University of Southern Queensland

Faculty of Engineering and Surveying

INVESTIGATION OF LIFE CYCLE MANAGEMENT OF ELECTROMAGNETIC FLOW METERS

A dissertation submitted by

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in fulfilment of the requirements of

Courses ENG4111 and ENG4112 Research Project

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ABSTRACT

This project seeks to improve the current management of electromagnetic flow meters at SunWater customer's irrigation offtakes in the Burdekin Haughton Water Supply Scheme.

SunWater is a water utility, the core business of which is to supply raw water for the agricultural, industrial and urban needs in the Burdekin, Bowen and Townsville regions.

The Burdekin Haughton Water Supply Scheme (BHWSS) is located approximately 100 kilometres south of Townsville in North Queensland.

Infrastructure Asset Management is the discipline of managing infrastructure assets to provide cost effective delivery of services. For SunWater, this entails capture, supply and distribution of raw water. Investment in water delivery assets is made on the basis that additional revenue will be recovered through improved productivity and delivery efficiency.

The metering of water use is a critical aspect of SunWater business to:

- monitor individual customer use against entitlement;
- bill customers for water use to obtain revenue: and
- determine water distribution efficiency of the system.

This dissertation details:

- the investigation and evaluation of the meters that are relevant to this project;
- a failure analysis conducted on electromagnetic flow meters in services in the BHWSS;
- the production of a reliability model that predicts the probability of failure of an electromagnetic flow meter in service in the BHWSS at a selected asset life;
- the recommendations to improve the reliability of the existing fleet and future installations of electromagnetic flow meters;
- the cost benefit analysis undertaken of setting up and maintaining a SCADA system whereby one meter coordinator can oversee the entire network.

CERTIFICATION

I certify that the ideas, designs and experimental work, results, analyses and conclusions set out in this dissertation are entirely my own effort, except where otherwise indicated and acknowledged.

I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

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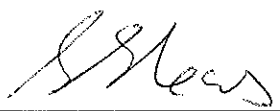

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ABBREVIATIONS

The following abbreviations have been used throughout the text:

AMP	Asset Management Plan
BHWSS	Burdekin Haughton Water Supply Scheme
CBA	Cost Benefit Analysis
CIT	Central Irrigation Trust
EM	Electromagnetic
GOC	Government-owned Corporation
GUI	Graphical User Interface
HMI	Human Machine Interfaces
IEEE	Institute of Electrical and Electronics Engineers
ISP	Internet Service Providers
LCD	Liquid Crystal Display
MAR	Meter Adjustment Report
MESA	Maintenance Engineering Society of Australia
ML	Megalitre
MTBF	Mean Time between Failures
NMI	National Measurement Institute
NPV	Net Present Value

PA	Propeller Actuated
PLC	Programmable Logic Controllers
RAT	Remote Access Telemetry
RTU	Remote Terminal Unit
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
SWIMS	SunWater Information Management System
TSP	Telecommunications Service Providers
VHF	Very High Frequency

1.0 INTRODUCTION

1.1 OVERVIEW

This study seeks to improve the current management of electromagnetic flow meters at SunWater customer's irrigation offtakes. However, early on in this study it was realised that management of the meters can become far less of an issue if the reliability of the meters is improved.

1.2 THE RESEARCH PROBLEM

SunWater is currently in the process of converting dethridge wheels to electromagnetic flow meters. SunWater has been steadily completing this project over the last 8 years however with the new Australian Standards for metering coming out in the not to distant future, this project will be ramping up substantially over the next couple of years.

The current fleet of electromagnetic flow meters have been failing and requiring continuous corrective maintenance. SunWater is unwilling to commit to a full fleet of these meters until their issues have been resolved. Once the issues are resolved these assets must be appropriately managed.

This research has briefly touched on Supervisory Control and Data Acquisition (SCADA) of flow meters. Investigation has been undertaken of what technology is available at present to carry out SCADA of flow meters and determine whether this technology would be of any use to SunWater. If this technology can provide information that SunWater may require then it must be determined if it will be a viable method of managing SunWater's fleet of electromagnetic flow meters.

1.3 PROJECT OBJECTIVES

This dissertation specifically details:

- the literature reviewed regarding past and present information on the main components of the life cycle management of electromagnetic flow meters available to SunWater.
- the investigation and evaluation of the meters that are relevant to this project;
- a failure analysis conducted on electromagnetic flow meters in services in the BHWSS;
- the production of a reliability model that predicts the probability of failure of an electromagnetic flow meter in service in the BHWSS at a selected asset life;
- the recommendations to improve the reliability of the existing fleet and future installations of electromagnetic flow meters;
- the cost benefit analysis undertaken of setting up and maintaining a SCADA system whereby one meter coordinator can oversee the entire network.

The objectives of this research morphed considerably as the project progressed. Numerous questions were raised such as:

- What particular flow meters are relevant to this project?
- How reliable is the current fleet of electromagnetic flow meters?
- What's going wrong with these meters?
- How is the expanding fleet of electromagnetic flow meters to be managed?

It became essential to answer these questions to achieve the objectives of this project.

1.4 SUMMARY

This dissertation aims to describe how the current management of electromagnetic flow meters at SunWater customer's irrigation offtakes can be improved. A follow-on from this is the improved reliability of the current fleet of electromagnetic flow meters and future installations. The SunWater Asset Management department investigate projects of this nature. As part of this particular project, literature has been reviewed to examine past & present information on the main components regarding the life cycle management of electromagnetic flow meters available to SunWater. These main components are:

- Asset Management;
- Electromagnetic Flow Meters; and
- SCADA.

Some background information regarding the project and a comprehensive explanation of the three main components follows in the next four chapters. The subsequent five chapters specifically address the objectives of this dissertation. The remaining chapters conclude the dissertation, make recommendations and detail further work to be completed.

2.0 BACKGROUND

2.1 INTRODUCTION

Water supply is the provision, by third parties in the water industry, of water resources of various qualities to different users. In regards to irrigation water supply in Queensland, SunWater is by far the largest bulk water supplier. The Burdekin Haughton Water Supply Scheme (BHWSS) makes up one of the many schemes owned and operated by SunWater which deliver water to the irrigators.

2.2 SUNWATER

SunWater is a company that provides water infrastructure and supply solutions throughout Queensland, Australia and internationally (SunWater 2009). As a Queensland Government-owned Corporation (GOC), SunWater provides direct water supply services to a large number of customers including irrigators, mines, power generators and local government. As a specialist water service provider, SunWater has extensive expertise in operating and maintaining dams, weirs, pump stations, pipelines, open channels and drainage systems.

SunWater's water storage and distribution infrastructure includes:

- 19 major dams;
- 63 weirs and barrages;
- 80 major pumping stations; and
- more than 2500 kilometres of pipelines and open channels.

SunWater supplies approximately 40% of the water used commercially in Queensland via 23 water supply schemes and has a proud history of supporting regional Queensland communities through these schemes (SunWater 2009).

2.3 THE BURDEKIN HAUGHTON WATER SUPPLY SCHEME

Queensland Parliament authorised the establishment of the Burdekin Haughton Water Supply Scheme - the largest land and water conservation scheme undertaken in Queensland (SunWater 2009). The scheme supplies water for the irrigation of new and existing farms in the lower Burdekin River region, and supplements the urban and industrial needs of Townsville.

The scheme begins with the Burdekin Falls Dam, one of the largest dams in Queensland. The dam forms Lake Dalrymple, which covers an area of 22,400 hectares and ponds water 50 kilometres up the Burdekin River.

Figure 2.1 Burdekin Falls Dam

The Burdekin Falls Dam operates in conjunction with the existing storages of Clare Weir and Gorge Weir on the Burdekin River, and Val Bird and Giru weirs on the Haughton River at Giru. Pumping stations are located on the Burdekin River, within the Clare Weir storage, to divert water to the Haughton, Elliot and Barratta Main Channels.

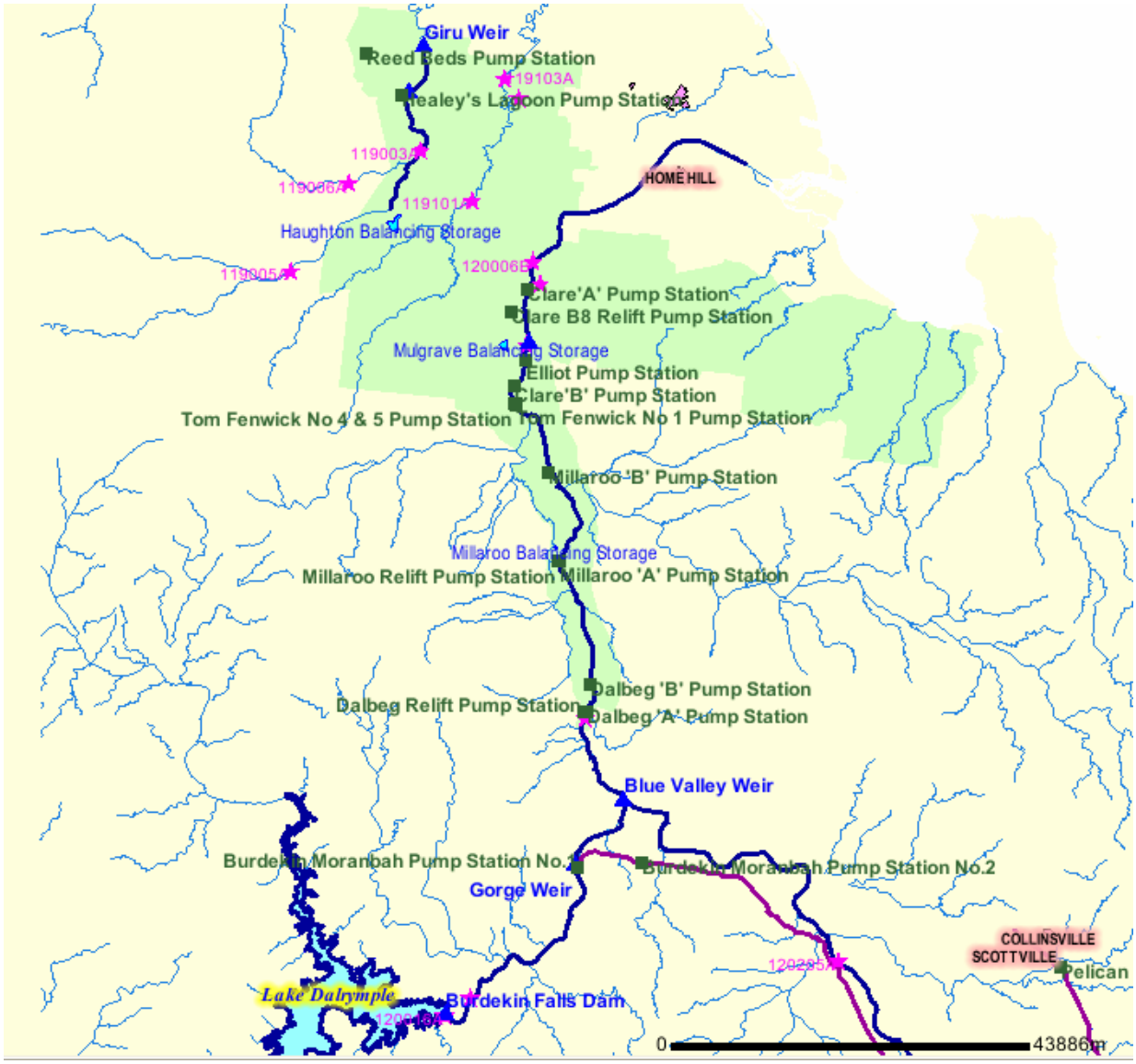

Figure 2.2 The Burdekin Haughton Water Supply Scheme

Channels have been developed on both sides of the Burdekin River and each section is served by major pump stations located on Clare Weir. The pump stations divert water into main channels on each bank of the river and then to customers by a system of distribution channels. The Tom Fenwick Pump Station services the Haughton and Barratta Main Channels, which provides water to customers between the Burdekin and Haughton rivers. In addition, the Haughton Main Channel supplements the Haughton River and Giru groundwater area. On the other side of the river, the Elliot Main Channel services the Leichhardt Downs area and has the potential to be extended eastwards towards Bowen.

