.783	27.547	0.775
11/03/2019 6:18	1085.708	27.547	0.776
11/03/2019 6:24	1087.692	27.543	0.778
11/03/2019 6:30	1089.325	27.54	0.779
11/03/2019 6:36	1091.25	27.543	0.781
11/03/2019 6:42	1092.942	27.547	0.793
11/03/2019 6:48	1094.4	27.55	0.799
11/03/2019 6:54	1095.8	27.55	0.804
11/03/2019 7:00	1096.967	27.55	0.807
11/03/2019 7:06	1098.192	27.55	0.808
11/03/2019 7:12	1099.242	27.55	0.81
11/03/2019 7:18	1100.117	27.553	0.813
11/03/2019 7:24	1100.875	27.557	0.821
11/03/2019 7:30	1101.517	27.557	0.829
11/03/2019 7:36	1102.1	27.56	0.834
11/03/2019 7:42	1102.742	27.563	0.838
11/03/2019 7:48	1103.325	27.563	0.841
11/03/2019 7:54	1103.675	27.567	0.842
11/03/2019 8:00	1103.967	27.567	0.844
11/03/2019 8:06	1104.083	27.567	0.845
11/03/2019 8:12	1104.083	27.567	0.846
11/03/2019 8:18	1104.083	27.567	0.847
11/03/2019 8:24	1104.083	27.567	0.848
11/03/2019 8:30	1103.792	27.567	0.849
11/03/2019 8:36	1103.5	27.567	0.849
11/03/2019 8:42	1102.858	27.57	0.85
11/03/2019 8:48	1102.567	27.57	0.85
11/03/2019 8:54	1101.983	27.57	0.851
11/03/2019 9:00	1101.225	27.57	0.851
11/03/2019 9:06	1100.408	27.57	0.852
11/03/2019 9:12	1099.533	27.57	0.852
11/03/2019 9:18	1098.6	27.573	0.852
11/03/2019 9:24	1097.55	27.573	0.852
11/03/2019 9:30	1096.5	27.573	0.853
11/03/2019 9:36	1095.333	27.573	0.853
11/03/2019 9:42	1094.108	27.573	0.853
11/03/2019 9:48	1092.767	27.573	0.852
11/03/2019 9:54	1091.425	27.573	0.851
11/03/2019 10:00	1089.908	27.573	0.847
11/03/2019 10:06	1088.45	27.573	0.843
11/03/2019 10:12	1086.933	27.573	0.839
11/03/2019 10:18	1085.592	27.573	0.837
11/03/2019 10:24	1084.192	27.577	0.836
11/03/2019 10:30	1082.558	27.58	0.836
11/03/2019 10:36	1081.1	27.58	0.831
11/03/2019 10:42	1079.7	27.58	0.815
11/03/2019 10:48	1078.242	27.58	0.81
11/03/2019 10:54	1076.725	27.583	0.807
11/03/2019 11:00	1075.383	27.59	0.805

11/03/2019 11:06	1073.867	27.597	0.804
11/03/2019 11:12	1072.525	27.607	0.802
11/03/2019 11:18	1071.475	27.61	0.801
11/03/2019 11:24	1070.133	27.62	0.799
11/03/2019 11:30	1068.908	27.647	0.799
11/03/2019 11:36	1067.742	27.703	0.8
11/03/2019 11:42	1066.692	27.68	0.8
11/03/2019 11:48	1065.758	27.673	0.8
11/03/2019 11:54	1065.175	27.677	0.8
11/03/2019 12:00	1064.242	27.687	0.8
11/03/2019 12:06	1063.25	27.707	0.8
11/03/2019 12:12	1062.317	27.733	0.799
11/03/2019 12:18	1061.558	27.757	0.798
11/03/2019 12:24	1060.858	27.77	0.799
11/03/2019 12:30	1060.1	27.77	0.8
11/03/2019 12:36	1059.458	27.763	0.796
11/03/2019 12:42	1058.875	27.757	0.757
11/03/2019 12:48	1058.117	27.76	0.718
11/03/2019 12:54	1057.708	27.76	0.696
11/03/2019 13:00	1057.242	27.763	0.687
11/03/2019 13:06	1056.6	27.763	0.684
11/03/2019 13:12	1056.017	27.77	0.683
11/03/2019 13:18	1055.433	27.773	0.682
11/03/2019 13:24	1054.85	27.777	0.68
11/03/2019 13:30	1054.383	27.783	0.68
11/03/2019 13:36	1054.383	27.79	0.679
11/03/2019 13:42	1053.917	27.79	0.679
11/03/2019 13:48	1053.742	27.797	0.679
11/03/2019 13:54	1053.158	27.8	0.679
11/03/2019 14:00	1052.867	27.803	0.679
11/03/2019 14:06	1052.692	27.807	0.678
11/03/2019 14:12	1052.283	27.81	0.678
11/03/2019 14:18	1052.108	27.81	0.678
11/03/2019 14:24	1051.992	27.813	0.678
11/03/2019 14:30	1051.642	27.817	0.678
11/03/2019 14:36	1051.525	27.817	0.678
11/03/2019 14:42	1051.058	27.82	0.678
11/03/2019 14:48	1050.942	27.82	0.678
11/03/2019 14:54	1050.767	27.823	0.678
11/03/2019 15:00	1050.65	27.827	0.678
11/03/2019 15:06	1050.767	27.83	0.677
11/03/2019 15:12	1050.65	27.83	0.677
11/03/2019 15:18	1050.475	27.83	0.677
11/03/2019 15:24	1050.65	27.83	0.677
11/03/2019 15:30	1050.592	27.833	0.677
11/03/2019 15:36	1050.592	27.833	0.677
11/03/2019 15:42	1050.592	27.833	0.677
11/03/2019 15:48	1050.65	27.837	0.677
11/03/2019 15:54	1050.942	27.833	0.677
11/03/2019 16:00	1051.408	27.83	0.677
11/03/2019 16:06	1051.7	27.83	0.677
11/03/2019 16:12	1051.992	27.83	0.677
11/03/2019 16:18	1052.458	27.83	0.677
11/03/2019 16:24	1053.042	27.823	0.678
11/03/2019 16:30	1053.45	27.823	0.678
11/03/2019 16:36	1053.917	27.82	0.678
11/03/2019 16:42	1054.967	27.813	0.678
11/03/2019 16:48	1055.9	27.81	0.678
11/03/2019 16:54	1056.775	27.807	0.68
11/03/2019 17:00	1057.825	27.807	0.712

11/03/2019 17:06	1058.583	27.803	0.76
11/03/2019 17:12	1059.925	27.8	0.782
11/03/2019 17:18	1061.558	27.797	0.788
11/03/2019 17:24	1063.25	27.793	0.79
11/03/2019 17:30	1065.642	27.793	0.791
11/03/2019 17:36	1068.325	27.79	0.792
11/03/2019 17:42	1070.308	27.787	0.793
11/03/2019 17:48	1072.233	27.787	0.793
11/03/2019 17:54	1074.158	27.79	0.794
11/03/2019 18:00	1076.142	27.79	0.799
11/03/2019 18:06	1077.6	27.793	0.817
11/03/2019 18:12	1079.583	27.793	0.843
11/03/2019 18:18	1081.392	27.797	0.856
11/03/2019 18:24	1083.142	27.797	0.861
11/03/2019 18:30	1084.95	27.797	0.867
11/03/2019 18:36	1086.642	27.8	0.875
11/03/2019 18:42	1088.1	27.8	0.882
11/03/2019 18:48	1089.617	27.803	0.887
11/03/2019 18:54	1091.133	27.803	0.89
11/03/2019 19:00	1092.3	27.803	0.894
11/03/2019 19:06	1093.7	27.8	0.899
11/03/2019 19:12	1094.75	27.8	0.903
11/03/2019 19:18	1095.625	27.8	0.906
11/03/2019 19:24	1096.5	27.8	0.908
11/03/2019 19:30	1097.258	27.797	0.91
11/03/2019 19:36	1097.842	27.797	0.911
11/03/2019 19:42	1098.6	27.797	0.912
11/03/2019 19:48	1099.242	27.797	0.913
11/03/2019 19:54	1099.533	27.793	0.914
11/03/2019 20:00	1099.825	27.793	0.914
11/03/2019 20:06	1100	27.793	0.915
11/03/2019 20:12	1100.292	27.793	0.915
11/03/2019 20:18	1100.292	27.793	0.916
11/03/2019 20:24	1100.408	27.79	0.917

ANNEX 4 – EM34 results

Table A4.13. EM34 measurement from the villages

Survey point	Village	10m-HD	20m-HD	Northings	Eastings	10_FW	20_FW	Adopted FW
ONO1x01	Tabuarorae	43.3	83.2	-1.95112	175.5718	1.84	1.09	1.84
ONO1x02	Tabuarorae	26.9	71.5	-1.95137	175.5717	6.24	1.90	6.24
ONO2X01	Tabuarorae	43.1	95.5	-1.95145	175.5707	1.86	0.61	1.86
ONO2X02	Tabuarorae	25.3	53.0	-1.9512	175.5707	7.03	4.54	7.03
ONO2X03	Tabuarorae	24.0	54.0	-1.9586	175.5709	7.74	4.33	7.74
ONO2X04	Tabuarorae	40.5	76.5	-1.95056	175.5711	2.26	1.50	2.26
ONO3X01	Tabuarorae	41.2	81.2	-1.94983	175.5708	2.15	1.20	2.15
ONO3X02	Tabuarorae	39.0	76.2	-1.94997	175.5706	2.53	1.52	2.53
ONO3X03	Tabuarorae	32.5	72.1	-1.95006	175.5703	4.11	1.84	4.11
ONO3X04	Tabuarorae	37.1	62.4	-1.94975	175.5701	2.92	2.91	2.92
ONO3X05	Tabuarorae	36.5	75.0	-1.94991	175.5698	3.05	1.61	3.05
ONO3X06	Tabuarorae	44.4	80.6	-1.94991	175.5694	1.69	1.23	1.69
ONO4X01	Tabuarorae	37.7	70.1	-1.94937	175.5699	2.79	2.03	2.79
ONO4X02	Tabuarorae	38.4	72.1	-1.94926	175.5697	2.65	1.84	2.65
ONO4X03	Tabuarorae	38.8	62.3	-1.94911	175.57	2.57	2.93	2.57
ONO4X04	Tabuarorae	31.1	64.7	-1.94904	175.5703	4.56	2.61	4.56
ONO4X05	Tabuarorae	33.4	70.9	-1.94907	175.5707	3.84	1.95	3.84
ONO5X01	Tabuarorae	48.8	94.6	-1.94729	175.5712	1.22	0.64	1.22
ONO5X02	Tabuarorae	56.4	92.6	-1.94723	175.571	0.69	0.70	0.69
ONO5X03	Tabuarorae	46.1	82.6	-1.94717		1.49	1.12	1.49
ONO5X04	Tabuarorae	45.2	74.4	-1.9472	175.5703	1.59	1.65	1.59
ONO1X01	Tabuarorae	62	113	-1.94182	175.5779	0.46	0.27	0.46
ONO1X02	Tabuarorae	71	137	-1.94162	175.578	0.23	0.09	0.23
ONO1X03	Tabuarorae	80	142	-1.94143	175.578	0.12	0.07	0.12
ONO2X01	Tabuarorae	83	142	-1.94111	175.5788	0.10	0.07	0.10
ONO2X02	Tabuarorae	73	131	-1.94132	175.5788	0.20	0.11	0.20
ONO2X03	Tabuarorae	65	123	-1.9417	175.5787	0.36	0.17	0.36
ONO2X04	Tabuarorae	70	125	-1.94191	175.5788	0.25	0.15	0.25
ONO2X05	Tabuarorae	58	111	-1.9422	175.5787	0.61	0.29	0.61
ONO2X06	Tabuarorae	60	106	-1.94244	175.5787	0.53	0.37	0.53
ONO2X07	Tabuarorae	61	110	-1.94268	175.5788	0.49	0.31	0.49
ONO2X08	Tabuarorae	65	110	-1.94294	175.5786	0.36	0.31	0.36
ONO3X01	Tabuarorae	51	89	-1.94443	175.5799	1.03	0.83	1.03
ONO3X02	Tabuarorae	50	87	-1.94419	175.5799	1.11	0.91	1.11
ONO3X03	Tabuarorae	53	85	-1.94400	175.5798	0.89	1.00	0.89
ONO3X04	Tabuarorae	50	77	-1.94372	175.5797	1.11	1.46	1.11
ONO3X05	Tabuarorae	46	87	-1.94342	175.5797	1.50	0.91	1.50
ONO3X06	Tabuarorae	49	95	-1.94321	175.5798	1.20	0.63	1.20
ONO3X07	Tabuarorae	47	93	-1.94295	175.5798	1.39	0.69	1.39
ONO3X08	Tabuarorae	51	95	-1.94266	175.579	1.03	0.63	1.03
ONO3X09	Tabuarorae	45	93	-1.94239	175.5799	1.62	0.69	1.62

ONO3X10	Tabuarorae	55	103	-1.94213	175.5799	0.77	0.43	0.77
ONO3X11	Tabuarorae	66	107	-1.94186	175.5799	0.34	0.35	0.34
ONO3X12	Tabuarorae	82	123	-1.94163	175.5799	0.10	0.17	0.10
ONO3X13	Tabuarorae	68	109	-1.94134	175.5799	0.29	0.32	0.29
ONO4X01	Aiaki	38	80	-1.96074	175.6155	2.73	1.27	2.73
ONO4X02	Aiaki	30	65	-1.9007	175.6158	4.95	2.58	4.95
ONO4X03	Aiaki	38	72	-1.90063	175.6161	2.73	1.85	2.73
ONO4X04	Aiaki	29	64	-1.90068	175.6627	5.33	2.70	5.33
ONO4X05	Aiaki	24	59	-1.9006	175.6166	7.74	3.42	7.74
ONO4X06	Aiaki	22	56	-1.90058	175.6168	8.99	3.94	3.94
ONO4X07	Aiaki	17	54	-1.90057	175.6171	13.05	4.33	4.33
ONO4X08	Aiaki	22	55	-1.9005	175.6174	8.99	4.13	4.13
ONO4X09	Aiaki	23	58	-1.90041	175.6177	8.34	3.59	3.59
ONO4X10	Aiaki	14	47	-1.9004	175.618	16.32	6.03	6.03
ONO4X11	Aiaki	10	47	-1.90038	175.6182	22.00	6.03	6.03
ONO4X12	Aiaki	13	54	-1.90042	175.6184	17.59	4.33	4.33
ONO5X01	Aiaki	19	66	-1.89749	175.6187	11.24	2.46	2.46
ONO5X02	Aiaki	12	51	-1.89752	175.6185	18.95	4.99	4.99
ONO5X03	Aiaki	8	42	-1.89754	175.6182	25.54	7.64	7.64
ONO5X04	Aiaki	9	41	-1.89755	175.6179	23.70	8.00	8.00
ONO5X05	Aiaki	13	45	-1.89753	175.6177	17.59	6.63	6.63
ONO5X06	Aiaki	20	54	-1.89757	175.6174	10.44	4.33	4.33
ONO5X07	Aiaki	23	55	-1.89757	175.6171	8.34	4.13	4.13
ONO5X08	Aiaki	21	59	-1.8976	175.6169	9.69	3.42	3.42
ONO5X09	Aiaki	28	68	-1.89761	175.6166	5.75	2.24	5.75
ONO5X10	Aiaki	33	69	-1.89752	175.6163	3.96	2.13	3.96
ONO5X11	Aiaki	40	77	-1.89749	175.616	2.35	1.46	2.35
ONO5X12	Aiaki	40	83	-1.89752	175.6158	2.35	1.10	2.35
ONO6X01	Aiaki	50	61	-1.89485	175.6153	1.11	3.11	1.11
ONO6X02	Aiaki	47	96	-1.89471	175.6159	1.39	0.60	1.39
ONO6X03	Aiaki	37	96	-1.8949	175.6158	2.94	0.60	2.94
ONO6X04	Aiaki	23	71	-1.89473	175.6161	8.34	1.94	1.94
ONO6X05	Aiaki	26	65	-1.89468	175.6163	6.67	2.58	6.67
ONO6X06	Aiaki	18	57	-1.89459	175.6166	12.11	3.76	3.76
ONO6X07	Aiaki	15	49	-1.89452	175.6169	15.15	5.49	5.49
ONO6X08	Aiaki	14	49	-1.89452	175.6171	16.32	5.49	5.49
ONO6X09	Aiaki	17	49	-1.89452	175.6174	13.05	5.49	5.49
ONO6X10	Aiaki	17	55	-1.89441	175.6176	13.05	4.13	4.13
ONO6X11	Aiaki	16	57	-1.8943	175.6179	14.06	3.76	3.76
ONO6X12	Aiaki	26	68	-1.8943	175.6181	6.67	2.24	6.67
ONO6X13	Aiaki	27	73	-1.89418	175.6184	6.19	1.77	6.19
ONO6X14	Aiaki	27	78	-1.89412	175.6187	6.19	1.40	6.19
ONO6X15	Aiaki	35	88	-1.894	175.6189	3.41	0.87	3.41
ONO7X01	Aiaki	20	67	-1.89186	175.618	10.44	2.35	2.35
ONO7X02	Aiaki	20	63	-1.89194	175.6178	10.44	2.83	2.83
ONO7X03	Aiaki	14	59	-1.89201	175.6176	16.32	3.42	3.42