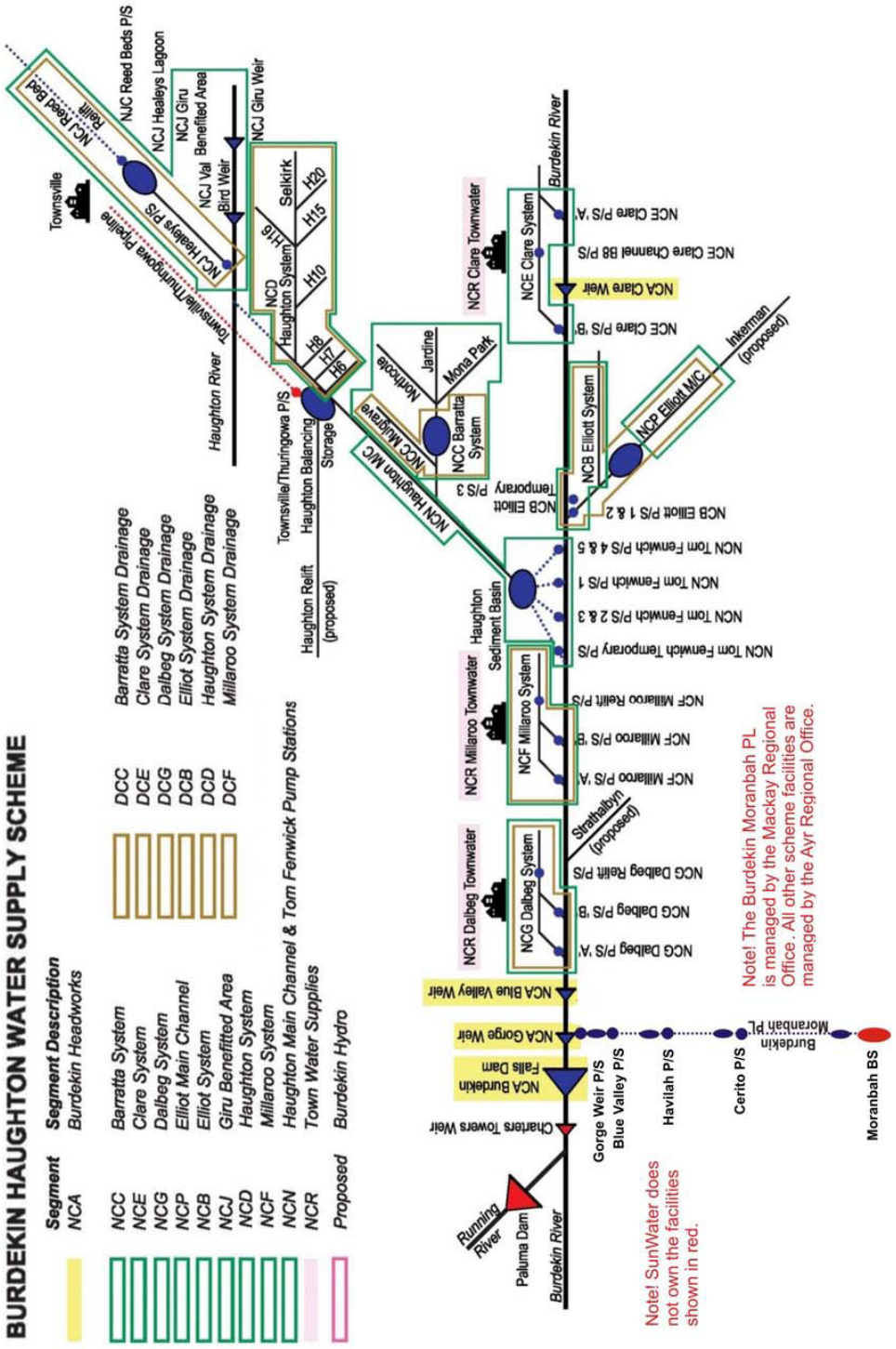

Figure 2.3: Diagram of Burdekin Haughton Water Supply Scheme reproduced from SunWater's Strategic Asset Management Plan (SunWater Corporate 2008)

2.4 DELIVERY OF WATER

In the BHWSS, customers must place water orders using the Streamline ordering system at least 48 hours prior to taking water. This allows SunWater to divert sufficient water into the channel system, and to minimise distribution losses.

The water ordering system assists SunWater to deliver water to customers in an efficient and timely way and enables customers to plan and manage their water use. Customers who take water without ordering are likely to reduce SunWater's ability to supply customers who have ordered according to the specified requirements. Furthermore, customers who order water and fail to take it increase the channel system's distribution losses, which could result in SunWater having to limit supplies to all customers later in the water year.

2.5 SUMMARY

SunWater's core business is the delivery of water. There has been extensive infrastructure established to deliver this water. This includes the dams, pump stations, channels, and pipelines throughout SunWater's water supply schemes. Asset management is essential to ensure the effective operation of this infrastructure.

3.0 ASSET MANAGEMENT

3.1 INTRODUCTION

As mentioned earlier, one of the many outputs of the SunWater Asset Management group is to undertake investigative projects regarding the infrastructure associated with delivering water to its customers. This chapter highlights the importance of asset management and explores SunWater's asset management plan.

3.2 INFRASTRUCTURE ASSET MANAGEMENT

Infrastructure Asset Management is the discipline of managing infrastructure assets. Assets in the water supply sector are typically owned and managed by local or state government. Investment in these assets is made with the intention that profits will accrue through increased productivity and improved efficiency.

The Organisation for Economic Co-operation and Development (cited in Austroads 2009) define asset management as:

"A systematic process of effectively maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing the tools to facilitate a more organised and flexible approach to making decisions necessary to achieve the public's expectations."

3.2.1 Asset Management Plan

An Asset Management Plan (AMP) is a tactical plan for managing an organisation's infrastructure and other assets in order to deliver an agreed standard of service. Typically, an AMP will cover more than a single asset, taking a system approach - especially where a number of assets are co-dependent and are required to work together in order to deliver an agreed standard of service.

An Asset Management Plan is defined in the International Infrastructure Management Manual (National Asset Management Steering Group 2006) as;

"A plan developed for the management of one or more infrastructure assets that combines multi-disciplinary management techniques (including technical & financial) over the lifecycle of the asset in the most cost effective manner to provide a specific level of service."

3.3 SUNWATER'S STRATEGIC ASSET MANAGEMENT PLAN (SAMP)

The aim of SunWater's Strategic Asset Management Plan (SunWater Corporate 2008) is "to manage our assets in a sustainable manner to meet SunWater's business objectives of safeguarding asset integrity and ensuring continuing asset serviceability at minimum whole of life cost."

The relevant sections of the SAMP to this project are water metering, SCADA & maintenance.

3.3.1 Water Metering

All customer delivery points are metered. Depending on the scheme, meters are either read monthly or quarterly. In general, if the scheme uses Capacity Share to manage a customer's water allocation, the meters are read monthly, otherwise they are read quarterly. All customers are billed quarterly. The bill shows the meter reading and the date on which it was read. It also shows how much water the customer has used in the current water year and how much of their water allocation remains.

3.3.2 Standardising SCADA systems

In the water industry, a proven SCADA system is a prerequisite for any automated flow distribution system (SunWater Corporate 2008). Many SunWater Water Supply Schemes have SCADA controlled parts, but they suffer incompatibility issues and are dependant on hardware, software and communication technology that can be difficult to maintain and upgrade.

SunWater has introduced a ten year strategic plan to upgrade, standardise, and integrate all existing SCADA systems and to introduce it to schemes that still rely on manual operation.

The plan aims to:

- standardise SCADA and control systems through standardised and detailed specifications;
- eliminate slow and vulnerable land lines in favour of the new communication technologies such as Ethernet LAN and the World Wide Web; and
- improve system security to conform to current industry standards.

3.3.3 Maintenance

Across SunWater, maintenance strategies are constantly evolving through a process of failure analysis and feedback from operators, maintainers, and customers.

Geraerds (1985) defined maintenance as "all activities aimed at keeping an item in, or restoring it to, the physical state considered necessary for the fulfilment of its product function." However the Maintenance Engineering Society of Australia (MESA) recognises the broader perspective of maintenance and defines it as "the engineering decisions and associated actions necessary and sufficient for the optimization of specified capability."

SunWater's asset maintenance strategies fall into the following categories:

- condition based maintenance – routine or non-routine condition assessment or monitoring determines the maintenance frequency;
- calendar based maintenance – the maintenance frequency is set at pre-determined intervals based on time (weekly, monthly etc);
- hours run based maintenance – the maintenance frequency is determined by the amount of work the asset has undertaken measured in machine run hours; and

- run to failure – the asset is operated until failure which triggers either a maintenance intervention or replacement.

SunWater's maintenance strategies are based on the risk of failure of the particular asset to be maintained.

3.4 THE NEED FOR ASSET MANAGEMENT

Jardine and Tsang (2006) state "the business imperative for organisations seeking to achieve performance excellence demand that these organisations continuously enhance their capability to create value for customers and improve the cost-effectiveness of their operations."

The three underlying reasons why SunWater requires asset management is so assets continue to operate, to mitigate the risks of assets falling over simultaneously and as preparation for asset failures.

SunWater operates under a statement of Corporate Intent agreed to with its Shareholding Ministers, the Queensland Treasurer, and the Minister for Natural Resources and Water. Therefore SunWater's business drivers are:

- customer satisfaction;
- sustainable business growth;
- long-term asset serviceability;
- sound environmental management; and
- providing a safe and rewarding workplace for SunWater employees.

The SAMP document helps provide a process to achieve these goals.

3.5 UNDERTAKING ASSET MANAGEMENT

In the SAMP document SunWater Corporate (2008) describe how SunWater will do the following:-

- Manage SunWater's assets in compliance with all relevant legislation, regulation, licences, permits, approvals and authorities.
- Set business objectives and strategies for SunWater's assets and monitor the performance of assets against these objectives and strategies.
- Clearly allocate responsibilities for the management of assets at all levels within SunWater and its business associates, and build competency through the provision of structured training.
- Know and track information about SunWater's assets, including performance, maintenance history, condition, criticality, estimated life and replacement cost. Maintain this information in an integrated corporate system, and use this information to improve the management of SunWater's assets.
- Document and implement procedures to cover the lifecycle of asset management, from asset creation, through operation, maintenance and asset refurbishment, to disposal.
- Manage SunWater's assets in an environmentally sustainable manner, with due regard to community values and heritage, and provide a safe working environment.
- Seek continuous improvement in asset management through setting up and applying processes for review and updating of procedures, and supporting research and development in asset management related areas.

3.6 SUMMARY

Asset management provides strategic and tactical direction for maintaining the many assets owned and operated by SunWater. Effective asset management can help achieve the goal of efficient water use in-spite of the extensive infrastructure involved in a water supply scheme. If the assets are well maintained and operating to their full potential then the likelihood of losses and overflows will be decreased and the ability to manage the system will be increased. Flow meters are one of the most crucial assets required for effective management of a water supply scheme.

4.0 ELECTROMAGNETIC FLOW METERS

4.1 INTRODUCTION

Queensland's development and economy depends on a handful of base resources, one of these being a suitable and readily available water supply. However because of a dry climate this cannot always be achieved. Therefore it is essential that the use of our water resources be as efficient as possible.

For SunWater to know how efficiently they operate their water supply schemes it is necessary to know how much water is available and how much of it can be used effectively. In order to ensure fair supply of water, SunWater must understand the behaviour of the system. The measurement of water is the best means to determine the efficiency and indicate where water losses occur.

Electromagnetic flow meters are one of the many types of meters currently in service throughout the Burdekin Haughton Water Supply Scheme. This chapter looks at these meters in further detail.

4.2 ELECTROMAGNETIC FLOW METERS IN SERVICE

Electromagnetic flow meters operate on the principle of Faraday's Law of electromagnetic induction. Faraday's law of electromagnetic induction states that the voltage induced across any conductor as it moves at right angles through a magnetic field is proportional to the velocity of that conductor (Chow 2006). Therefore regarding flow meters the voltage induced within the conductive fluid (water) is measured via two electrodes that are mounted perpendicular to both the magnetic field and the axis of the pipe/meter.

Electromagnetic flow meters:-

- have no moving parts;
- are accurate for all water turbidity's;
- are not affected by weed loads; and
- have very low head loss characteristics.

When compared to other technologies, electromagnetic flow meters are relatively expensive to purchase although this is expected to be offset by low maintenance costs (SunWater Graduates 2004).

Electromagnetic flow meters are used widely in urban and wastewater systems and in industrial applications where a high degree of accuracy is required. They have been used sparingly in Australian irrigation systems mainly due to their relatively high purchase cost (SunWater Graduates 2004). However, now with the Australian metering standard and other accuracy requirements being put into place they seem to be one of the better options.

The three electromagnetic flow meters currently in service in the BHWSS are the Tyco Emflux 2060, the Tyco Emflux Irriflow (both in conjunction with the Emflux I300 Flow Transmitter) and Siemens' Sitrans FM Magflow 8000.

4.2.1 Tyco Emflux 2060

The 2060 flow detectors in service in the BHWSS are of steel welded construction and have an abrasive resistant liner. They are typically used for water distribution at both farm outlets and pump stations.

Figure 4.1: Tyco's Emflux Model EM 2060

4.2.2 Tyco Emflux Irriflow

The Irriflow is designed to meet the specific requirements of an open channel irrigation scheme which some parts of the BHWSS, particularly the older sections of Clare, Millaroo and Dalbeg are. It is typically used in the BHWSS for overflow measurement and in special cases at farm outlets.

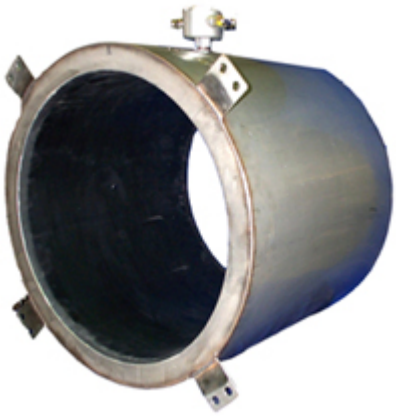

Figure 4.2: Tyco's Emflux Irriflow

4.2.3 Emflux I300 Flow Transmitter

The Emflux I300 is a flow meter transmitter that operates off a solar powered battery. It is used in conjunction with the two previously mentioned flow detectors to provide display and output of flow measurement. It is designed to meet the requirements of remote and non-powered site applications. It is used in the BHWSS in conjunction with all Tyco electromagnetic flow meters.

Figure 4.3: Tyco's Emflux I300 Flow Transmitter

4.2.4 Siemens Sitrans FM Magflow 8000

The Sitrans FM MAG 8000 allows the flexibility to install a reliable water meter virtually anywhere without sacrificing accuracy or performance. The meter is battery powered therefore no mains power is required. The meter complies with all water meter standards. They are also typically used throughout the BHWSS for water distribution at both farm outlets and pump stations.

4.3 USE OF ELECTROMAGNETIC FLOW METERS

SunWater Operations & Maintenance (2004) outline why they measure water delivered to customers in Principles of Water Flow and Water Measurement.

It is desirable to measure water delivered for the following reasons:

- Water is charged for according to the actual quantity supplied.
- Encouragement is given to use water efficiently because water wasted is money wasted.
- Water is delivered to the user in accordance with their allocation.

- Metering provides the irrigator with the water use data essential for efficient farm management.
- Efficiency of delivery can be more accurately determined and losses traced.

These points are further detailed in Water Meters (SunWater Operations and Maintenance 2004) whereby it states that the metering of water use is a critical part of water management as it allows SunWater to:

- monitor individual customer use against entitlement;
- bill customers for water use to obtain revenue; and
- calculate the water distribution efficiency of the system.

4.3.1 Legislative Requirements

A point that has been neglected in the SunWater documentation to date is that of legislative requirements. In Non-Urban Meter Installation and Maintenance (Irrigation Australia Limited 2008) it states that a national policy framework, the Metrological Assurance System, for measuring and metering water taken from water resources, including water delivered to and taken by non-urban customers in water supply schemes will be agreed by the Natural Resource Management Council. It also states that this framework will be implemented in each jurisdiction through State water policies and legislation.