ONO7X04	Aiaki	18	58	-1.89213	175.6173	12.11	3.59	3.59
ONO7X05	Aiaki	21	60	-1.8922	175.617	9.69	3.26	3.26
ONO7X06	Aiaki	18	55	-1.89234	175.6168	12.11	4.13	4.13
ONO7X07	Aiaki	17	54	-1.89246	175.6166	13.05	4.33	4.33
ONO7X08	Aiaki	21	59	-1.89261	175.6163	9.69	3.42	3.42
ONO7X09	Aiaki	23	61	-1.89269	175.6161	8.34	3.11	3.11
ONO7X10	Aiaki	18	61	-1.89277	175.6159	12.11	3.11	3.11
ONO7X11	Aiaki	22	65	-1.89286	175.6156	8.99	2.58	2.58
ONO7X12	Aiaki	29	75	-1.8296	175.6154	5.33	1.61	5.33
ONO7X13	Aiaki	37	90	-1.89318	175.6151	2.94	0.79	2.94
ONO7X14	Aiaki	49	102	-1.89331	175.6149	1.20	0.45	1.20
ONO8X01	Aiaki	52	107	-1.89049	175.6144	0.96	0.35	0.96
ONO8X02	Aiaki	45	93	-1.89042	175.6146	1.62	0.69	1.62
ONO8X03	Aiaki	42	90	-1.89042	175.6149	2.02	0.79	2.02
ONO8X04	Aiaki	29	77	-1.89036	175.6152	5.33	1.46	5.33
ONO8X05	Aiaki	26	78	-1.89028	175.6154	6.67	1.40	6.67
ONO8X06	Aiaki	24	69	-1.8901	175.6156	7.74	2.13	7.74
ONO8X07	Aiaki	25	72	-1.89996	175.6158	7.19	1.85	7.19
ONO8X08	Aiaki	26	73	-1.89981	175.6161	6.67	1.77	6.67
ONO8X09	Aiaki	25	73	-1.89969	175.6163	7.19	1.77	7.19
ONO8X10	Aiaki	28	76	-1.89963	175.6166	5.75	1.53	5.75
ONO8X11	Aiaki	30	80	-1.8995	175.6168	4.95	1.27	4.95
ONO8X12	Aiaki	38	87	-1.89931	175.617	2.73	0.91	2.73
ONO8X13	Aiaki	45	95	-1.89914	175.6172	1.62	0.63	1.62
ONO8X14	Aiaki	47	94	-1.89899	175.6175	1.39	0.66	1.39
ONO6X01	Aiaki	56.6	123.5	-1.87577	175.5998	0.68	0.16	0.68
ONO6X02	Aiaki	58.1	122.4	-1.87542	175.5996	0.61	0.17	0.61
ONO6X03	Aiaki	51.4	111.9	-1.87511	175.6	1.00	0.28	1.00
ONO6X04	Aiaki	44.1	97.4	-1.87489	175.6003	1.73	0.56	1.73
ONO6X05	Aiaki	39.5	93.7	-1.87465	175.6005	2.44	0.66	2.44
ONO6X06	Aiaki	37.5	88.2	-1.87433	175.6007	2.83	0.86	2.83
ONO6X07	Aiaki	36.3	88.5	-1.87411	175.601	3.09	0.85	3.09
ONO6X08	Aiaki		83.7	-1.87376	175.6011	46.37	1.07	1.07
ONO6X09	Aiaki	30.2	77.8	-1.87352	175.6014	4.88	1.41	4.88
ONO6X10	Aiaki	25	71.4	-1.87325	175.6016	7.19	1.91	7.19
ONO6X11	Aiaki	30.2	79.3	-1.87303	175.6019	4.88	1.31	4.88
ONO7X01	Aiaki	49.8	112.4	-1.87679	175.6033	1.13	0.27	1.13
ONO7X02	Aiaki	45.7	105.5	-1.87665	175.6034	1.54	0.38	1.54
ONO7X03	Aiaki	47.8	112.1	-1.87635	175.6037	1.31	0.28	1.31
ONO7X04	Aiaki	52	115.2	-1.8761	175.6039	0.96	0.24	0.96
ONO7X05	Aiaki	54.9	114.9	-1.87583	175.6042	0.77	0.24	0.77
ONO7X06	Aiaki	56.1	113.9	-1.87565	175.6045	0.71	0.26	0.71
ONO7X07	Aiaki	55.9	112	-1.87541	175.6047	0.72	0.28	0.72
ONO7X08	Aiaki	51.6	107.7	-1.87516	175.605	0.99	0.34	0.99
ONO7X09	Aiaki	48.5	107.5	-1.87493	175.6052	1.25	0.35	1.25
ONO7X10	Aiaki	54.9	113.8	-1.87467	175.6055	0.77	0.26	0.77

ONO8X01	Aiaki	61.2	115.4	-1.87594	175.6069	0.48	0.24	0.48
ONO8X02	Aiaki	54	110.3	-1.87612	175.6067	0.83	0.30	0.83
ONO8X03	Aiaki	39.6	89.3	-1.87629	175.6064	2.42	0.82	2.42
ONO8X04	Aiaki	38.7	96.2	-1.87648	175.6061	2.59	0.59	2.59
ONO8X05	Aiaki	48.8	99	-1.87663	175.6057	1.22	0.52	1.22
ONO8X06	Aiaki	47.5	104.3	-1.87689	175.6055	1.34	0.40	1.34
ONO8X07	Aiaki	36.1	95.3	-1.87707	175.6052	3.14	0.62	3.14
ONO8X08	Aiaki	41.1	103.3	-1.87737	175.605	2.16	0.42	2.16
ONO8X09	Aiaki	43.7	107.3	-1.87761	175.6047	1.78	0.35	1.78
ONO9X01	Aiaki	49.7	109.8	-1.87959	175.607	1.14	0.31	1.14
ONO9X02	Aiaki	41.7	96.2	-1.87929	175.6073	2.07	0.59	2.07
ONO9X03	Aiaki	52	103.4	-1.87907	175.6075	0.96	0.42	0.96
ONO9X04	Aiaki	49.7	104.9	-1.87889	175.6078	1.14	0.39	1.14
ONO9X05	Aiaki	57.3	109.6	-1.87866	175.6081	0.65	0.31	0.65
ONO9X06	Aiaki	48.4	102.3	-1.8784	175.6083	1.26	0.44	1.26
ONO9X07	Aiaki	42.6	98.1	-1.87827	175.6086	1.93	0.54	1.93
ONO9X08	Aiaki	31.4	83.6	-1.87801	175.6089	4.46	1.07	4.46
ONO10X02	Aiaki	68	118.3	-1.88016	175.6097	0.29	0.21	0.29
ONO10X03	Aiaki	55.3	111.2	-1.88033	175.6095	0.75	0.29	0.75
ONO10X04	Aiaki	42.7	99.4	-1.88056	175.6092	1.92	0.51	1.92
ONO10X05	Aiaki	33.6	80.9	-1.88078	175.6089	3.79	1.22	3.79
ONO10X06	Aiaki	37.6	95.1	-1.88099	175.6086	2.81	0.62	2.81
ONO11X01	Aiaki	50.2	116.7	-1.88455	175.6115	1.10	0.22	1.10
ONO11X02	Aiaki	42.4	107.4	-1.88426	175.6117	1.96	0.35	1.96
ONO11X03	Aiaki	54.6	118.7	-1.8841	175.612	0.79	0.20	0.79
ONO9X01	Tekawa	55	123	-1.804	175.5316	0.77	0.17	0.77
ONO9X02	Tekawa	47	115	-1.80381	175.5318	1.39	0.24	1.39
ONO9X03	Tekawa	68	141	-1.80361	175.532	0.29	0.07	0.29
ONO9X04	Tekawa	72	148	-1.80357	175.5323	0.22	0.05	0.22
ONO9X05	Tekawa	80	152	-1.80327	175.5325	0.12	0.04	0.12
ONO9X06	Tekawa	79	129	-1.80326	175.5327	0.13	0.13	0.13
ONO9X07	Tekawa	58	119	-1.80306	175.5329	0.61	0.20	0.61
ONO9X08	Tekawa	54	113	-1.80286	175.5331	0.83	0.27	0.83
ONO9X09	Tekawa	64	118	-1.8026	175.5332	0.39	0.21	0.39
ONO9X10	Tekawa	67.3	126.8	-1.80238	175.5333	0.31	0.14	0.31
ONO9X11	Tekawa	67.8	121	-1.80213	175.5334	0.30	0.18	0.30
ONO9X12	Tekawa	53.3	113.8	-1.80187	175.5335	0.87	0.26	0.87
ONO9X13	Tekawa	56.8	121	-1.80164	175.5336	0.67	0.18	0.67
ONO9X14	Tekawa	52.8	121	-1.80135	175.5336	0.90	0.18	0.90
ONO9X15	Tekawa	58.4	130.1	-1.80108	175.5337	0.60	0.12	0.60
ONO9X16	Tekawa	57.2	128.2	-1.80081	175.5337	0.65	0.13	0.65
ONO9X17	Tekawa	53.3	117.8	-1.80054	175.5337	0.87	0.21	0.87
ONO9X18	Tekawa	61.8	128.9	-1.80028	175.5337	0.46	0.13	0.46
ONO9X19	Tekawa	75	128	-1.80007	175.5339	0.17	0.13	0.17
ONO9X20	Tekawa	69	130	-1.79987	175.5341	0.27	0.12	0.27
ONO9X21	Tekawa	74	124	-1.79965	175.5342	0.19	0.16	0.19

ONO9X22	Tekawa	47	99	-1.7995	175.5345	1.39	0.52	1.39
ONO9X23	Tekawa	37	89	-1.79931	175.5346	2.94	0.83	2.94
ONO10X01	Tekawa	27	78	-1.80029	175.5377	6.19	1.40	6.19
ONO10X02	Tekawa	19	60	-1.80054	175.5376	11.24	3.26	3.26
ONO10X03	Tekawa	22	56	-1.80076	175.5375	8.99	3.94	3.94
ONO10X04	Tekawa	13	48	-1.80103	175.5374	17.59	5.75	5.75
ONO10X05	Tekawa	11	42	-1.80126	175.5372	20.42	7.64	7.64
ONO10X06	Tekawa	9	35	-1.80151	175.5371	23.70	10.63	10.63
ONO10X07	Tekawa	9	36	-1.80174	175.5379	23.70	10.14	10.14
ONO10X08	Tekawa	7	35	-1.80197	175.5369	27.51	10.63	10.63
ONO10X09	Tekawa	7	31	-1.80219	175.5368	27.51	12.83	12.83
ONO10X10	Tekawa	6	21	-1.80242	175.5367	29.64	20.58	20.58
ONO10X11	Tekawa	6	31	-1.80268	175.5366	29.64	12.83	12.83
ONO10X12	Tekawa	6	29	-1.80292	175.5365	29.64	14.11	14.11
ONO10X13	Tekawa	6	27	-1.80318	175.5364	29.64	15.50	15.50
ONO10X14	Tekawa	7	31	-1.80341	175.5362	27.51	12.83	12.83
ONO10X15	Tekawa	9	33	-1.80364	175.5361	23.70	11.68	11.68
ONO10X16	Tekawa	15	42	-1.80388	175.5359	15.15	7.64	7.64
ONO10X17	Tekawa	18	52	-1.80402	175.5357	12.11	4.76	4.76
ONO10X18	Tekawa	24	57	-1.80419	175.5355	7.74	3.76	7.74
ONO10X19	Tekawa	23	60	-1.8044	175.5353	8.34	3.26	3.26
ONO10X20	Tekawa	27	65	-1.80459	175.5352	6.19	2.58	6.19
ONO10X21	Tekawa	24	66	-1.80483	175.535	7.74	2.46	7.74
ONO10X22	Tekawa	30	75	-1.80508	175.5349	4.95	1.61	4.95
ONO10X23	Tekawa	30	75	-1.80526	175.5347	4.95	1.61	4.95
ONO10X24	Tekawa	31	76	-1.80545	175.5345	4.60	1.53	4.60
ONO10X25	Tekawa	44	89	-1.80557	175.5343	1.74	0.83	1.74
ONO11x01	Tekawa	40	92	-1.8075	175.536	2.35	0.72	2.35
ONO11x02	Tekawa	36	81	-1.80731	175.5362	3.16	1.21	3.16
ONO11x03	Tekawa	30	75	-1.80707	175.5363	4.95	1.61	4.95
ONO11x04	Tekawa	23	61	-1.80689	175.5365	8.34	3.11	3.11
ONO11x05	Tekawa	19	53	-1.80669	175.5366	11.24	4.54	4.54
ONO11x06	Tekawa	18	50	-1.80642	175.5367	12.11	5.23	5.23
ONO11x07	Tekawa	15	46	-1.8062	175.5369	15.15	6.32	6.32
ONO11x08	Tekawa	12	39	-1.80599	175.5371	18.95	8.80	8.80
ONO11x09	Tekawa	8	34	-1.80574	175.5372	25.54	11.14	11.14
ONO11x10	Tekawa	10	37	-1.80548	175.5372	22.00	9.67	9.67
ONO11x11	Tekawa	11	38	-1.80528	175.5374	20.42	9.22	9.22
ONO11x12	Tekawa	11	38	-1.80502	175.5375	20.42	9.22	9.22
ONO11x13	Tekawa	8	34	-1.80479	175.5376	25.54	11.14	11.14
ONO11x14	Tekawa	9	35	-1.8046	175.5378	23.70	10.63	10.63
ONO11x15	Tekawa	8	31	-1.80432	175.5379	25.54	12.83	12.83
ONO11x16	Tekawa	9	38	-1.8041	175.538	23.70	9.22	9.22
ONO11x17	Tekawa	7	32	-1.80383	175.538	27.51	12.24	12.24
ONO11x18	Tekawa	6	28	-1.80355	175.5381	29.64	14.79	14.79
ONO11x19	Tekawa	7	31	-1.80328	175.5381	27.51	12.83	12.83

ONO11x20	Tekawa	5	31	-1.80304	175.5382	31.94	12.83	12.83
ONO11x21	Tekawa	6	32	-1.80276	175.5381	29.64	12.24	12.24
ONO11x22	Tekawa	8	30	-1.8025	175.5381	25.54	13.45	13.45
ONO11x23	Tekawa	7	34	-1.80222	175.538	27.51	11.14	11.14
ONO11x24	Tekawa	9	36	-1.80196	175.5381	23.70	10.14	10.14
ONO11x25	Tekawa	11	39	-1.80172	175.5382	20.42	8.80	8.80
ONO11x26	Tekawa	13	45	-1.80147	175.5383	17.59	6.63	6.63
ONO11x27	Tekawa	16	50	-1.80124	175.5384	14.06	5.23	5.23
ONO11x28	Tekawa	18	55	-1.801	175.5385	12.11	4.13	4.13
ONO12X01	Tekawa	26	71	-1.80002	175.5368	6.67	1.94	6.67
ONO12X02	Tekawa	21	61	-1.8003	175.5368	9.69	3.11	3.11
ONO12X03	Tekawa	17	53	-1.80047	175.5366	13.05	4.54	4.54
ONO12X04	Tekawa	16	41	-1.80071	175.5364	14.06	8.00	8.00
ONO12X05	Tekawa	12	42	-1.80087	175.5362	18.95	7.64	7.64
ONO12X06	Tekawa	8	38	-1.80011	175.5362	25.54	9.22	9.22
ONO12X07	Tekawa	13	41	-1.80138	175.5362	17.59	8.00	8.00
ONO12X08	Tekawa	11	39	-1.80165	175.5361	20.42	8.80	8.80
ONO12X09	Tekawa	12	40	-1.8019	175.536	18.95	8.39	8.39
ONO12X10	Tekawa	8	36	-1.80213	175.5359	25.54	10.14	10.14
ONO12X11	Tekawa	11	30	-1.80235	175.5358	20.42	13.45	13.45
ONO12X12	Tekawa	11	35	-1.80259	175.5356	20.42	10.63	10.63
ONO12X13	Tekawa	12	40	-1.80282	175.5355	18.95	8.39	8.39
ONO12X14	Tekawa	10	37	-1.80306	175.5354	22.00	9.67	9.67
ONO12X15	Tekawa	14	44	-1.8033	175.5353	16.32	6.95	6.95
ONO12X16	Tekawa	22	59	-1.80353	175.5351	8.99	3.42	3.42
ONO12X17	Tekawa	24	62	-1.80376	175.535	7.74	2.97	7.74
ONO12X18	Tekawa	25	63	-1.80396	175.5348	7.19	2.83	7.19
ONO12X19	Tekawa	27	69	-1.80413	175.5346	6.19	2.13	6.19
ONO12X20	Tekawa	32	75	-1.80432	175.5344	4.26	1.61	4.26
ONO12X21	Tekawa	37	79	-1.80454	175.5342	2.94	1.33	2.94
ONO12X22	Tekawa	46	93	-1.80474	175.5341	1.50	0.69	1.50
ONO12X23	Tekawa	54	100	-1.80496	175.5339	0.83	0.49	0.83
ONO12X24	Tekawa	49	101	-1.80515	175.5337	1.20	0.47	1.20
ONO12X25	Tekawa	44	96	-1.80536	175.5335	1.74	0.60	1.74
ONO16x1	Tanaeang	16.5	52.2	-1.80861	175.5415	13.55	4.72	4.72
ONO16x2	Tanaeang	15.8	52.2	-1.80833	175.5415	14.27	4.72	4.72
ONO16x3	Tanaeang	13.7	47.2	-1.80806	175.5415	16.69	5.97	5.97
ONO16x4	Tanaeang	13.4	44.2	-1.80783	175.5416	17.07	6.88	6.88
ONO16x5	Tanaeang	14.1	40.9	-1.80758	175.5417	16.20	8.04	8.04
ONO16x6	Tanaeang	13.3	43.6	-1.80735	175.5418	17.20	7.08	7.08
ONO16x7	Tanaeang	15.3	43.2	-1.80713	175.542	14.82	7.21	7.21
ONO16x8	Tanaeang	14.4	40.1	-1.80695	175.5422	15.85	8.35	8.35
ONO16x9	Tanaeang	15.0	41.5	-1.80674	175.5423	15.15	7.82	7.82
ONO16x10	Tanaeang	14.5	39.1	-1.80647	175.5425	15.73	8.76	8.76
ONO16x11	Tanaeang	14.1	38.5	-1.80629	175.5426	16.20	9.01	9.01
ONO16x12	Tanaeang	13.7	37.1	-1.80606	175.5428	16.69	9.62	9.62

ONO16x13	Tanaeang	13.3	37.4	-1.80587	175.543	17.20	9.49	9.49
ONO16x14	Tanaeang	13.5	34.8	-1.80569	175.5432	16.95	10.73	10.73
ONO16x15	Tanaeang	13.9	37.4	-1.80545	175.5433	16.45	9.49	9.49
ONO16x16	Tanaeang	12.5	35.9	-1.80519	175.5433	18.26	10.18	10.18
ONO16x17	Tanaeang	12.5	35.4	-1.80498	175.5435	18.26	10.43	10.43
ONO16x18	Tanaeang	9.8	30.1	-1.80487	175.5437	22.33	13.39	13.39
ONO16x19	Tanaeang	13.7	36.1	-1.80462	175.5438	16.69	10.09	10.09
ONO16x20	Tanaeang	14.7	39.2	-1.80437	175.5439	15.49	8.71	8.71
ONO16x21	Tanaeang	13.7	33.2	-1.80406	175.5438	16.69	11.57	11.57
ONO16x22	Tanaeang	14.1	39.9	-1.80386	175.544	16.20	8.43	8.43
ONO16x23	Tanaeang	13.5	38.7	-1.80365	175.5442	16.95	8.92	8.92
ONO16x24	Tanaeang	12.5	36.2	-1.80341	175.5443	18.26	10.04	10.04
ONO16x25	Tanaeang	12.6	36.8	-1.80324	175.5445	18.12	9.76	9.76
ONO16x26	Tanaeang	11.4	36.8	-1.803	175.5446	19.82	9.76	9.76
ONO16x27	Tanaeang	11.1	36.0	-1.80298	175.5449	20.27	10.14	10.14
ONO16x28	Tanaeang	11.0	37.6	-1.80298	175.5452	20.42	9.40	9.40
ONO16x29	Tanaeang	12.3	36.9	-1.8028	175.5453	18.53	9.71	9.71
ONO16x30	Tanaeang	13.9	43.1	-1.8025	175.5454	16.45	7.25	7.25
ONO16x31	Tanaeang	17.5	51.7	-1.80227	175.5456	12.57	4.83	4.83
ONO17x1	Tanaeang	14.6	51	-1.80242	175.5464	15.61	4.99	4.99
ONO17x2	Tanaeang	13.1	34	-1.80321	175.5459	17.46	11.14	11.14
ONO17x3	Tanaeang	14.4	41.4	-1.80405	175.5456	15.85	7.85	7.85
ONO17x4	Tanaeang	29	50.2	-1.80506	175.5447	5.33	5.18	5.33
ONO17x5	Tanaeang	21.5	43.7	-1.80602	175.544	9.33	7.05	7.05
ONO17x6	Tanaeang	19.2	44.8	-1.80693	175.5435	11.08	6.69	6.69
ONO17x7	Tanaeang	15.9	44.6	-1.80757	175.5427	14.17	6.75	6.75
ONO17x8	Tanaeang	17.3	51.6	-1.80868	175.5424	12.76	4.85	4.85
ONO14x1	Tanaeang	30.1	66.7	-1.80949	175.5461	4.91	2.38	4.91
ONO14x2	Tanaeang	22.2	53.7	-1.80926	175.5463	8.86	4.39	4.39
ONO14x3	Tanaeang	22.1	49.2	-1.80906	175.5463	8.92	5.43	5.43
ONO14x4	Tanaeang	17.9	39.3	-1.80866	175.5467	12.21	8.67	8.67
ONO14x5	Tanaeang	18.9	39.8	-1.80836	175.5468	11.33	8.47	8.47
ONO14x6	Tanaeang	17.9	37.3	-1.80805	175.5472	12.21	9.53	9.53
ONO14x7	Tanaeang	16.1	39.3	-1.8078	175.5472	13.96	8.67	8.67
ONO14x8	Tanaeang	16.2	39.8	-1.80743	175.5473	13.85	8.47	8.47
ONO14x9	Tanaeang	16	38.8	-1.80716	175.5475	14.06	8.88	8.88
ONO14x10	Tanaeang	17.1	39.8	-1.80681	175.5476	12.96	8.47	8.47
ONO14x11	Tanaeang	15.3	35.1	-1.80654	175.5478	14.82	10.58	10.58
ONO14x12	Tanaeang	11.7	33.6	-1.8062	175.548	19.38	11.35	11.35
ONO14x13	Tanaeang	11.5	32.1	-1.80591	175.5482	19.67	12.18	12.18
ONO14x14	Tanaeang	9.9	31.2	-1.80566	175.5484	22.16	12.71	12.71
ONO14x15	Tanaeang	8.4	28.8	-1.80532	175.5485	24.79	14.24	14.24
ONO14x16	Tanaeang	7.8	28.6	-1.80503	175.5486	25.92	14.37	14.37
ONO14x17	Tanaeang	9.2	30.6	-1.80469	175.5487	23.35	13.08	13.08
ONO14x18	Tanaeang	9.2	32.4	-1.80439	175.5489	23.35	12.01	12.01
ONO14x19	Tanaeang	9.1	32.7	-1.80412	175.5491	23.53	11.84	11.84