The National Measurement Act provides the basis for the national measurement regulations. Exemptions did exist for rural irrigation meters however in July 2009 it was the intention of the National Water Initiative to lift these exemptions. The National Measurement Institute (NMI) has developed a metrological control system for utility meters which consists of pattern approval and uniform test procedures for all new meters. Standards Australia has developed standard specifications for flow meters. The Australian Standards are currently in draft form and are identified as ATS4747-2008.

4.3.2 The National Measurement Institute

The National Measurement Institute webpage (2009) states that it is "responsible for Australia's national infrastructure in analytical, biological, chemical, legal and physical measurements." Under the National Measurement Act 1960, NMI is responsible for "coordinating Australia's national measurement system, and for establishing, maintaining and realising Australia's units and standards of measurement, thereby allowing Australian industry to operate competitively in a global environment."

It also states that

"NMI delivers essential services to the Australian economy by;

- providing the legal and technical framework for disseminating measurement standards;
- working with clients in industry and government to provide measurement expertise, calibration services, chemical and biological analyses and pattern approval testing; and
- supporting Australia's standards and conformance infrastructure."

It is the above mentioned, pattern approval, to which pertains most to this project.

4.3.3 Pattern Approval

Irrigation Australia Limited (2008) define pattern approval in Non-Urban Meter Installation and Maintenance as the process whereby an impartial body examines the pattern of an instrument against a set of national or international metrological specifications. This determines whether an instrument is capable of retaining its calibration over a range of environmental and operating conditions and ensures that the instrument is not capable of facilitating fraud. Pattern approval is gained through the NMI by the examination of the pattern of a measuring instrument and testing of sample instruments. The specifications against which a sample instrument is tested agree to the greatest possible extent with international specifications. Once the pattern of an instrument has been approved a certificate of approval is issued. Subsequent production instruments made to the pattern must be marked with the approval number contained in that certificate. The marking of this number on a production instrument is the primary indication to a trade

measurement inspector or a licensed certifier that the measuring instrument is of an approved pattern.

4.3.4 Australian Technical Specification

The Australian Technical Specification 4747-2008 was prepared by the Standards Australia Committee CE-024, and is titled the Measurement of Water Flow in Open Channels and Closed Conduits. The objective of this technical specification was to provide manufacturers with requirements for irrigation and non-urban water meters to meet the requirements of the NMI. The specification includes essential requirements to maintain progress with technology in the water meter industry. The main benefit of the standard will be the common accuracy and compliance of all meters manufactured and installed in non-urban locations.

4.4 USE OF ELECTROMAGNETIC FLOW METERS

ATS 4747-2008 details that manufacturers will provide work instructions or guidelines for the correct installation of their meters. These guidelines should cover all aspects including specifications, performance analysis and general installation. The manufacturer's installation guidelines should be consistent with ATS 4747-2008 and pattern approval requirements. Installers must check to ensure the nominal diameter requirements of the meter meet either ATS 4747-2008 or the pattern approval requirements. ATS 4747-2008 specifies a minimum of 10 nominal diameters upstream of the meter and 5 downstream.

Figure 4.4: A recent Electromagnetic Meter installation

4.5 CURRENT MANAGEMENT OF ELECTROMAGNETIC FLOW METERS

4.5.1 Meter Reading

Water meters in the BHWSS are read every quarter for billing purposes. The meters are also read after events such as water harvesting. It is necessary that all meters are read accurately, recorded accurately and are auditable. It is important that all meters are read during the quarterly meter read as this forms the basis of the billing and management of water use by SunWater. An added bonus to the meter read is the detection of failed meters.

4.5.2 SCADA

The SunWater Graduates (2004) state that all current electromagnetic meters have the ability to output information that can be recorded and transmitted to a central control station, or used to control on-site equipment in an automated process situation. SunWater does not currently utilise this technology.

4.5.3 Information Management

All water usage data is recorded on a program called SWIMS. The SWIMS program encompasses the following business functionality:-

- the management of the allocation, availability and quality of the scheme water information associated with SunWater's resource operating licences and bulk water entitlements;
- customer water account management associated with water supply to water customers;
- water products management for water supply services and associated tariff schedules;
- water billing management for processes associated with billing for water supply services including rates and charges; and
- customer contact management including tools to manage customer contacts using SunWaterOnline.

The process for entering data into SWIMS is:-

- If the flow meter is working:
    1. Water officer reads meter and records reading in meter book.
    2. Meter book is delivered to the office.
    3. Information in meter book is verified and meter reading entered.
    4. Periodic billing process is undertaken (when all meter readings for the scheme are entered and all Meter Adjustment Reports (MAR) for usage estimates received and entered).
    5. Customers are issued with tax invoices (on a scheme basis).

- If the flow meter is not working:

    1. Customer service representative verifies information from meter book and informs meter reader (if not already noted or received) that a Meter Adjustment Report is required for input into SWIMS

    2. Meter reader, in consultation with irrigator; sign off on a water usage estimate, known as the MAR. This figure usually refers to the Streamline water order. At present there is no way to determine whether more water than was ordered was used.

    3. The MAR is delivered to the office.

    4. Meter reading (usually as per previous quarter) and MAR for usage estimate entered into SWIMSR2.

    5. Periodic billing process is undertaken (when all meter readings for the scheme are entered and all MARs for usage received and entered)

    6. Customers are issued with tax invoices (on a scheme basis).

4.5.4 Maintenance

At the current time, apart from repair and replacement, SunWater has no maintenance plans in place for this particular asset. The SunWater Graduates (2004) reinforce this policy and state that having no moving parts the EM flow meters should require little maintenance.

SunWater currently manages the electromagnetic flow meter fleet by the run to failure strategy. As explained previously this means the flow meters are operated until failure which triggers either a maintenance intervention or replacement. The main reason this strategy is used is due to the fact that the risk from failure is very low. If the meter fails SunWater intervenes as required and simply lodges a meter adjustment report for the usage over the time the meter was not operating.

SunWater document any work undertaken on its assets and this information is noted in SAP PM, the asset database used by SunWater whereby all assets are listed by functional location. If works are more than standard meter maintenance, a work order is raised against the functional location to track costs. Otherwise a notification is used to track work completed.

4.6 SUMMARY

The measurement of water is the one of the most important means to determine the efficiency of a system and indicate where water losses occur. EM flow meters are an effective way to measure water because they are accurate for all water turbidity's, are not affected by weed loads and have very low head loss characteristics. To ensure that the EM flow meters are operational and fully functional it is essential to utilise an effective management system. SCADA is one of the many methods of managing flow meters.

5.0 SUPERVISORY CONTROL AND DATA ACQUISITION

5.1 INTRODUCTION

A key process regarding SCADA is the ability to monitor an entire system in real time. A Supervisory Control and Data Acquisition system allows for more reliable data with 100% accuracy in the transfer of information from the site in question to the recording stations. It also allows for more up to date information to be provided to the recording stations. This chapter focuses on the process of the SCADA systems available and the SCADA systems in use throughout the BHWSS.

5.2 SUPERVISORY CONTROL AND DATA ACQUISITION

The phrase Supervisory Control & Data Acquisition (SCADA) is defined by SunWater Corporate (2008) as covering all of the components that could be reasonably expected to comprise a system for remote and local management and control of water supply assets including:-

- transducers & actuators;
- power systems;
- PLCs (Programmable Logic Controllers);
- RTUs (Remote Telemetry Units);
- telecommunications including MODEMs and associated equipment;
- data communication protocols;
- TSPs (Telecommunications Service Providers) & ISPs (Internet Service Providers);
- HMIs (Human Machine Interfaces);

- reporting and data visualisation tools;
- data & information management storage devices (Data Historians); and
- other support items involved in the process of managing the supply of water.

For the most part, the brains of a SCADA system are performed by the Remote Terminal Units (SunWater Corporate 2008). The Remote Terminal Units (RTUs) consist of a programmable logic converter. The RTUs are usually set to specific requirements; however, most RTUs allow human intervention to override. In addition, any changes or errors are usually automatically logged and/or displayed. Most often, a SCADA system will monitor and make slight changes to function optimally. SCADA systems are considered closed loop systems and run with relatively little human intervention.

One of the key processes of SCADA is the ability to monitor an entire system in real time. This is facilitated by data acquisitions including meter reading, checking status of sensors, etc that are communicated at regular intervals depending on the system. Besides the data being used by the RTU, it is also displayed to a human that is able to interface with the system to override settings or make changes when necessary.

The two systems currently on the market which were reviewed as part of this project are the Ajenti water management system and the JO COM RAT system.

5.2.1 Ajenti Water Management System

Ajenti is a water management system that combines sophisticated data logging and wireless communication. It is a new water management system that is cost-effective, simple to use and extremely reliable (Tasmanian Water Use Management Project Team 2009). Developed by Hydro Tasmania Consulting, the system collects, transmits and presents water flow data allowing clients to readily report, analyse and adjust their water usage on the internet. An Ajenti system can be installed, commissioned and returning data in less than an hour without the need for specialised skills, expensive equipment or extensive RTU knowledge. The large liquid crystal display (LCD) display allows users to view the unit's status on the spot, negating the need

for diagnostic software or tools. All Ajenti units are identical, making them completely interchangeable, which is particularly useful in the event of accidental damage or failure.

5.2.2 JO COM RAT System

The JO COM company are a subsidiary company of AWMA. The JO COM RAT (Remote Access Telemetry) utilises internet access to collect data from isolated sites, as well as remotely control the infrastructure at these sites. By using internet technology and the mobile phone network, AWMA is able to provide low cost but high speed access to remote sites (AWMA – Water Control Solutions 2009). Modems utilised by the system provide permanent internet access. There are no connection charges and running costs are based on the amount of data transferred - not the amount of time on-line. Because existing networks are utilised, system installation costs are minimal for a wide area telemetry system, especially when compared to a radio network. The JO COM RAT system has three key components which make up the complete system. The first is the local area network which is made up of low cost VHF radio nodes. These radio nodes monitor digital/pulse inputs for the flow meters. The second component of this system is the JO COM RAT Hub Station which connects the local network to the hub computer. The hub uses the computer as its main processor which has serial ports for connection to the VHF master transmitter and a cellular modem to connect to the internet. The third component of the JO COM RAT system is the office server which can run a Linux or Windows operating system. The server is required so all field data can be transferred securely and efficiently. The office server enables interfacing with existing or new SCADA systems. If these programs are not available JO COM can design and implement web pages providing multi-level protected access to all remote sites in the system which can be controlled and monitored from any computer connected to the internet.

5.3 USING SUPERVISORY CONTROL AND DATA ACQUISITION

SunWater Corporate (2008) states that the SCADA Strategic Plan was developed to "normalise, formalise, standardise, and describe a pathway for SCADA development, to meet future performance objectives of SunWater." In turn this was driven by:

- a requirement for more accountability in asset performance – especially with respect to operational efficiencies;
- improved alert and prevention of potential vandalism and/or malicious acts (terrorism) against water supply assets; and
- improved management of water as a commercial resource for irrigation customers, communities and the industry in the context of ongoing adverse climatic conditions.

The above dot points specifically follow on from the previous discussions regarding electromagnetic flow meters and their efficiency requirements.

A SCADA system will allow for more reliable data with 100% accuracy in the transfer of information from the flow meters to the recording stations and also allow for more up to date information to be provided to the recording stations.

SunWater already has a SCADA system in use for management and control of regulating gates at strategic points throughout the Haughton system of the irrigation scheme. These regulating gates control and distribute the irrigation water throughout the system. A company known as Rubicon was engaged to set up this system.

The Mimic Screen Sub-system User Reference Guide by Rubicon Systems Australia (2000) provides sufficient information to operate the MIMIC screen sub-systems of the Irrigation Management System and System Planning Modules of the Rubicon software suite. The Mimic screen sub-system is written in the Java programming language. Whilst it is closely integrated with the existing form and schematic facilities, at the operating system level, it operates as a completely independent program.

The Rubicon software provides a Graphical User Interface (GUI) for data monitored and controlled by the Rubicon SCADA/Data Collection subsystem. This data is presented in a process graphics format in accordance with the general conventions used within the broader SCADA industry. The design of the screen system is based on simple and easy to use intuitive graphical representations that require little or no end-user training. Extensive use of colour, symbols, time series graphs and animation is made throughout the system.

Immediately after the software has been invoked, contact is made with the IMS event server to get the latest value of all tags for the system. After the real time database has been built on the client, the system builds and lays out the screens. The default or Overview Screen is shown below.