ONO14x20	Tanaeang	10.9	36.1	-1.80378	175.5492	20.57	10.09	10.09
ONO14x21	Tanaeang	13.6	40.8	-1.80346	175.5494	16.82	8.08	8.08
ONO15x1	Tanaeang	22.9	62.1	-1.80236	175.5467	8.41	2.96	2.96
ONO15x2	Tanaeang	14.5	41.5	-1.80265	175.5465	15.73	7.82	7.82
ONO15x3	Tanaeang	12.6	38.2	-1.80297	175.5463	18.12	9.14	9.14
ONO15x4	Tanaeang	12	38.6	-1.80329	175.5462	18.95	8.96	8.96
ONO15x5	Tanaeang	14	38.2	-1.80361	175.546	16.32	9.14	9.14
ONO15x6	Tanaeang	17.2	43.1	-1.80392	175.5459	12.86	7.25	7.25
ONO15x7	Tanaeang	19	47.2	-1.80428	175.5458	11.24	5.97	5.97
ONO15x8	Tanaeang	28.2	51.7	-1.80466	175.5459	5.66	4.83	5.66
ONO15x9	Tanaeang	20.8	44.4	-1.80503	175.5456	9.83	6.82	6.82
ONO15x10	Tanaeang	24.9	44.8	-1.80536	175.5456	7.24	6.69	7.24
ONO15x11	Tanaeang	22.7	43.2	-1.80571	175.5456	8.53	7.21	7.21
ONO15x12	Tanaeang	22.7	42.8	-1.80606	175.5456	8.53	7.35	7.35
ONO15x13	Tanaeang	24.7	45.1	-1.80643	175.5456	7.35	6.60	7.35
ONO15x14	Tanaeang	20.5	42.6	-1.80671	175.5454	10.05	7.42	7.42
ONO15x15	Tanaeang	24.4	45.1	-1.80687	175.5451	7.52	6.60	7.52
ONO15x16	Tanaeang	23.3	44.7	-1.80703	175.5448	8.16	6.72	6.72
ONO15x17	Tanaeang	24.9	48.8	-1.80733	175.5446	7.24	5.54	7.24
ONO15x18	Tanaeang	27.8	54.9	-1.80763	175.5444	5.83	4.15	5.83
ONO15x19	Tanaeang	28.6	61.1	-1.80793	175.5442	5.50	3.10	5.50
ONO15x20	Tanaeang	25.3	57.2	-1.80821	175.544	7.03	3.73	7.03
ONO15x21	Tanaeang	26.4	65.4	-1.80848	175.5438	6.48	2.53	6.48
ONO15x22	Tanaeang	27.8	67.7	-1.80879	175.5436	5.83	2.27	5.83
ONO15x23	Tanaeang	28.4	72.3	-1.80903	175.5434	5.58	1.83	5.58
ONO12X01	Tekawa	43.9	102.7	-1.80879	175.5384	1.76	0.43	1.76
ONO12X02	Tekawa	26.1	73.5	-1.8084	175.5384	6.62	1.73	6.62
ONO12X03	Tekawa	23.2	65.2	-1.80814	175.5387	8.22	2.55	2.55
ONO12X04	Tekawa	19.1	55.1	-1.80814	175.5387	11.16	4.11	4.11
ONO12X05	Tekawa	17	48.3	-1.80749	175.539	13.05	5.67	5.67
ONO12X06	Tekawa	12.9	42.6	-1.80731	175.5393	17.72	7.42	7.42
ONO12X07	Tekawa	15.6	47.3	-1.80699	175.5384	14.49	5.94	5.94
ONO12X08	Tekawa	11.2	38	-1.80674	175.5396	20.12	9.22	9.22
ONO12X09	Tekawa	9.8	36.1	-1.80645	175.5399	22.33	10.09	10.09
ONO12X10	Tekawa	10.8	31.8	-1.80624	175.5401	20.72	12.36	12.36
ONO12X11	Tekawa	10.8	36.8	-1.80608	175.5404	20.72	9.76	9.76
ONO12X12	Tekawa	11.3	37.6	-1.80585	175.5406	19.97	9.40	9.40
ONO12X13	Tekawa	11.3	36.1	-1.80557	175.5408	19.97	10.09	10.09
ONO12X14	Tekawa	7.6	38.2	-1.80523	175.5406	26.31	9.14	9.14
ONO12X15	Tekawa	11	37.1	-1.80491	175.5409	20.42	9.62	9.62
ONO12X16	Tekawa	16.4	36.1	-1.80455	175.5408	13.65	10.09	10.09
ONO12X17	Tekawa	11	34.3	-1.80438	175.5411	20.42	10.98	10.98
ONO12X18	Tekawa	12.9	31.1	-1.80411	175.5413	17.72	12.77	12.77
ONO12X19	Tekawa	13.4	40.4	-1.80377	175.5416	17.07	8.23	8.23
ONO12X20	Tekawa	10.9	37.2	-1.80342	175.5417	20.57	9.58	9.58
ONO12X21	Tekawa	13.4	45.5	-1.80311	175.5421	17.07	6.47	6.47

ONO12X22	Tekawa	14.9	49	-1.80286	175.5423	15.27	5.49	5.49
ONO12X23	Tekawa	14.1	49.9	-1.80252	175.5425	16.20	5.26	5.26
ONO12X24	Tekawa	14	50.8	-1.80234	175.5427	16.32	5.04	5.04
ONO12X25	Tekawa	16.5	53.9	-1.80219	175.543	13.55	4.35	4.35
ONO12X26	Tekawa	16.5	57	-1.80199	175.5431	13.55	3.76	3.76
ONO13X01	Tekawa	22.4	67.4	-1.80159	175.5417	8.73	2.30	2.30
ONO13X02	Tekawa	16.5	54.7	-1.80194	175.5415	13.55	4.19	4.19
ONO13X03	Tekawa	18.4	53.4	-1.80225	175.5415	11.76	4.46	4.46
ONO13X04	Tekawa	21.3	47.6	-1.80255	175.5415	9.47	5.86	5.86
ONO13X05	Tekawa	13.9	38.8	-1.80293	175.5414	16.45	8.88	8.88
ONO13X06	Tekawa	15.7	42	-1.803	175.541	14.38	7.64	7.64
ONO13X07	Tekawa	11.7	41.2	-1.80314	175.5407	19.38	7.93	7.93
ONO13X08	Tekawa	11.1	41.6	-1.80338	175.5404	20.27	7.78	7.78
ONO13X09	Tekawa	10.9	41.9	-1.8037	175.5403	20.57	7.67	7.67
ONO13X10	Tekawa	8.3	34.6	-1.80404	175.5402	24.97	10.83	10.83
ONO13X11	Tekawa	10.3	34.9	-1.8041	175.5399	21.51	10.68	10.68
ONO13X12	Tekawa	8.6	32.1	-1.80414	175.5395	24.42	12.18	12.18
ONO13X13	Tekawa	10.9	33	-1.80438	175.5393	20.57	11.68	11.68
ONO13X14	Tekawa	12.3	38.9	-1.80467	175.5391	18.53	8.84	8.84
ONO13X15	Tekawa	13.2	38.9	-1.80501	175.539	17.33	8.84	8.84
ONO13X16	Tekawa	11.2	38.5	-1.80524	175.5388	20.12	9.01	9.01
ONO13X17	Tekawa	11	36.4	-1.80537	175.5347	20.42	9.95	9.95
ONO13X18	Tekawa	11.6	36.5	-1.80548	175.5381	19.52	9.90	9.90
ONO13X19	Tekawa	10.2	33.2	-1.80577	175.5381	21.67	11.57	11.57
ONO13X20	Tekawa	12.7	40.2	-1.80612	175.5381	17.99	8.31	8.31
ONO13X21	Tekawa	11.7	44.5	-1.80646	175.5381	19.38	6.79	6.79
ONO13X22	Tekawa	14.7	43.5	-1.80664	175.5388	15.49	7.11	7.11
ONO13X23	Tekawa	21.8	53.7	-1.80699	175.5377	9.13	4.39	4.39
ONO13X24	Tekawa	23.7	59.2	-1.80732	175.5375	7.92	3.39	7.92
ONO13X25	Tekawa	23.5	68.7	-1.80761	175.5373	8.04	2.16	2.16
ONO13X26	Tekawa	30.6	79.9	-1.80789	175.5371	4.73	1.28	4.73
ONO1x1	Kakaawa	41.8	84.9	-1.81787	175.5548	2.05	1.01	2.05
ONO1x2	Kakaawa	39.2	80.6	-1.81752	175.5551	2.49	1.23	2.49
ONO1x3	Kakaawa	34.8	84.4	-1.81774	175.5554	3.46	1.03	3.46
ONO1x4	Kakaawa	41.1	89.1	-1.81753	175.5557	2.16	0.83	2.16
ONO1x5	Kakaawa	49.6	92.3	-1.81766	175.5561	1.15	0.71	1.15
ONO1x6	Kakaawa	56.8	106.7	-1.81783	175.5564	0.67	0.36	0.67
ONO1x7	Kakaawa	51.5	108.6	-1.81805	175.5567	1.00	0.33	1.00
ONO1x8	Kakaawa	37.5	94.0	-1.81809	175.5570	2.83	0.66	2.83
ONO2x1	Kakaawa	50.3	88.5	-1.8192	175.5568	1.09	0.85	1.09
ONO2x2	Kakaawa	27.8	80.3	-1.81913	175.5564	5.83	1.25	5.83
ONO2x3	Kakaawa	25.9	72.4	1.81913	175.5561	6.72	1.82	6.72
ONO2x4	Kakaawa	23.4	64.6	-1.81924	175.5558	8.10	2.63	2.63
ONO2x5	Kakaawa	24.1	70.4	-1.81929	175.5555	7.69	2.00	7.69
ONO2x6	Kakaawa	32.1	87.6	-1.81926	175.5552	4.23	0.89	4.23
ONO2x7	Kakaawa	31.0	78.9	-1.81921	175.5548	4.60	1.34	4.60
ONO2x8	Kakaawa	38.4	85.4	-1.81912	175.5546	2.65	0.98	2.65
ONO3x1	Kakaawa	48.2	106.1	-1.82073	175.5539	1.27	0.37	1.27
ONO3x2	Kakaawa	41.3	94.0	-1.8208	175.5548	2.13	0.66	2.13
ONO3x3	Kakaawa	35.8	87.6	-1.82083	175.5548	3.21	0.89	3.21
ONO3x4	Kakaawa	31.7	35.2	-1.82075	175.5551	4.36	10.53	10.53
ONO3x5	Kakaawa	37.2	83.4	-1.82084	175.5555	2.89	1.08	2.89
ONO3x6	Kakaawa	46.5	97.1	-1.82078	175.5558	1.45	0.57	1.45
ONO3x7	Kakaawa	48.8	106.4	-1.8208	175.5562	1.22	0.37	1.22
ONO3x8	Kakaawa	44.4	105.1	-1.82072	175.5565	1.69	0.39	1.69
ONO4x1	Kakaawa	51.9	118	-1.82321	175.5556	0.97	0.21	0.97
ONO4x2	Kakaawa	36.7	73.2	-1.82315	175.5552	3.00	1.75	3.00
ONO4x3	Kakaawa	28.9	76.9	-1.82311	175.5549	5.37	1.47	5.37
ONO4x4	Kakaawa	29.1	73.4	-1.82306	175.5545	5.29	1.73	5.29
ONO4x5	Kakaawa	21.7	65	-1.82297	175.5542	9.19	2.58	2.58

ONO4x6	Kakaawa	23.7	67.3	-1.82292	175.5538	7.92	2.31	7.92
ONO4x7	Kakaawa	43.2	95.5	-1.82286	175.5535	1.85	0.61	1.85
ONO5x1	Kakaawa	46.5	89.5	-1.82467	175.5528	1.45	0.81	1.45
ONO5x2	Kakaawa	25.9	64.7	-1.82467	175.5532	6.72	2.61	6.72
ONO5x3	Kakaawa	18.7	55.1	-1.82462	175.5534	11.50	4.11	4.11
ONO5x4	Kakaawa	20.0	54.0	-1.82466	175.5538	10.44	4.33	4.33
ONO5x5	Kakaawa	21.3	37.9	-1.82461	175.5542	9.47	9.27	9.27
ONO5x6	Kakaawa	30.6	73.5			4.73	1.73	4.73
ONO5x7	Kakaawa	29.5	81.5	-1.82445	175.5548	5.14	1.18	5.14
ONO5x8	Kakaawa	33.8	96.0	-1.82447	175.5553	3.73	0.60	3.73
ONO6x1	Kakaawa	45.3	107.6	-1.82657	175.5549	1.58	0.34	1.58
ONO6x2	Kakaawa	59.5	93	-1.82653	175.5543	0.55	0.69	0.55
ONO6x3	Kakaawa	39.5	86.2	-1.82654	175.5565	2.44	0.95	2.44
ONO6x4	Kakaawa	35.3	75	-1.82656	175.554	3.33	1.61	3.33
ONO6x5	Kakaawa	30.5	65.1	-1.82671	175.5533	4.77	2.57	4.77
ONO6x6	Kakaawa	20.9	58.3	-1.82669	175.5534	9.76	3.54	3.54
ONO6x7	Kakaawa	16.8	52.6	-1.82661	175.553	13.25	4.63	4.63
ONO6x8	Kakaawa	23.5	59.5	-1.82657	175.5526	8.04	3.34	3.34
ONO6x9	Kakaawa	26.9	62.1	-1.8265	175.5523	6.24	2.96	6.24
ONO1x1	Otoae	44.0	119.9	-1.87537	175.5979	1.74	0.19	1.74
ONO1x2	Otoae	50.0	104.0	-1.87513	175.5982	1.11	0.41	1.11
ONO1x3	Otoae	38.5	101.2	-1.87483	175.5984	2.63	0.47	2.63
ONO1x4	Otoae	35.5	91.6	-1.87459	175.5987	3.29	0.73	3.29
ONO1x5	Otoae	41.9	92.7	-1.8743	175.5988	2.04	0.70	2.04
ONO1x6	Otoae	44.0	90.6	-1.87419	175.5991	1.74	0.77	1.74
ONO1x7	Otoae	36.6	65.9	-1.87389	175.5992	3.03	2.47	3.03
ONO1x8	Otoae	25.3	68.2	-1.8736	175.5994	7.03	2.22	7.03
ONO1x9	Otoae	26.1	71.0	-1.8731	175.5998	6.62	1.94	6.62
ONO1x10	Otoae	25.5	72.0	-1.87299	175.6001	6.92	1.85	6.92
ONO1x11	Otoae	23.4	63.9	-1.87278	175.6004	8.10	2.71	2.71
ONO1x12	Otoae	21.0	64.1	-1.87257	175.6006	9.69	2.69	2.69
ONO1x13	Otoae	18.9	65.6	-1.87225	175.6008	11.33	2.51	2.51
ONO2x1	Otoae	38	95	-1.87069	175.5981	2.73	0.63	2.73
ONO2x2	Otoae	33.5	88	-1.87093	175.5979	3.81	0.87	3.81
ONO2x3	Otoae	29.5	82.6	-1.87124	175.5977	5.14	1.12	5.14
ONO2x4	Otoae	30	74.3	-1.87154	175.5975	4.95	1.66	4.95
ONO2x5	Otoae	30	72.1	-1.87177	175.5973	4.95	1.84	4.95
ONO2x6	Otoae	25.4	73.2	-1.87198	175.597	6.98	1.75	6.98
ONO2x7	Otoae	22.8	69.2	-1.87228	175.5967	8.47	2.11	2.11
ONO2x8	Otoae	60	98.4	-1.87257	175.5965	0.53	0.53	0.53
ONO2x9	Otoae	32.7	94.5	-1.87283	175.5963	4.05	0.64	4.05
ONO2x10	Otoae	36.6	97.2	-1.87314	175.5962	3.03	0.56	3.03
ONO2x11	Otoae	35.4	99.4	-1.87347	175.596	3.31	0.51	3.31
ONO2x12	Otoae	37.8	99.4	-1.87385	175.596	2.77	0.51	2.77
ONO3x1	Otoae	48	109.9	-1.87272	175.5928	1.29	0.31	1.29
ONO3x2	Otoae	42.7	102	-1.87246	175.5929	1.92	0.45	1.92
ONO3x3	Otoae	44.7	107.2	-1.87208	175.593	1.65	0.35	1.65
ONO3x4	Otoae	40	102	-1.87173	175.5932	2.35	0.45	2.35
ONO3x5	Otoae	37.7	99.5	-1.87142	175.5934	2.79	0.51	2.79
ONO3x6	Otoae	40.9	86.2	-1.87105	175.5935	2.20	0.95	2.20
ONO3x7	Otoae	37	100.1	-1.87076	175.5936	2.94	0.49	2.94