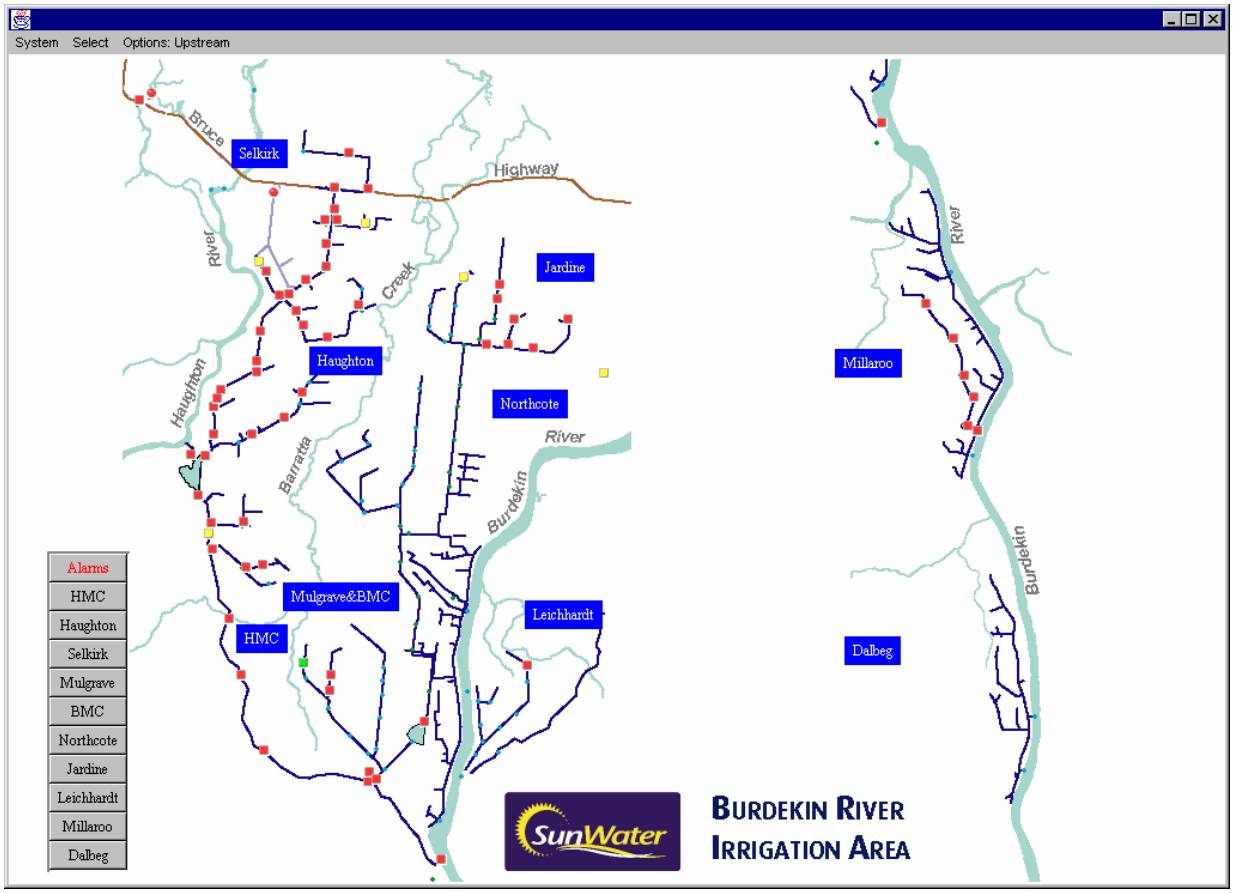

Figure 5.1: Overview screen for the BHWSS Regulator Gate control system

The design intention of the overview screen is to provide the operator with a comprehensive overview or summary of the status of the complete system. Given the amount of information that needs to be presented, this information is presented in a summary form. Facilities are provided from pull down menus, buttons and hot-keys to navigate to other screens and invoke more functions such as trending.

Rubicon Systems Australia (2000) provides detailed information on the actual operation of the system in the Mimic Screen Sub-system User Reference Guide. This includes sub-system screens, site screens, viewing alarms, screen navigation, trending data and paging.

5.4 MANAGEMENT OF SUPERVISORY CONTROL AND DATA ACQUISITION

A SCADA system, as with all assets requires management. Currently maintenance is conducted on the Haughton SCADA system every 6 months. Work done at this time is completed by SunWater's electricians. This work is considered preventative maintenance as detailed above under the maintenance section in the SAMP. Corrective maintenance is also completed where required.

5.5 EXTERNAL CASE STUDIES

5.5.1 CIT Remote Flow Meter Monitoring, Riverland irrigation districts, SA

AWMA were engaged by the Central Irrigation Trust (CIT) on a remote meter reading project. The purpose of the project was to develop a radio telemetry network that enabled remote access to electronic meter readings, including water consumption and flow rates.

This project demonstrated how introducing innovative irrigation metering technology and data systems can improve water use efficiency. It allowed the Central Irrigation Trust based at Barmera to transfer consumption and flow data from 2300 electronic water meters on irrigation farms to a central computer system every 15 minutes. This allowed farmers and system managers live access to information on flow and consumption 24 hours a day seven days a week.

The project:

- gave irrigators access to flow and consumption data to maximise water use efficiency;
- provided information that lead to more precise irrigation schedules improving crop productivity and provided water savings of 1100 megalitres per year;
- built the capacity of water planners to analyse how water is supplied and improve performance; and
- increased the ability to fine tune water delivery to meet critical demands.

The project advanced the National Water Initiative objectives of improving water resource accounting and increasing water use efficiency in agriculture (Jim Atsaves and Gavin McMahon 2008).

5.5.2 Gnangara Mound Metering Project

The Gnangara Mound Metering Project is trialling meter reading using remote technology. This technology is beneficial in situations where a meter is located in a hazardous position, where there are property access and bio-security issues, and for accurate data logging capabilities (Metering on the Gnangara Mound 2009).

Remote readout technology uses radio frequency signals to send flow measurements from a meter (with a pulse output device) to a receiver. The range can be increased by using high gain antennas or relaying a signal from one pulse device to another and eventually to a receiver.

Remote readout technology enables meter readings to be obtained where time, potential hazards or great distances make it difficult and / or costly. It also minimises the potential for human error and provides greater data integrity.

The Gnangara Mound Metering Project has been able to retrofit meters with pulse emitting registers necessary for this technology.

5.5.3 Tasmanian Water Use Management Project

This project was to collect and manage water use data for all irrigation licensees through the installation of 3000 telemetry units on farm water meters which are being rolled out across Tasmania. The water use data from the on-farm meters will be stored on a central web based database and licensees will be able to access their own daily water use, total use and use against their allocation on line. A training program will be offered for irrigators, and will link with existing state-wide research and extension programs on water use efficiency.

The project will provide water users and managers with reliable water use data for water management and planning purposes across Tasmania. Licensees will have real time access to accurate water use data which will result in more water efficient production (Tasmanian Water Use Management Project 2009). The project will advance the National Water Initiative objectives of improving water metering and measuring and increase efficiency of water use in agriculture.

5.6 SUMMARY

A SCADA system provides 100% accuracy in the transfer of information from a particular site to a recording station. SCADA provides irrigators and suppliers with reliable water use data for water management and planning purposes, which results in efficient water usage and delivery. Therefore it is essential that SunWater improve the current management of electromagnetic flow meters at customer's irrigation offtakes to achieve efficient water usage and delivery.

6.0 FLOW METERS

6.1 INTRODUCTION

This chapter and the subsequent four chapters outline the processes that were followed to address the project objectives. This particular chapter investigates and evaluates the meters that are relevant to this project. This includes the EM meters as well as dethridge wheels and propeller actuated meters currently being replaced by the EM meters.

6.2 FLOW METERS

There are currently 1299 flow meters installed in the BHWSS. These meters are spread between the various sections of the BHWSS as shown below.

Table 6.1 Metered Outlet Locations

Section / System	Total Number of Metered Outlets
Burdekin River	66
Giru Benefited Area	201
Barratta System	234
Haughton System	196
Elliot Section	44
Clare Section	259
Millaroo Section	182
Dalbeg Section	117

The particular meter types pertaining to this project include:

- dethridge wheels;
- propeller actuated meters; and
- electromagnetic flow meters.

A summary of each of the meter types are presented in the following sections. Much of the background and influencing factors regarding electromagnetic flow meters has been mentioned previously.

6.2.1 Dethridge Wheel

The dethridge wheel is a simple and robust mechanical flow meter. It consists of a fabricated paddle wheel (cylindrical metal drum fitted with eight vanes around the circumference mounted on a horizontal axle) running in a concrete flume emplacement. Volumes passed are recorded in megalitres (ML) on an inbuilt revolution counter. By timing the speed of wheel rotation, flow rates in ML/day can be easily calculated. A control mechanism is incorporated in the structure to regulate flow and this is usually a manually operated gate.

Figure 6.1: A Dethridge Wheel

The main advantage of the dethridge wheel is its ease of use and its method of operation is easily understood by field staff and customers (SunWater Graduates 2004). The capital cost is economical in comparison with many other meters of similar capacity and no power source is required. However, it is a safety hazard due to the large mass of the meter wheel, manually operated gates and exposed rotating vanes. It can also create a barrier to access along the channels. Unfortunately the dethridge wheels can also be physically manipulated (tampered) so that they do not rotate. The accuracy of these meters has been known to fluctuate by up to 20 percent (SunWater Graduates 2004).

SunWater currently has a rolling replacement program converting dethridge wheels to electromagnetic flow meters. There are currently 245 dethridge wheels still in service in the BWHSS. Therefore as these meters are replaced the number of electromagnetic flow meters which are to be managed increases.

6.2.2 Propeller Actuated Meters

Propeller actuated (PA) meters consist of a propeller with a rotational axis set parallel to the water flow. There are two main types of propeller actuated meters, open flow and closed flow. Open flow type PA meters have an extended spindle shaft that is mounted on the downstream end of a pipe culvert with the propeller projecting inside the pipe. Closed flow type PA meters are fully enclosed in closed pipe work systems and come in a variety of connection types such as flanged, spigot, saddle, tee insert and weld on.

Figure 6.2: A saddle type Propeller Actuated flow meter

Propeller actuated meters have a mechanical readout and have the ability to measure flow rate and totalised flow. These meters can also easily retrofit electronic/remote readout capabilities by fitting a magnetically operated signal sensor.

PA meters are robust and have a long working life (SunWater Graduates 2004). These meters can operate in relatively turbid water, are tolerant to silty/sandy water and can be installed and repaired locally by SunWater staff. The closed type meters can be installed horizontally or on an incline without loss of accuracy. Propeller actuated meters can, however, be fouled by weed and

are susceptible to tampering. They also have higher maintenance requirements and head loss compared to non-obstructive flow meters (SunWater Graduates 2004).

SunWater also currently have a rolling replacement program converting saddle type propeller actuated meters to electromagnetic flow meters. There are currently 54 saddle type meters still in service in the BWHSS. Therefore as these meters are replaced the number of electromagnetic flow meters which are to be managed increases.

6.2.3 Electromagnetic Flow Meters

There are currently 167 electromagnetic flow meters in service in the BHWSS. They are distributed throughout the following sections of the BHWSS.

Table 6.2 Electromagnetic Flow Meter Locations

Section / System	Total Number of Metered Outlets
Burdekin River	0
Giru Benefited Area	0
Barratta System	4
Haughton System	2
Elliot Section	0
Clare Section	97
Millaroo Section	29
Dalbeg Section	35

As mentioned earlier, the three electromagnetic flow meters currently in service in the BHWSS are the Tyco Emflux 2060, the Tyco Emflux Irriflow (both in conjunction with the Emflux I300 Flow Transmitter) and Siemens' Sitrans FM Magflow 8000.

Data checks were conducted during a recent meter read to confirm the number and type of the meters. This checking was required due to confusion between information in SWIMS and in SAP (the financial and asset databases respectively.)

6.3 WATER USAGE

As mentioned previously water meters in the BHWSS are read every quarter for billing purposes and all water usage data is then recorded on a program called SWIMS. The water usage report for the sample group, which is discussed later, and the entire Brand X electromagnetic flow meters, which is also discussed later, can be found in Appendix B. This information was retrieved from the system with the assistance of SunWater's system analyst.

The water usage data was used to produce two outputs, the average yearly usage for the sample group and the average yearly usage for the entire Brand X EM flow meter fleet.

The average yearly usage for the sample group was determined by adding all of the quarterly usages for the six sample meter locations for each of the water years analysed. An average was then taken from the six outputs to produce the average yearly usage for the sample group. The figure produced was 206.23 ML/year.

The average yearly usage for the Brand X type EM flow meters was determined by summing the total water usages of the Brand X electromagnetic flow meter fleet for each of the water years analysed. This figure was then divided by the number of Brand X meters in service for each of the water years to give the average yearly usages for the entire fleet for the water years respectively. The average was then determined of these results. The figure produced was 204.39 ML/year.

An original objective was to determine at what usage it became necessary to implement SCADA of a particular customer's offtake. However given the small number of meters currently converted to electromagnetic flow meters there is no need to determine this usage. It was originally thought that trickle irrigation would not be required to be monitored however this view has changed. The main reason for this is that the greatest cost is in the setting up of the system not necessarily the number of meters analysed. Also given the accuracy of most other variables in the efficiency analysis and water balance models it would be counter productive to not monitor trickle irrigation just because of its low usage.

6.4 METER FAILURE

A failure analysis was conducted on the entire fleet of electromagnetic flow meters in service throughout the BHWSS. Due to the low risk of meter failure, SunWater has traditionally kept limited records of these instances. However, with the creation of the Metering Co-ordinator position, in late 2007, the record keeping has improved dramatically. During the failure analysis it was realised that the rate of failure of a particular brand of electromagnetic meter was noticeably higher than the others. Therefore only this particular brand of meter, referred to as Brand X previously and from this point forward, has been thoroughly investigated.

There have been a total of 84 documented failures for the investigated brand of meter. All of these failures are detailed in Appendix C. It is interesting to note that all of the failures to date have occurred in the display box.

Using the meter failure spreadsheet the Mean Time Between Failure (MTBF) was determined. MTBF is defined as the sum of operational periods divided by the number of observed failures (Ebeling 2002). The MTBF was found for this project by summing the total operational hours of all the electromagnetic flow meters and dividing by the total number of meter failures. The MTBF determined was 2793.02 days. It must be noted that this figure is not entirely correct due to undocumented failures which may have occurred between the initial installations of electromagnetic flow meters on the 24th August 2001 until the creation of the Metering Co-ordinator position, in late 2007. However for the purpose of this project this figure will suffice.

6.5 SUMMARY

There are 167 electromagnetic flow meters in service throughout the BHWSS. This figure is expected to expand to 466 with the rolling replacement SunWater is currently undertaking. The average yearly usage for the current fleet of Brand X EM meters is 204.39 ML/year. During the failure analysis it was determined that the rate of failure of Brand X EM meters was noticeably higher than the others. There have been a total of 84 documented failures for the Brand X meter which lead to an MTBF of 2793.02 days. Therefore only this particular brand of meter has been thoroughly investigated in this and following chapters.

7.0 MODELLING

7.1 INTRODUCTION

This chapter explores and evaluates the reliability of the current fleet of Brand X EM flow meters in service throughout the BHWSS. Due to the low MTBF it was essential to investigate the reliability of the Brand X EM flow meter. This was done by analysis of the fleet using asset engineering calculations. An approximate costing was also undertaken to justify the investigation of the problem.

7.2 RELIABILITY

For engineering purposes SunWater adopts a similar approach to reliability to that defined by the Institute of Electrical and Electronics Engineers (IEEE) being "the ability of a system or component to perform its required functions under stated conditions for a specified period of time."