ONO3x8	Otoae	36.8	62.2	-1.87043	175.5936	2.98	2.94	2.98
ONO4x1	Otoae	18.2	89.4	-1.86891	175.591	11.94	0.81	0.81
ONO4x2	Otoae	36.5	95.5	-1.87007	175.5909	3.05	0.61	3.05
ONO4x3	Otoae	37.6	93.2	-1.87045	175.5908	2.81	0.68	2.81
ONO4x4	Otoae	36.1	95.5	-1.87081	175.5907	3.14	0.61	3.14
ONO4x5	Otoae	37.6	92.5	-1.87111	175.5905	2.81	0.70	2.81
ONO4x6	Otoae	40.6	99.3	-1.8714	175.5903	2.25	0.51	2.25
ONO5x1	Otoae	35.7	104.5	-1.87049	175.5877	3.24	0.40	3.24
ONO5x2	Otoae	35.1	87.2	-1.87016	175.5878	3.38	0.90	3.38
ONO5x3	Otoae	29.3	86.9	-1.86979	175.588	5.22	0.92	5.22
ONO5x4	Otoae	31.3	89.9	-1.86948	175.5882	4.49	0.80	4.49
ONO5x5	Otoae	44	93.8	-1.8691	175.5891	1.74	0.66	1.74
ONO5x6	Otoae	45.2	106.2	-1.86877	175.5884	1.59	0.37	1.59
ONO6x1	Otoae	50.8	105	-1.86736	175.5848	1.05	0.39	1.05
ONO6x2	Otoae	42	89	-1.86767	175.5846	2.02	0.83	2.02
ONO6x3	Otoae	37.3	90.8	-1.86797	175.5844	2.87	0.76	2.87
ONO6x4	Otoae	36.1	89.3	-1.86828	175.5842	3.14	0.82	3.14
ONO6x5	Otoae	39.8	93	-1.86863	175.5841	2.38	0.69	2.38
ONO6x6	Otoae	44	91.5	-1.86893	175.5838	1.74	0.74	1.74
ONO6x7	Otoae	51.2	111.8	-1.86925	175.5836	1.02	0.28	1.02
ONO7x1	Otoae	49	106	-1.86893	175.5817	1.20	0.37	1.20
ONO7x1	Otoae	45.9	106	-1.86864	175.5819	1.51	0.37	1.51
ONO7x1	Otoae	44.5	104.7	-1.8683	175.5821	1.68	0.40	1.68
ONO7x1	Otoae	41.3	96.4	-1.86801	175.5824	2.13	0.59	2.13
ONO7x1	Otoae	43.2	93.5	-1.86769	175.5823	1.85	0.67	1.85
ONO7x1	Otoae	41.5	92.4	-1.8674	175.5826	2.10	0.71	2.10
ONO7x1	Otoae	41.6	96.9	1.87537	175.5979	2.08	0.57	2.08
ONO1x1	Buariki	36.6	78.4	-1.81093	175.5488	3.03	1.37	3.03
ONO1x2	Buariki	34	70	-1.81059	175.5488	3.67	2.04	3.67
ONO1x3	Buariki	30.3	65.2	-1.81024	175.549	4.84	2.55	4.84
ONO1x4	Buariki	25.6	56	-1.80993	175.5492	6.87	3.94	6.87
ONO1x5	Buariki	23.6	54.1	-1.80973	175.5495	7.98	4.31	7.98
ONO1x6	Buariki	25.7	55.7	-1.80949	175.5498	6.82	4.00	6.82
ONO1x7	Buariki	28.9	57.2	-1.80936	175.5501	5.37	3.73	5.37
ONO1x8	Buariki	26	52.6	-1.80922	175.5504	6.67	4.63	6.67
ONO1x9	Buariki	18.4	46.1	-1.80896	175.5507	11.76	6.29	6.29
ONO1x10	Buariki		45.4	-1.8097	175.5509	46.37	6.50	6.50
ONO1x11	Buariki	17.4	37.4	-1.80847	175.5518	12.67	9.49	9.49
ONO1x12	Buariki	20.4	43.7	-1.80817	175.5514	10.13	7.05	7.05
ONO1x13	Buariki	21.5	48.6	-1.80787	175.5516	9.33	5.59	5.59
ONO1x14	Buariki	25.8	51.6	-1.80755	175.5518	6.77	4.85	6.77
ONO1x15	Buariki	36.2	61.4	-1.80727	175.5520	3.12	3.06	3.12
ONO1x16	Buariki	44.3	61.2	-1.80702	175.5522	1.70	3.08	1.70
ONO1x17	Buariki	75.8	120.7	-1.80688	175.0000	0.16	0.19	0.16
ONO1x18	Buariki	75.8	124.6	-1.80671	175.5529	0.16	0.15	0.16
ONO1x19	Buariki	62.5	121.2	-1.8066	175.5532	0.44	0.18	0.44
ONO1x20	Buariki	54.3	114.1	-1.80635	175.5534	0.81	0.25	0.81
ONO1x21	Buariki	74.9	133.9	-1.80606	175.5536	0.17	0.10	0.17
ONO1x22	Buariki	88.1	146.7	-1.80579	175.5538	0.07	0.05	0.07
ONO1x23	Buariki	136.2	176.4	-1.80552	175.5541	0.00	0.01	0.00
ONO2x1	Buariki	55.6	122.9	-1.80705	175.5563	0.73	0.17	0.73
ONO2x2	Buariki	70.5	126.2	-1.80727	175.556	0.24	0.14	0.24

ONO2x3	Buariki	78.9	126.4	-1.80744	175.5557	0.13	0.14	0.13
ONO2x4	Buariki	76.4	110.8	-1.80762	175.5554	0.16	0.30	0.16
ONO2x5	Buariki	61.3	91.4	-1.80784	175.5551	0.48	0.74	0.48
ONO2x6	Buariki	19.9	54.7	-1.808	175.5548	10.51	4.19	4.19
ONO2x7	Buariki	17.5	43.6	-1.8083	175.5546	12.57	7.08	7.08
ONO2x8	Buariki	17.1	43.6	-1.80841	175.5542	12.96	7.08	7.08
ONO2x9	Buariki	17.2	42.6	-1.80856	175.5539	12.86	7.42	7.42
ONO2x10	Buariki	18.4	41.1	-1.80872	175.5536	11.76	7.97	7.97
ONO2x11	Buariki	14.4	43	-1.80889	175.5533	15.85	7.28	7.28
ONO2x12	Buariki	19.8	45.8	-1.80902	175.5529	10.59	6.38	6.38
ONO2x13	Buariki	23.3	46.6	-1.80919	175.5526	8.16	6.14	6.14
ONO2x14	Buariki	17.6	42.9	-1.80936	175.5523	12.48	7.32	7.32
ONO2x15	Buariki	14.8	38.7	-1.80948	175.552	15.38	8.92	8.92
ONO2x16	Buariki	14.9	39.4	-1.8096	175.5516	15.27	8.63	8.63
ONO2x17	Buariki	17.8	43.9	-1.80979	175.5513	12.30	6.98	6.98
ONO2x18	Buariki	19.1	46.8	-1.81006	175.551	11.16	6.09	6.09
ONO2x19	Buariki	22.9	51.3	-1.81032	175.5509	8.41	4.92	4.92
ONO2x20	Buariki	27.4	59.4	-1.81058	175.5506	6.01	3.36	6.01
ONO2x21	Buariki	26.8	61.6	-1.81079	175.5503	6.29	3.03	6.29
ONO2x22	Buariki	34.5	72.6	-1.81112	175.5501	3.54	1.80	3.54
ONO3x1	Buariki	54.8	104.4	-1.81299	175.552	0.78	0.40	0.78
ONO3x2	Buariki	50	84.8	-1.81263	175.5522	1.11	1.01	1.11
ONO3x3	Buariki	36.5	68.6	-1.81231	175.5523	3.05	2.17	3.05
ONO3x4	Buariki	28.6	56	-1.81201	175.5525	5.50	3.94	5.50
ONO3x5	Buariki	25.7	47.2	-1.81171	175.5527	6.82	5.97	6.82
ONO3x6	Buariki	23.3	47.8	-1.81151	175.553	8.16	5.81	5.81
ONO3x7	Buariki	21.5	44.5	-1.81136	175.5534	9.33	6.79	6.79
ONO3x8	Buariki	20.5	42.1	-1.81114	175.5536	10.05	7.60	7.60
ONO3x9	Buariki	19.5	41	-1.81087	175.5539	10.83	8.00	8.00
ONO3x10	Buariki	20.4	43.2	-1.81064	175.5542	10.13	7.21	7.21
ONO3x11	Buariki	20.3	44.6	-1.81059	175.5545	10.21	6.75	6.75
ONO3x12	Buariki	20.2	44.6	-1.81055	175.5548	10.28	6.75	6.75
ONO3x13	Buariki	19.7	45.5	-1.81045	175.5552	10.67	6.47	6.47
ONO3x14	Buariki	21	47.7	-1.81044	175.5555	9.69	5.83	5.83
ONO3x15	Buariki	28.5	53.1	-1.8104	175.5559	5.54	4.52	5.54
ONO3x16	Buariki	29.3	57.4	-1.81028	175.5563	5.22	3.69	5.22
ONO3x17	Buariki	34.2	68	-1.81025	175.5566	3.62	2.24	3.62
ONO3x18	Buariki	54.4	90.7	-1.81013	175.557	0.80	0.77	0.80
ONO3x19	Buariki	113.9	139.6	-1.80994	175.5572	0.01	0.08	0.01
ONO3x20	Buariki	140.2	157.1	-1.80977	175.5576	0.00	0.03	0.00
ONO4x1	Buariki	92.7	99.2	-1.81421	175.5582	0.05	0.51	0.05
ONO4x2	Buariki	73.6	112.9	-1.81422	175.5578	0.19	0.27	0.19
ONO4x3	Buariki	66.5	108.6	-1.81427	175.5575	0.33	0.33	0.33
ONO4x4	Buariki	50.4	90.3	-1.81436	175.5572	1.08	0.78	1.08
ONO4x5	Buariki	42.7	77.9	-1.81439	175.5568	1.92	1.40	1.92
ONO4x6	Buariki	34	71.7	-1.81467	175.5567	3.67	1.88	3.67
ONO4x7	Buariki	34.7	68.5	-1.8147	175.5563	3.49	2.18	3.49
ONO4x8	Buariki	38.2	68.6	-1.81476	175.5559	2.69	2.17	2.69
ONO4x9	Buariki	36.8	71.8	-1.81485	175.5556	2.98	1.87	2.98
ONO4x10	Buariki	42.8	77.4	-1.81497	175.5552	1.91	1.44	1.91
ONO4x11	Buariki	50.1	84	-1.81509	175.5549	1.11	1.05	1.11
ONO4x12	Buariki	49.8	81.3	-1.8152	175.5545	1.13	1.19	1.13
ONO4x13	Buariki	50.7	83.6	-1.81538	175.5541	1.06	1.07	1.06
ONO4x14	Buariki	57.5	92.2	-1.81553	175.5539	0.64	0.71	0.64
ONO1x1	Tameo	43.3	91	-1.83549	175.5503	1.84	0.76	1.84
ONO1x2	Tameo	31.3	69.2	-1.83538	175.5507	4.49	2.11	4.49
ONO1x3	Tameo	28.3	62.4	-1.83533	175.551	5.62	2.91	5.62
ONO1x4	Tameo	28.5	62.6	-1.83527	175.5514	5.54	2.89	5.54
ONO1x5	Tameo	25.4	54.9	-1.83517	175.5517	6.98	4.15	6.98
ONO1x6	Tameo	21.1	54.4	-1.83516	175.552	9.61	4.25	4.25

ONO1x7	Tameo	20.7	55.5	-1.83515	175.5563	9.91	4.04	4.04
ONO1x8	Tameo	25	59.8	-1.83518	175.5527	7.19	3.29	7.19
ONO1x9	Tameo	27.8	63.2	-1.83521	175.5531	5.83	2.81	5.83
ONO1x10	Tameo	31.6	69.6	-1.8352	175.5534	4.39	2.07	4.39
ONO2x1	Tameo	31.9	77	-1.83407	175.5541	4.30	1.46	4.30
ONO2x2	Tameo	25	65.3	-1.83409	175.5538	7.19	2.54	7.19
ONO2x3	Tameo	23.3	63.5	-1.83425	175.5533	8.16	2.77	2.77
ONO2x4	Tameo	27.8	62	-1.83435	175.5532	5.83	2.97	5.83
ONO2x5	Tameo	20.2	54.3	-1.83454	175.5528	10.28	4.27	4.27
ONO2x6	Tameo	20	53	-1.83465	175.5525	10.44	4.54	4.54
ONO2x7	Tameo	18.6	53	-1.83468	175.5522	11.58	4.54	4.54
ONO2x8	Tameo	18.3	52.1	-1.83456	175.5518	11.85	4.74	4.74
ONO2x9	Tameo	21.7	54.7	-1.83453	175.5514	9.19	4.19	4.19
ONO2x10	Tameo	23.7	57.7	-1.83449	175.5511	7.92	3.64	7.92
ONO2x11	Tameo	25.5	60.3	-1.83453	175.5507	6.92	3.22	6.92
ONO2x12	Tameo	27.5	68.2	-1.8346	175.5504	5.97	2.22	5.97
ONO2x13	Tameo	31.4	93	-1.83459	175.55	4.46	0.69	4.46
ONO3x1	Tameo	33.6	81.2	-1.83283	175.5504	3.79	1.20	3.79
ONO3x2	Tameo	27.6	66.8	-1.83284	175.5507	5.92	2.37	5.92
ONO3x3	Tameo	24.3	64	-1.83286	175.5511	7.57	2.70	7.57
ONO3x4	Tameo	18.7	50.7	-1.83295	175.5514	11.50	5.06	5.06
ONO3x5	Tameo	16.5	49	-1.83303	175.5517	13.55	5.49	5.49
ONO3x6	Tameo	15.7	50.7	-1.83296	175.552	14.38	5.06	5.06
ONO3x7	Tameo	14.5	41.7	-1.83292	175.5524	15.73	7.74	7.74
ONO3x8	Tameo	17.1	53.2	-1.83278	175.5526	12.96	4.50	4.50
ONO3x9	Tameo	19.1	57.5	-1.83265	175.5529	11.16	3.67	3.67
ONO3x10	Tameo	28.4	69.6	-1.83251	175.5532	5.58	2.07	5.58
ONO3x11	Tameo	36.8	85.3	-1.83244	175.5535	2.98	0.99	2.98
ONO3x12	Tameo	39.5	98	-1.83228	175.5539	2.44	0.54	2.44
ONO4x1	Tameo	43.2	106.9	-1.83101	175.5541	1.85	0.36	1.85
ONO4x2	Tameo	33.4	85.9	-1.83103	175.5538	3.84	0.96	3.84
ONO4x3	Tameo	30.1	71.5	-1.83094	175.5535	4.91	1.90	4.91
ONO4x4	Tameo	20.1	57	-1.8308	175.5532	10.36	3.76	3.76
ONO4x5	Tameo	11.9	42.6	-1.83065	175.5528	19.09	7.42	7.42
ONO4x6	Tameo	13.6	49.2	-1.83046	175.5525	16.82	5.43	5.43
ONO4x7	Tameo	14.9	50.4	-1.83037	175.5522	15.27	5.14	5.14
ONO4x8	Tameo	18.4	53.1	-1.83037	175.5519	11.76	4.52	4.52
ONO4x9	Tameo	21.1	57.4	-1.83039	175.5515	9.61	3.69	3.69
ONO4x10	Tameo	25.3	66.2	-1.83031	175.5512	7.03	2.44	7.03
ONO4x11	Tameo	40	82.7	-1.83024	175.5508	2.35	1.12	2.35

Annex 5 – Selected field photos

Figure A5.1: The team having a field training session on the operation of EM34 prior to the assessment proper.

Figure A5.2: EM34 field survey undertaken by MISE team.

Figure A5.3: Well assessment undertaken by water technician, MISE and Public health staff members in Tanaeang Village.

Figure A5.4: Preparation of groundwater and rainwater samples for *E. coli* analyses.

Figure A5.5: MISE and Public Health staff members working together to ensure compliance to sampling procedures.

Figure A5.6: Samples prepared and properly labelled, ready for 24-hours incubation.

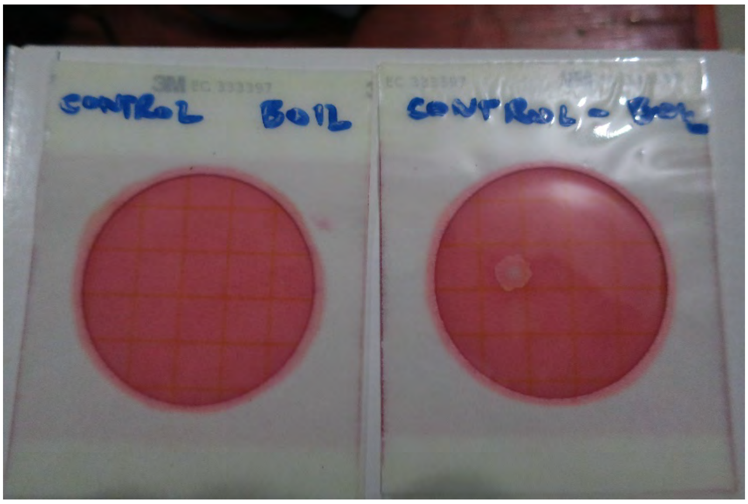

Figure A5.7: Control dish showing boiled rainwater sample that was used for quality control and assurance.

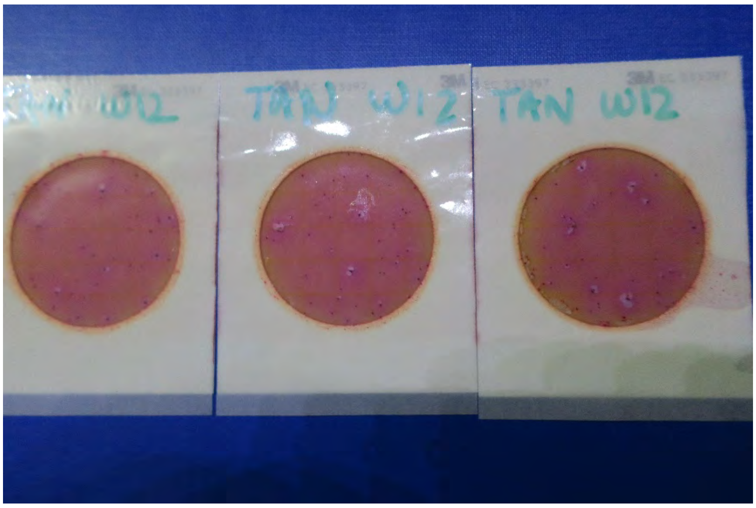

Figure A5.8: *E. coli* plates for a community well in Tanaeang, which has a count of too many total coliforms but no *E. coli*.

Figure A5.9: Installation work of the automatic TB-3 rain gauge beside the old manual kit, which is mounted on a concrete plinth.

Figure A5.10: Rain gauge post and tipping-bucket element installed and levelled.

Figure A5.11: Calibration of the TB-3 rain gauge using the field calibration kit, with the training exercise being run by the KMS staff and delivered to the MISE water technicians.

Figure A5. 12: Newly installed TB3 rain gauge mounted on a steel post (right), constructed near the old manual rain gauge.

Figure A5.13: Church building in Taboarorae, a potential rainwater harvesting centre, but is not equipped with fascia board, gutter and down pipe.

Figure A5.14. KIRIWATSAN rainwater tanks connected to the Taboarorae village *manneaba*.

Figure A5:15: Community engagement in Taboarorae village, generating useful and practical discussions and information exchange as in the other villages.

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