Therefore the failure analysis, conducted as part of this project, provided the information to produce a reliability model that predicts the probability of a failure of an electromagnetic flow meter installed and operated in the BHWSS at a selected asset life.

7.3 RELIABILITY MODEL

The theory behind the reliability model was taken from the Efunda Engineering Fundamentals website (2008) and is listed below, it must be noted that the MTBF was determined during the failure analysis (Chapter 6.4):-

- λ (a positive constant) = 1 / MTBF
- $R(t) = e \wedge (- \lambda * t)$
- $F(t) = 1 - R(t)$
- $f(t) = \lambda * R(t)$

The positive constant λ represents the failure rate. Failure rate is the frequency with which an engineered system or component fails (Ebeling 2002). It is simply the inverse of the MTBF. The reliability function – R(t) – is the probability that a unit does not fail in the specified time interval – t – (Efunda 2008). It is this reliability function which is most relevant to this project. By using the MTBF data determined for the relevant flow meters, this function allows the ability to predict the probability of one of these electromagnetic flow meters, in service in the BHWSS, failing at a specified time. The failure distribution function – F(t) – is simply the opposite probability to the reliability function. It is the probability that a unit does fail in the specified time interval – t – (Efunda 2008). The function – f(t) – is simply the density function of failure (Efunda 2008).

The first batch of electromagnetic flow meters was installed on the 24th August 2001. Therefore at the analysis date on the 8th of December 2008 their operational life was 2663 days. The output from the model and the reliability function are shown below. A full listing of results is shown in Appendix D.

Table 7.1 Outputs from the Reliability Model

MTBF	2793.02381
λ	0.000358035

Failure rate

Probability of Failure at 2663 days 61.46%

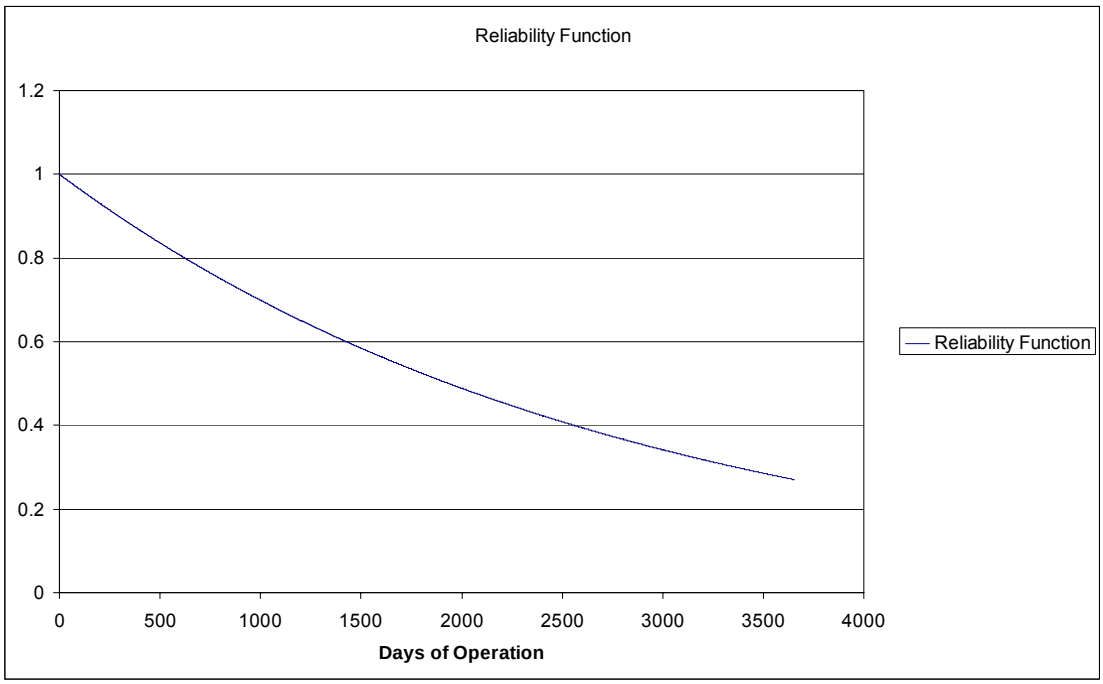

Figure 7.1: Reliability Function

A probability of failure of 61.46% for the original meters leads to a reliability of only 38.54%. This is far too low given that these meters have an expected asset life of 15 years (SunWater Water Services 2008).

7.4 REPAIR COSTS

After discussion with the Meter Co-ordinator in the Ayr office an agreed value for approximate repair costs of the Brand X EM flow meters were determined. This approximation has been displayed below:

Table 7.2 Brand X Repair Costs

Task	Cost	Description
Remove computer, box up and send away for repairs	$ 180.00	2 hours for water officer
Repair costs	$ 621.37	Average from purchase orders
Sap information incl purchase order, work orders, notis	$ 180.00	2 hours for admin officer
MAR's	$ 90.00	1 hour for water officer
Replace repaired computer	$ 180.00	2 hours for water officer
Total	**$ 1,251.37**	

Adopting the usage data, the number of failures for each of the water years and the above information, the yearly cost per ML delivered was able to be determined. This was achieved for each particular water year by multiplying the number of failures by the repair cost then dividing by the number of meters in service for the particular water year. This result was then divided again by the total usage for the water year in question. The following chart displays the results for each water year.

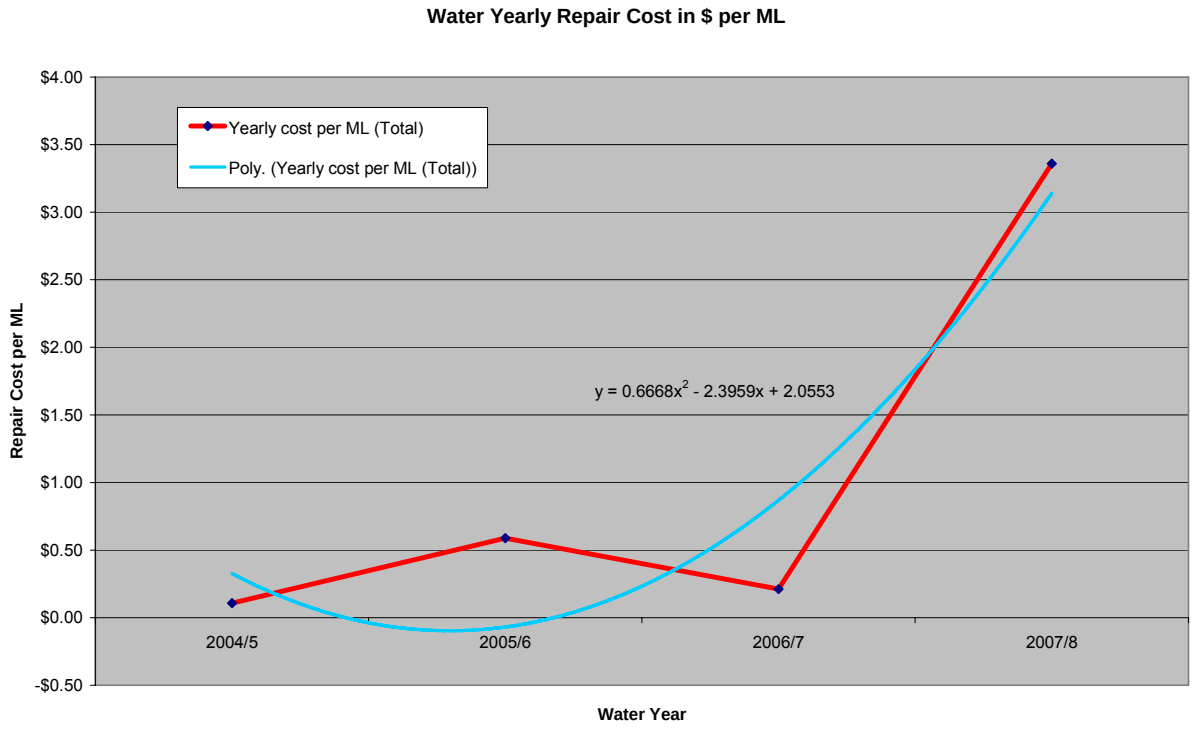

Figure 7.2: Water Yearly Repair Cost in $ per ML

It is easy to interpret from the above chart that the money spent on flow meter repairs is increasing for each water year. The polynomial displayed on the chart represents this increase however the limited data points must be taken into consideration when drawing this conclusion. The increase in failures has also coincided with the creation of the Metering Co-ordinator position so it is hard to use this chart for any real justification of an increase in failures. This chart does however show the substantial amount of money being spent on meter repairs. Given that water is charged at $45.75 per ML (Corporate 2006), SunWater cannot afford to be spending $3.36 (over 7%) of that revenue purely on Brand X EM flow meter repairs.

7.5 SUMMARY

The reliability of an electromagnetic flow meter installed and operated in the BHWSS with an asset life of 2663 days is only 38.54%. This is far too low given that these meters have an expected asset life of 15 years and are currently only 7.3 years old. Due to the low reliability and extensive repairs it has been established that the Brand X EM flow meters are not cost effective. Also SunWater cannot afford to be spending over 7% of the revenue raised from irrigation offtakes on Brand X EM flow meter repairs. These results show that an investigation must be undertaken to rectify the current issues with the Brand X EM flow meter.

8.0 INVESTIGATION INTO FAILURES

8.1 INTRODUCTION

This chapter details the investigation into the problems associated with the Brand X EM flow meter. The investigation discusses the accidental damage or suspected tampering of the meter, the environmental issues with respect to the high heat and humidity in northern regions and further explores the detailed condition assessment of the Brand X EM flow meter.

8.2 ACCIDENTAL DAMAGE OR SUSPECTED TAMPERING

Since the first electromagnetic flow meter was installed on the 24th of August 2001 there have been four confirmed instances of accidental damage or tampering. The concise Oxford dictionary of current English (1990) defines the verb tamper as 'to interfere with (something) without authority or so as to cause damage.'

After reviewing the SunWater documentation regarding these issues it was determined that on three occasions the cabling to the meter had been somehow broken or cut. This cutting of the cabling has therefore rendered the flow meters useless.

Figure 8.1: A broken or cut meter cable

The meter in Figure 8.2 was damaged by a trash fire which burnt around the meter pole that houses the cabling. The burning of trash is one of the final processes of the harvesting of sugar cane. Once harvested, the remaining sugar cane, known as trash, left in the paddock is raked up and burnt. Due to the high heat developed inside the pole, during this burning of trash, the cabling was damaged hence rendered the meter useless.

Figure 8.2: A burnt meter pole

Due to the fact that there is very little evidence or prosecution to prove tampering no further analysis was conducted. However an interesting point to note is that all of the documented cases of accidental damage or suspected tampering have occurred in the Clare section, with three of the four cases occurring on the same channel.

8.3 TEMPERATURE AND HUMIDITY

Due to the high number of failures detailed above it was decided to conduct temperature and humidity testing as part of this project. This was done for a couple of reasons. Due to the northern location of the BHWSS, temperature and humidity can often be quite high. Also the main crop in the Burdekin Haughton Water Supply Scheme is sugar cane which is required to be burnt before harvesting. The harvesting season is typically between the middle of June to the end of November. Due to the meters generally being located in close proximity to the crop it was assumed that the meter display boxes may be subjected to temperature spikes throughout the burning process of the cane harvesting season.

The nominated ambient temperature range of the electromagnetic flow meters in service is 0 to 55 degrees Celsius. These values have been identified as the thresholds whereby the meters will be judged.

To conduct the relevant temperature and humidity testing all software, sensors and associated items were procured through the SunWater purchasing group. The software purchased was called ‘eTemperature’ and provided the viewing and programming of the six temperature logging devices. The ‘eTemperature’ software allowed the:

- programming (setup) a temperature logger;
- downloading of the readings from a temperature logger;
- displaying of the readings as a table and graph;
- saving of the readings to files for later recall;

- reloading of the readings from file; and
- exporting of the results to the clipboard and other programs.

The temperature and humidity testing was conducted at six selected sites throughout the BHWSS. One logger was placed in the Barratta system, two were placed in the Clare section, two in the Millaroo section and the last logger was placed in the Dalbeg section.

The first step in the testing was the calibration of the data loggers. Initial calibration involved placing all six data loggers in the meter display box at Clare Main Channel B at 9863.33m (CB077W1) for one week, Friday 28th November 2008 till Thursday 4th December 2008. This data was then reviewed to confirm that all of the loggers were operating within an accepted tolerance of +or- 5°C. The average, minimum, maximum and standard deviation of the hourly data range is shown below.

Table 8.1 Calibration Statistics

Average Range =	1.240712	°C
Minimum Range =	0.073	°C
Maximum Range =	3.503	°C
Standard Deviation =	0.783144	

This calibration process determined that the data loggers were within the required tolerance.

The temperature and humidity loggers were then placed inside the meter display boxes. The exact locations of the sites were:-

- Barratta Ba1 at 9455.0m (BM270W1);
- Clare Channel B3 at 3622.0m (CB212W1);
- Clare Channel B3 at 3825.0m (CB213W1);
- Millaroo Main Channel A at 1986.0m (MA020W2);
- Millaroo Main Channel A at 2106.17m (MA021W1); and
- Dalbeg Channel 2 at 3072.7m (DB039W1).

Figure 8.3: Data logger inside a display unit

The test period for this project was from Monday 15th of December 2009 to Thursday 15th of October 2009. The water officers were made aware of the testing and refrained from excessive

opening of the selected meter display boxes during the testing period. SunWater has elected to continue the testing for another year or further depending results.

Information was downloaded from the loggers on three separate occasions:-

- Tuesday 24th of February 2009;
- Thursday 4th of June 2009; and
- Thursday 15th of October 2009.

As SunWater only had one licence for the software it was installed onto a computer in the office. This meant that to download information from the loggers they had to be transported back into the office, docked in the computer and re-transferred back to site. Therefore data collected during the downloading process has been omitted. Raw temperature data for the month of January 2009 can be viewed for the Barratta Ba1 at 9455.0m (BM270W1) site in Appendix D.

The temperature and humidity values were analysed in Microsoft Excel by a standard statistical analysis whereby the hourly average, maximum, minimum, standard deviation and % time over the threshold was determined. These statistics can be viewed in Appendix E.

The main point of interest from the testing was that the temperature was never logged outside of the allowable operating range. Another interesting point to note is that the highest temperatures were typically recorded between 1pm and 4pm. This is shown below on the 24 hour variation graph for Millaroo Main Channel A at 1986.0m (MA020W2) on Wednesday 23rd September 2009.

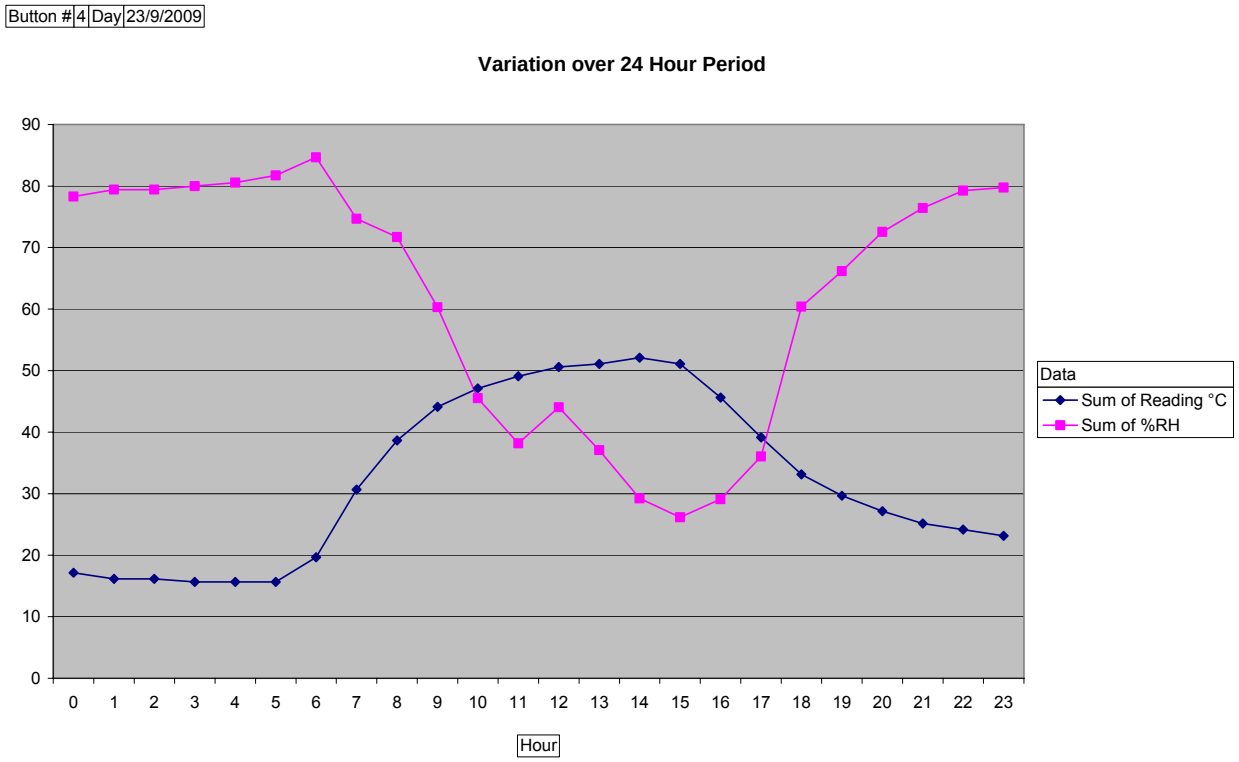

Figure 8.4: 24 hour variation graph for Millaroo Main Channel A at 1986.0m (MA020W2) on Wednesday 23rd September 2009

8.4 CONDITION ASSESSMENT

Once realising that temperature was not the main issue the focus on the investigation turned to the actual meter components. The manufacturer of the Brand X EM flow meter was contacted and came to site to undertake a thorough investigation. During this investigation it was determined that water and vermin (ants) were gaining access into the meter display box and causing failure of the internal components. This was further justified when the repair reports were investigated to reveal minor corrosion on some of the internal components. The root cause of this failure was determined to be the incorrect initial installation of the meter in the field. This problem has been fixed and noted for reference of future installations.

8.5 SUMMARY

After conceding that tampering or accidental damage was not an issue of concern and confirming that the ambient temperature did not impact the Brand X EM flow meter operation, the detailed condition assessment determined the root cause of the failures. The problem has now been rectified and it is anticipated that failure rates of the Brand X flow meter will substantially decline. With increased reliability of the Brand X EM flow meter established, it is now essential to adopt an effective management system.

9.0 MANAGEMENT OF ELECTROMAGNETIC FLOW METERS

9.1 INTRODUCTION

This chapter details the costs and benefits associated with an improved method of managing the EM flow meters currently in service. This research focuses on SCADA as the method of management. Much of the background and influencing factors regarding SCADA have already been mentioned.

9.2 COST BENEFIT ANALYSIS

For most projects where a decision regarding investment is required, the financial analysis will be the primary decision tool. The financial analysis requires the collection and organisation of data, computation, and application of decision rules.

SunWater has adopted a primary decision rule which is widely accepted in the commercial business environment, that is, investment will only be considered if the Net Present Value (NPV) of the investment, over the life of the analysis, has a value greater than zero.

The standard SunWater template for business case improvements has been used to undertake the cost benefit analysis. This template was set up by the SunWater accountants and updated most recently in November 2006. The variables of interest include the pre-tax discounted cash rate of 11.50% and the inflation rate of 2.50%. All financial data inputs into the model are expressed in current dollars. Current dollars are defined as the dollars of the first year of forecast.

In order to carry out the financial analysis, two categories of data were collected and analysed. These were cost and benefit. The only benefits or savings that have been accounted for are those that are direct in nature. No overhead savings were recognised.

The essential elements on the Cost category are:

- all project development costs (planning, design, approval, purchasing, supervision, installation and project closure);
- the price of the product;
- training / seminars costs; and
- all recurring operations, maintenance and renewals costs.

The essential elements in the Benefit category are:

- the fact that meter reading costs are no longer accrued; and
- the fact that Meter Adjustment Report costs for EM meters which can be fixed by the Meter Coordinator on site are no longer accrued.

9.3 FINANCIAL COSTS

9.3.1 Project Development Costs

Estimated project development costs are shown below.

Table 9.1: Project Development Costs

Planning	16	hours	x	Project Manager	=	$2,107.52
Design	32	hours	x	Project Manager	=	$4,215.04
	4	hours	x	Asset Engineering Manager	=	$755.96
Approvals	4	hours	x	Asset Engineering Manager	=	$755.96
	4	hours	x	Asset Engineer	=	$664.32
Purchasing	8	hours	x	Procurement Officer	=	$847.60
	4	hours	x	Project Manager	=	$530.88
Supervision	34	hours	x	Project Manager	=	$4,478.48
	4	hours	x	Asset Engineering Manager	=	$755.96
Installation	170	hours	x	Electrician	=	$19,958.00
	170	hours	x	Trades Assistant	=	$16,065.00
Project Closure	16	hours	x	Project Manager	=	$2,107.52
Total Costs						**$53,242.24**

9.3.2 Price of Product

9.3.2.1 Ajenti

Due to its success in the Tasmanian Water Use Project, it was decided to analyse the Ajenti water management system. This system has been explained in depth previously.

As the three main sections containing electromagnetic flow meters (Clare, Millaroo and Dalbeg) are long and narrow sections, multiple meters are in close proximity to each other. This reduces the costs of the system significantly as short haul radio Ajenti's can be used to transmit data up to 2kms (line of sight) from the sites to the one Ajenti (it has 5 counter inputs). The cost of an Ajenti with full functionality is about $1500 whereas the Ajenti short haul device is around $650. Opting for a fully functional Ajenti with four radio inputs not only reduces the capital cost but

also reduces the ongoing operation and maintenance costs. The main savings of this option is the use of only one data plan per system with Telstra.

The initial purchase cost was determined by multiplying the number of systems required, 34, by the cost of the system, $4100. This returned a total cost of $139400.

9.3.2.2 JO COM RAT

Due to its success in the CIT Remote Flow Meter Monitoring Project, it was also decided to analyse the JO COM RAT management system. This system has also been explained in depth previously.

Due to the geographical locations of the three sections a Hub would be required in each section. Each Hub would require mobile coverage for its operation. The Hubs have an approximate radio radius of seven kilometres. A small VHF radio with 100mw output would then be required in each of the meter sites. The Hub and radio work as a master slave system with the Hub being the master. A mains powered Hub costs approximately $6000 with a typical radio system around $1000. The system can fit inside the current display box of the Tyco irriflow meters however an extra cabinet and solar panel would be required for the Siemens meters.

Given there are three main sections the cost for the hubs would be $18000 with an additional $167000 for the radio units. This returns a total cost for the product of $185000.

9.3.3 Training

The term training refers to the acquisition of knowledge, skills and competencies as a result of the teaching that relates to specific useful competencies. In respect to this topic it relates to the acquisition of the skills required to operate and maintain the SCADA systems. A notional $5000 value has been used for both systems, which is typical of the cost associated with the initial training regarding the regulator gate SCADA system.

9.3.4 Recurring Operating and Maintaining Costs

9.3.4.1 Ajenti

As mentioned previously the fully functional Ajenti transmits data via Telstra. The cost of a data plan is $5 per month or $60 per year. The recurring Telstra cost was determined by multiplying the yearly cost by the number of systems. This returned a cost of $2040.

It was estimated that the Meter Co-ordinator would be required to spend an extra one hour per week reviewing the system. At $105.95 per hour that equates to a recurring labour cost of $5086 per year.

The maintenance costs have been estimated using the costs associated with the SCADA controlled overshot gate channel regulation system. It currently takes the electricians two days to undertake routine maintenance on this system. For the purpose of this analysis the same will be adopted for the meter system. The cost of six monthly routine maintenance conducted by two electricians for two days is $3006.75 which equates to $6013.50 per year.

9.3.4.2 JO COM RAT

As the modem inside the Hub connects to the internet to transmit data to the server, an ongoing data plan would be required. Each Hub will require one of these data plans. The cost of a data plan able to transmit the required data is $10 per month or $120 per year, per Hub. This gives a recurring cost of $360 a year.

The Meter Co-ordinator and estimated maintenance costs will remain the same as those used in the Ajenti calculations.

9.4 TANGIBLE BENEFITS

9.4.1 Meter Reading

If a SCADA system was to be installed into service the meters would no longer require a quarterly meter read. Hence the total meter read cost for each of the three main sections has

been factored down by the percentage of electromagnetic flow meters which would no longer require to be read. This developed an $885.14 per quarter or $3541 per year saving. Also as the meters are no longer required to be read the meter books are no longer required to be produced and the information collected from the meter read is no longer required to be input into the system. This developed a $1371.09 per quarter or $5484 per year saving. Meter reading is also required during the water harvesting period. During the water harvesting period irrigators are charged a per ML rate which only includes costs to deliver water from the river to the farm. This is substantially lower than the normal costs which include headworks assets such as the Dam. As water harvesting only occurs when the Dam overtops for the purpose of this project we will only adopt one water harvesting period per year. This is quite a conservative assumption. The extra saving for the water harvesting period is $1371.09. The total benefit for meter reading therefore equates to $6855.47.

9.4.2 Meter Adjustment Report

With a SCADA system in place meter adjustment reports will still be required when meters fail and require to be sent away however the benefit of live up-to-date information will be in the meters which are able to be reset and returned to service with minor maintenance. After discussion with the Meter Co-ordinator in the Ayr office it was agreed that approximately five meters a year can be returned to service with only minor maintenance. Given the costs associated with each MAR totalling $506.85, including time for both the water officer and administration support. Then the total yearly benefit is determined by multiplying the five meters by the MAR costs giving a $2534.25 benefit.

9.5 INTANGIBLE BENEFITS

A detailed costing for the below mentioned benefits was unable to be determined during the course of the project.

9.5.1 Ability to Police Water Orders

At present, given water meters are only read quarterly, it is near impossible to police the water taken by irrigators. Typically, investigation into water orders only occurs when a customer has ordered water and the system is unable to deliver that water. Once this issue is raised the water officer must first check that the correct water has been pumped into the system and there are no unnecessary losses i.e. water going out overflows, channel banks overtopping. If this is the case then individual meters are read to determine where the missing water is located. If a customer is found to be taking more water than ordered then the offtake in question is shut down or wound back depending on the circumstances.

If however a live, up to date system was displayed on the Meter Coordinators work station he would quickly be able to locate the missing water and act accordingly.

9.5.2 Lost Revenue Due to Meter Failure

Given meters are currently read every quarter by SunWater there is a chance that a meter can fail at some point during the quarter. Irrigation charges include both Part A and Part B charges. Part A costs are charged whether allocation is used or not therefore it is the Part B costs which must be focused on to realise this benefit.

The current process is to simply charge the irrigator for water ordered on the streamline water ordering system discussed earlier. However this is problematic as the irrigator may disagree with the estimate as they sometimes order more water than they require. They believe that this ensures the required water is supplied into the channel to allow for irrigators who take without order or take more than ordered. Discussion typically then takes place and unless the irrigator can provide exact start/stop times by means of power records or other means SunWater will typically offer no greater than 10% off the original water order.

Also it has been mooted that if the irrigator was to realise that the meter was not functional than they may take water without order hence rendering the above process useless.

If however a SCADA system was in place, SunWater would know the exact instance that a meter fails and react accordingly by means of surveillance or other methods. Therefore the dispute

over water order verses water use would not be required and the temptation to take water without order would be removed.

9.5.3 Accurate and up to date Information for Water Balance Models and Efficiency Analysis

Water balance models determine where all the water in a distribution system is going. In a perfect world a water balance model is depicted by the equation –

Water into the system = Water out of the system.

The model must therefore take into account factors such as evaporation, seepage, leakage and overflow. An efficiency analysis is simply the comparison of water pumped verse water delivered.

A parcel of the data for these two analysis tools is currently provided by the quarterly meter reads. This information is taken from the SWIMS system once all the readings have been verified and signed off.

Live and up to date meter readings will allow these analysis tools to be updated on the fly. In regards to the water balance model this would allow quick comparison of overflow data and irrigation data as these are the two main variables of the – Water out of the system – part of the above equation. In regards to the efficiency analysis this would allow quick comparisons of water delivered and water pumped which would provide the ability to modify pump selection and run hours. Follow on benefits from this would include:

- savings in electricity;
- savings on maintenance and repairs; and
- savings in replacement cost.

9.6 DISADVANTAGES

The main disadvantage to the installation of a SCADA system to constantly monitor and transmit data for the EM flow meters is utilising an asset to manage another asset. Once installed, the SCADA system itself will require management. There is currently a perfect example of manual control verses Supervisory Control and Data Acquisition. This is the self regulating float gate channel regulation system and the SCADA controlled overshot gate channel regulation system. The SCADA controlled overshot gate regulation system was described in depth earlier. This system provides effective control and ability to isolate certain sections whilst maintaining water elsewhere. It also provides many data acquisition functions allowing trending and more efficient water distribution. However it also requires a far greater operator input and develops much higher maintenance costs than the self regulating float gate channel regulation system.

9.7 SUMMARY

As explained above both the costs and benefits of installing the SCADA system were determined. A table showing both these breakdowns is shown below.

Table 9.2: CBA Input Breakdowns

Ajenti CBA Inputs Breakdown		RAT CBA Inputs Breakdown	
Project Development costs	$ 53,242.24	Project Development costs	$ 53,242.24
Price of Product	$ 139,400.00	Price of Product	$ 185,000.00
Training in Product	$ 5,000.00	Training in Product	$ 5,000.00
Total upfront cost	**$ 197,642.24**	**Total upfront cost**	**$ 243,242.24**
On going Telstra cost	$ 2,040.00	On going Telstra cost	$ 360.00
On going operations cost	$ 5,085.60	On going operations cost	$ 5,085.60
On going maintenance cost	$ 6,013.50	On going maintenance cost	$ 6,013.50
Total ongoing cost	**$ 13,139.10**	**Total ongoing cost**	**$ 11,459.10**
Quarterly Meter Read Benefit	$ 5,484.38	Quarterly Meter Read Benefit	$ 5,484.38
Water Harvest Meter Read Benefit	$ 1,371.09	Water Harvest Meter Read Benefit	$ 1,371.09
Total Meter Read benefit	**$ 6,855.47**	**Total Meter Read benefit**	**$ 6,855.47**
Meter Adjustment Report benefit	**$ 2,534.25**	**Meter Adjustment Report benefit**	**$ 2,534.25**

The results of the cost benefit analysis undertaken shows that not only is the system not viable the on going costs are actually greater than the tangible benefits determined. Refer to Appendix G for the full CBA. As mentioned earlier SunWater's primary decision rule is that, investment will only be considered if the NPV of the investment, over the life of the analysis, has a value greater than zero. Therefore SunWater should not proceed with the implantation of either of the two SCADA systems.

If however a value of $20000 was assigned to the intangible benefits both the Ajenti and RAT systems would have a payback period of 11 years and 12 years respectively. This assumed value of $20000 for the intangible benefits is quite conservative given the follow-on benefits from up to date efficiency analysis and water balance models previously mentioned and also if the new found ability to police water orders were to become available. Refer to Appendix H for the updated CBA.

10.0 ASSET WORKS

An original objective of this project was to set up a SCADA system for a particular metering point and gather data. Due to time constraints this objective was not achieved. After researching the options for the displaying of data it was intended to set up a SCADA system for a particular metering point and gather data including:-

- Meter status – operational or not
- Totalised flow
- Instantaneous flow rate
- Alarms
  - Temperature & humidity inside field box
  - Tampering
  - Pipe not full
  - Reverse flow
  - Low battery

These data options are all available to the current fleet of meters. Even though this data was not collected it is easy to comprehend the data values and their relevance to this project.

The operational status will allow the meter coordinator to have an idea of exactly what meters are operational and what meters are not. This will lead to improved ability to schedule repairs and maintenance.

The totalised flow data would be used to replace the quarterly meter read. This has the follow on effects of no longer requiring the production of the meter books and also simplifies the transfer of data from the meter, into the meter book and finally into SWIMS.

The instantaneous flow rate would be used in comparison with the streamline order flow rate. This will allow water orders to be compared with actual water being taken. It will give greater control to the water officers policing the taking of water.

The alarms will all assist in the management of the EM flow meters:

- Temperature and humidity can be constantly checked.
- Water officers will be alerted to tampering instantaneously which will increase the chances of catching an irrigator in the act.
- The low battery warning will allow maintenance to be conducted at the appropriate time.

11.0 CONCLUSIONS

This project has established that the improved reliability of electromagnetic flow meters is crucial to effective management of water usage and delivery. This then decreases the necessity for a complex management system such has SCADA.

This conclusion was determined by the investigation and evaluation of the electromagnetic flow meters, dethridge wheels and propeller actuated flow meters. This evaluation ascertained that the electromagnetic flow meters were the most effective metering device.

Furthering this investigation, it was necessary to conduct a failure analysis of electromagnetic flow meters in service in the BHWSS. Results of the failure analysis highlighted the increased failure rate of one particular electromagnetic flow meter; Brand X.

In order to gain further insight into the cause of this meters decreased function, a model was produced to determine the reliability of the Brand X flow meter.

A detailed investigation explored the possible reasons for the Brand X flow meters high failure rate. This investigation determined the root cause of the failure, as incorrect installation. Once rectified it is anticipated that failure rates will decline significantly allowing for accurate readings of water usage.

It was then necessary to compare the viability of installing a complex management system such as SCADA as oppose to continuing with manual meter reading and data inputting. This comparison included a cost benefit analysis which determined that it was not cost effective to install SCADA.

The use of reliable electromagnetic flow meters in all metering points allows for accurate manual readings which therefore decreases the need for implementation of management systems such as SCADA.

12.0 RECOMMENDATIONS

SunWater should not proceed with the implantation of either of the two SCADA systems unless it is willing to accept or determine some dollar value for the intangible benefits mentioned. If SunWater was to install a SCADA system it is recommended that the RAT system be utilised. This recommendation is due to the fact that the RAT system has the ability to handle the expansion of the fleet for the cheapest cost. Given that the number of the EM meter fleet throughout the BHWSS is ever increasing this expansion is inevitable.

The main advantages of constant monitoring of EM flow meters are:

- improved management of the fleet;
- the ability to police water orders;
- the prevention of lost revenue through meter failure; and
- more accurate and up to date information for efficiency analysis and water balance models.

The main disadvantage with the introduction of a SCADA system is the utilising an asset which will require its own management to manage another asset.

13.0 FURTHER WORK

Given the limited time frame for to conduct this project further work may be completed:

- A more thorough investigation of the intangible benefits of setting up a system whereby one operator can oversee the entire fleet of EM flow meters in the BHWSS is required. This would allow the allocation of a dollar value to some of the previously mentioned intangible benefits.
- In the coming years, as water reform and regulations become more stringent, there may be a requirement to redo the cost benefit analysis adjusting the benefits resulting from the compliance to new regulations.
- The installation of a pilot program for one area could be trialled. Dalbeg would be a good example because it is the most remote of the three sections. The pilot could then display the many advantages of setting up a system whereby one operator can oversee the entire fleet of EM flow meters in the BHWSS. This pilot would also give a better indication of the maintenance and management issues regarding the project.
- Obviously the installation of a complete system whereby one operator can oversee the entire fleet of EM flow meters in the BHWSS would be the final work to be followed up from this project.

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APPENDIX A

PROJECT SPECIFICATION

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG 4111/4112 Research Project
PROJECT SPECIFICATION

FOR: STEVEN SHEARS

TOPIC: INVESTIGATION OF LIFE CYCLE MANAGEMENT OF ELECTRONIC FLOW METERS

SUPERVISOR: Dr David Thorpe
Peter Marshall, Asset Engineering Manager, SunWater
Ben Mills, Asset Engineer, SunWater

SPONSERSHIP: SunWater

PROJECT AIM: This project seeks to improve the current management of electromagnetic flow meters at SunWater customer's irrigation offtakes in the BHWSS.

PROGRAMME: Issue B, 15th October 2009

1) Conduct a literature review of the main components regarding this project. These include asset management, electromagnetic flow meters, SCADA and previous work completed on this topic.
2) Detail the relevant fleet of meters in the BHWSS.
3) Determine at what customer usage it becomes necessary to implement SCADA of a particular customer's offtake.
4) Analyse the Electromagnetic Flow Meters in BHWSS.
5) Create a reliability model of electromagnetic flow meters in service in the BHWSS.
6) Improve the reliability of the electromagnetic flow meters in service in the BHWSS.
7) Determine what information is required to be monitored by SCADA at customer offtakes.
8) Analyse the costs associated regarding management of meters by SCADA.
9) Submit an academic dissertation on the research in the format required by the University of Southern Queensland.

Time Permitting
10) Set up a SCADA system for a particular metering point and gather data.

AGREED

_____(Student) Date: 29 / 10 /2009

_____(USQ Supervisor) Date: / /2009

_____(Technical Advisor) Date: 29 / 10 /2009

_____(Technical Advisor) Date: 29 / 10 /2009

Examiner/Co-examiner:_____

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG 4111/4112 Research Project
PROJECT SPECIFICATION

FOR: STEVEN SHEARS

TOPIC: INVESTIGATION OF LIFE CYCLE MANAGEMENT OF MANAGEMENT OF ELECTRONIC FLOW METERS

SUPERVISOR: Dr David Thorpe
Peter Marshall, Asset Engineering Manager, SunWater
Ben Mills, Asset Engineer, SunWater

SPONSERSHIP: SunWater

PROJECT AIM: This project seeks to improve the current management of electromagnetic flow meters at customer's irrigation offtakes.

PROGRAMME: Issue A, 24th March 2009

1) Describe and define the current management system regarding electromagnetic flow meters at customer's offtakes by SunWater.
2) Conduct a literature review of the issues with electromagnetic flow meters.
3) Research the current management methods regarding electromagnetic flow meters in other organisations.
4) Analyse the current management system with respect to making improvements.
5) Define the cost-benefit of any improvements.
6) Report results to SunWater.
7) Submit an academic dissertation on the research in the format required by the University of Southern Queensland.

As time permits:

8) Create a model that can determine at what customer usage it becomes viable to implement Supervisory Control and Data Analysis (SCADA) of a particular customer's offtake.

AGREED

S Shears (Student) Date: 23/3/2009

D. J. Thorpe (USQ Supervisor) Date: 9/4/2009

(Technical Advisor) Date: 23/03/2009

(Technical Advisor) Date: 23/3/2009

Examiner/Co-examiner: 16/04/2009 30/04/09

APPENDIX B

WATER USAGE REPORT

Usages for the Sample Group

Meter	04/05 Usage (ML)	05/06 Usage (ML)	06/07 Usage (ML)	07/08 Usage (ML)	Average Yearly Usage (ML)
BM2701W1	1265.25	649.32	1321.813	497.329	933.428
CB212W1	110.879	41.901	31.686	14.642	49.777
CB213W1	73.125	102.504	17.696	39.271	58.149
MA020W2	137.84	30.98	5.285	53.000	56.77625
MA020W1	86.05	82.851	32.406	53.961	63.817
DB074W1	102.082	72.508	36.772	90.399	75.44025

Average Yearly Usage for sample group (ML/Year)
206.23125

Total Flow Volumes through all Brand X EM Meters

	04/05 Usage (ML)	05/06 Usage (ML)	06/07 Usage (ML)	07/08 Usage (ML)	Average Yearly Usage for sample group (ML/Year)
Total	35082.834	21273.871	23726.921	16390.765	204.3948962

APPENDIX C

METER FAILURE SPREADSHEET

SUNWATER BRAND X EM METERS

Details									Job Status							
Service/Dismantled Date	Off - Take Number	Serial Number	Name of Irrigator/Land Owner	Service Detail	Quotation Number	Purchase Order Number	Work Order Number	Notifcation Number	Sent for repair Date	Returned from Repairer Date	Reassembled/ Returned to service Date	Reassembled by	Work Order Sign Off	Installation Date	Life Span	Days since last failure
11-Feb-08	BM270W1	2404/15711	Hesp						11-February-2008	20-March-2008	03-April-2008	S. Isaacs	Y	06-May-2005	1011	249
14-Apr-08	BM271W1	2404/15696	Hesp	Menu reverts back to Auto Calibrate	20074621	5700056359	5084111	10102624	16-April-2008	15-July-2008	24-July-2008	S. Isaacs	Y	12-February-2004	1523	137
14-Oct-08	BM271W1	2404/15696	Hesp	Meter scrolling menu continuously	20086482	5700059003	5088368	10106702	15-October-2008	24-November-2008	24-November-2008	Shane Isaacs		12-February-2004	82	14
08-Apr-08	CA039W1	1403/14685	Stevens	Menu scrolls continuously	20073866	5700055032	5080672	10099665	10-April-2008	02-June-2008	03-June-2008	S. Isaacs	N	23-June-2003	1751	188
05-Jun-08	CA039W1	1403/14685	Stevens	Menu scrolls continuously	20074621	5700056359	5080672	10099665	05-June-2008	15-July-2008	21-July-2008	S.Isaacs	N	23-June-2003	2	140
21-Oct-08	CA045W1	1403/14682		Meter has no reading on screen	20076358	5700058910	5087841	10106186	23-October-2008					23-June-2003	1947	0
29-Sep-08	CA046W2	1403/14679	Torrisi	Not registering usage	20076364	5700058909	5087397	10105728	30-September-2008					23-June-2003	1925	0
20-Nov-07	CA047W1	14861			20071830				21-November-2007	01-December-2007	03-December-2007	S. Isaacs	Y	23-June-2003	1611	371
08-Apr-08	CA097W3	2301/12754	Booth	Meter asking for a pin No	20073866	5700055034	5080492	10099515	10-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y			188
16-Apr-08	CA102W1	2301/12744	Polletto	No display on LCD screen	20074621	5700056359	5084144	10102660	18-April-2008	15-July-2008	21-July-2008	S. Isaacs	Y	24-August-2001	2427	140
14-Oct-08	CA102W1	2301/12744	Poletto	Solar power not getting to battery	20076482	5700059003	5087394	10105726	15-October-2008	24-November-2008	24-November-2008	Shane Isaacs		24-August-2001	85	14
14-Oct-08	CA105W2	2301/12750		Meter not registering usage	20076482	5700059003	5087762	10106089	15-October-2008	24-November-2008	24-November-2008	Shane Isaacs		24-August-2001	2608	14
11-Feb-08	CA106W1	2401/12756					5079270		11-February-2008	20-March-2008	03-April-2008	S. Isaacs	Y	24-August-2001	2362	249
29-Sep-08	CA106W1	2401/12756	Marchioni	Not registering usage	20076364	5700058909	5087398	10105729	30-September-2008					24-August-2001	179	0
08-Apr-08	CA107W1	2301/12743	Marchioni	Not registering ML/D flow	20073866	5700055026	5080494	10099516	10-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y	24-August-2001	2419	188
04-Aug-08	CA109W1	2001/12704	Marchioni	Meter asking for a pin No	20075776	5700058192	5086208	10104513	05-August-2008	31-October-2008	03-November-2008	S.Isaacs	Y	24-August-2001	2537	35
29-May-08	CA110W1	2001/12699	Patroni	Menu reverts back to Auto Calibrate	20074621	5700056359	5084352	10102882	02-June-2008	15-July-2008	24-July-2008	S. Isaacs	Y	24-August-2001	2470	137
16-Apr-08	CA119W1	2801/12813		Not registering ML/D flow	20073866	5700055027	5083194	10101786	18-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y	24-August-2001	2427	188
30-Sep-08	CA119W1		Emmi	Requires new Solar Panel	20075910	5700058343	5087393	10105725			21-October-2008	Shane Isaacs	Y	24-August-2001	119	48
16-Apr-08	CA120W1	2001/12700		Meter asking for a pin No	20073866	5700055040	5083209	10101801	18-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y	24-August-2001	2427	188
08-Apr-08	CA121W1	2301/12758	Mitchell	No display on LCD screen	20073866	5700055030	5080497	10099519	10-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y	24-August-2001	2419	188
08-Apr-08	CA136W1	2301/12753	Minuzzo	Auto Calibrating Continuously	20073866	5700055038	5080673	10099666	10-April-2008	02-June-2008	03-June-2008	S. Isaacs	Y	24-August-2001	2419	188
04-Aug-08	CA136W1	2301/12753	Minuzzo	No display on LCD screen	20075776	5700058192	5086194	10104501	05-August-2008	31-October-2008	03-November-2008	S.Isaacs	Y	24-August-2001	62	35
08-Sep-08	CA205W1	2501/12774	Torrisi	Meter asking for Pin No	20075785	5700058407	5087019	10105205	09-September-2008	31-October-2008	03-November-2008	S.Isaacs	Y	24-August-2001	2572	35
08-Sep-08	CB049W1	2104/15663	Rapisarda	Meter not registering M/D usage	20075785	5700058407	5087004	10105290	09-September-2008	31-October-2008	03-November-2008	S.Isaacs	Y	10-May-2006	852	35
17-Nov-08	CB049W1	2104/15663	Rapisarda	Meter not registering M/D usage			5087004	10105290	26-November-2008					10-May-2006	14	0
28-May-08	CB051W2	2404/15726	Rapisarda	Not registering ML/D flow	20074621	5700056359	5084347	101012877	02-June-2008	15-July-2008	21-July-2008	S. Isaacs	Y	17-May-2006	742	140
28-May-08	CB052W1	2804/15842	Rapisarda	Not registering ML/D flow	20074621	5700056359	5084348	101012878	02-June-2008	15-July-2008	21-July-2008	S. Isaacs	Y	01-July-2004	1427	140
30-Oct-08	CB052W1	2804/15842	Rapisarda	Not registering usage			5088171	10106524	31-October-2008					01-July-2004	101	0
14-Jul-08	CB058W1	1803/14713		Meter asking for Pin No	20075216	5700057248	5085739	10104062	15-July-2008	18-November-2008	19-November-2008	S. Isaacs	Y	31-July-2003	1810	19
27-Oct-08	CB066W1	1803/14715	Rapisarda	Meter not totalising usage			5088012	10106368	28-October-2008					31-July-2003	1915	0
20-Nov-07	CB068W2	12747			20071830				21-November-2007	01-December-2007	04-December-2007	S. Isaacs	Y	31-July-2003	1573	370
16-Apr-08	CB068W2	12747B	Fiamingo	No display on LCD screen	20074621	5700056359	5084143	10102659	18-April-2008	15-July-2008	21-July-2008	S. Isaacs	Y	31-July-2003	134	140
14-Jul-08	CB166W1	1804/15625		Not registering usage	20075216	5700057248	5085753	10104076	15-July-2008	18-November-2008	19-November-2008	S. Isaacs	Y	19-May-2006	787	19
06-Jun-08	CB169W1	2604/15749	Florianis	Not registering usage	20074621	5700056359	5084736	10103178	05-June-2008	15-July-2008	21-July-2008	S.Isaacs	Y	01-July-2004	1436	140
14-Jul-08	CB197W1	1803/14703	Rapisarda	Not registering usage	20075216	5700057248	5085746	10104069	15-July-2008	18-November-2008	19-November-2008	S. Isaacs	Y	31-July-2003	1810	19
11-Feb-08	CB213W1	1903/14724	Patroni/Booth farming				5079268		11-February-2008	20-March-2008	03-April-2008	S. Isaacs	Y	31-July-2003	1656	249
20-Nov-07	CB219W1	1603/14689	Rapisarda		20071830				21-November-2007	01-December-2007	03-December-2007	S. Isaacs	Y	31-July-2003	1573	371
14-May-08	CB219W1	1603/14689	Rapisarda	No display on LCD screen	20074621	5700056359	5084112	10102625	16-April-2008	15-July-2008	21-July-2008	S. Isaacs	Y	31-July-2003	163	140
06-Nov-08	CB219W1	1603/14689	Rapisarda	No power to the front panel			5088415	10106752	07-November-2008					31-July-2003	108	0
11-Feb-08	CB220W1	1903/14737	Booth Farming	Not registering usage			5079267		11-February-2008	20-March-2008	03-April-2008	S. Isaacs	Y	31-July-2003	1656	249
14-Jul-08	CB220W1	1903/14737	Rapisarda	Not registering usage	20075216	5700057248	5085751	10104074	15-July-2008	18-November-2008	19-November-2008	S. Isaacs	Y	31-July-2003	102	19
14-Jul-08	CB220W2	1903/14738	Rapisarda	Requires new screen	20075216	5700057248	5085752	10104075	15-July-2008	18-November-2008	19-November-2008	S. Isaacs	Y	31-July-2003	1810	19
14-Jul-08	CB220W3	1903/14733	Rapisarda	Menu scrolling continuously	20075216	5700057248	5085756	10104079	15-July-2008	18-November-2008	18-November-2008	S. Isaacs	Y	31-July-2003	1810	20
30-May-08	DB074W1	2604/15790	Cavallin	Menu won't scroll through options	20074621	5700056359	5084360	10102890	02-June-2008	15-July-2008	22-July-2008	S.Power	Y	11-September-2004	1357	139
27-Oct-08	DB074W1	2604/15790	Cavallin	Menu won't scroll through options			5088010	10106666	28-October-2008					11-September-2004	97	0
16-Apr-08	MA020W2	2704/15763		No display on LCD screen	20073866	5700055025	5083197	10101789	18-April-2008	02-June-2008	03-June-2008	M. Wheeler	Y	01-June-2004	1415	188
11-Jun-08	MA021W1	2401/12771	Perks	No Read out on LCD screen	20074621	5700056359	5084850	10103323	12-June-2008	15-July-2008	22-July-2008	S.Power	Y	28-November-2001	2387	139
11-Jun-08	MA024W1	2304/15664	Maxwell	Not registering usage	20074621	5700056359	5084851	10103324	12-June-2008	15-July-2008	22-July-2008	S.Power	Y	01-May-2004	1502	139

Mean time to failure
2793.02381

APPENDIX D

RELIABILITY MODEL

Operational Days	Reliability Function	Failure Distribution	Density Function of Failure
1	0.999642029	0.000357971	0.000357907
2	0.999284187	0.000715813	0.000357779
3	0.998926472	0.001073528	0.000357651
4	0.998568885	0.001431115	0.000357523
5	0.998211427	0.001788573	0.000357395
6	0.997854096	0.002145904	0.000357267
7	0.997496894	0.002503106	0.000357139
8	0.997139819	0.002860181	0.000357011
9	0.996782872	0.003217128	0.000356883
10	0.996426053	0.003573947	0.000356755
11	0.996069361	0.003930639	0.000356628
12	0.995712798	0.004287202	0.0003565
13	0.995356361	0.004643639	0.000356372
14	0.995000053	0.004999947	0.000356245
15	0.994643872	0.005356128	0.000356117
16	0.994287819	0.005712181	0.00035599
17	0.993931892	0.006068108	0.000355862
18	0.993576094	0.006423906	0.000355735
19	0.993220423	0.006779577	0.000355608
20	0.992864879	0.007135121	0.00035548
21	0.992509462	0.007490538	0.000355353
22	0.992154173	0.007845827	0.000355226
23	0.99179901	0.00820099	0.000355099
24	0.991443975	0.008556025	0.000354972
25	0.991089067	0.008910933	0.000354844
26	0.990734286	0.009265714	0.000354717
27	0.990379632	0.009620368	0.00035459
28	0.990025105	0.009974895	0.000354464
29	0.989670705	0.010329295	0.000354337
30	0.989316432	0.010683568	0.00035421
31	0.988962286	0.011037714	0.000354083
32	0.988608266	0.011391734	0.000353956
33	0.988254373	0.011745627	0.00035383
34	0.987900607	0.012099393	0.000353703
35	0.987546967	0.012453033	0.000353576
36	0.987193454	0.012806546	0.00035345
37	0.986840068	0.013159932	0.000353323
38	0.986486808	0.013513192	0.000353197
39	0.986133674	0.013866326	0.00035307
40	0.985780667	0.014219333	0.000352944
41	0.985427787	0.014572213	0.000352818
42	0.985075032	0.014924968	0.000352691
43	0.984722404	0.015277596	0.000352565
44	0.984369902	0.015630098	0.000352439
45	0.984017527	0.015982473	0.000352313
46	0.983665277	0.016334723	0.000352186
47	0.983313154	0.016686846	0.00035206
48	0.982961156	0.017038844	0.000351934
49	0.982609285	0.017390715	0.000351808
50	0.982257539	0.017742461	0.000351682
51	0.98190592	0.01809408	0.000351557
52	0.981554426	0.018445574	0.000351431
53	0.981203058	0.018796942	0.000351305
54	0.980851816	0.019148184	0.000351179
55	0.9805007	0.0194993	0.000351053
56	0.980149709	0.019850291	0.000350928
57	0.979798844	0.020201156	0.000350802
58	0.979448105	0.020551895	0.000350677
59	0.979097491	0.020902509	0.000350551
60	0.978747003	0.021252997	0.000350426
61	0.97839664	0.02160336	0.0003503
62	0.978046402	0.021953598	0.000350175
63	0.97769629	0.02230371	0.000350049
64	0.977346304	0.022653696	0.000349924
65	0.976996442	0.023003558	0.000349799
66	0.976646706	0.023353294	0.000349674
67	0.976297095	0.023702905	0.000349548
68	0.975947609	0.024052391	0.000349423
69	0.975598248	0.024401752	0.000349298
70	0.975249013	0.024750987	0.000349173
71	0.974899902	0.025100098	0.000349048
72	0.974550916	0.025449084	0.000348923
73	0.974202055	0.025797945	0.000348798
74	0.97385332	0.02614668	0.000348673
75	0.973504709	0.026495291	0.000348549
76	0.973156222	0.026843778	0.000348424
77	0.972807861	0.027192139	0.000348299
78	0.972459624	0.027540376	0.000348174
79	0.972111512	0.027888488	0.00034805
80	0.971763524	0.028236476	0.000347925
81	0.971415661	0.028584339	0.000347801
82	0.971067923	0.028932077	0.000347676
83	0.970720309	0.029279691	0.000347552
84	0.970372819	0.029627181	0.000347427
85	0.970025454	0.029974546	0.000347303
86	0.969678213	0.030321787	0.000347179
87	0.969331097	0.030668903	0.000347054
88	0.968984105	0.031015895	0.00034693
89	0.968637237	0.031362763	0.000346806
90	0.968290493	0.031709507	0.000346682
91	0.967943873	0.032056127	0.000346558
92	0.967597377	0.032402623	0.000346434
93	0.967251006	0.032748994	0.00034631
94	0.966904758	0.033095242	0.000346186
95	0.966558634	0.033441366	0.000346062
96	0.966212635	0.033787365	0.000345938
97	0.965866759	0.034133241	0.000345814
98	0.965521007	0.034478993	0.00034569
99	0.965175378	0.034824622	0.000345566
100	0.964829874	0.035170126	0.000345443
101	0.964484493	0.035515507	0.000345319
102	0.964139235	0.035860765	0.000345195
103	0.963794102	0.036205898	0.000345072

104	0.963449091	0.036550909	0.000344948
105	0.963104205	0.036895795	0.000344825
106	0.962759442	0.037240558	0.000344701
107	0.962414802	0.037585198	0.000344578
108	0.962070285	0.037929715	0.000344455
109	0.961725892	0.038274108	0.000344331
110	0.961381623	0.038618377	0.000344208
111	0.961037476	0.038962524	0.000344085
112	0.960693453	0.039306547	0.000343962
113	0.960349552	0.039650448	0.000343839
114	0.960005775	0.039994225	0.000343716
115	0.959662121	0.040337879	0.000343593
116	0.95931859	0.04068141	0.00034347
117	0.958975182	0.041024818	0.000343347
118	0.958631897	0.041368103	0.000343224
119	0.958288735	0.041711265	0.000343101
120	0.957945695	0.042054305	0.000342978
121	0.957602779	0.042397221	0.000342855
122	0.957259985	0.042740015	0.000342732
123	0.956917314	0.043082686	0.00034261
124	0.956574765	0.043425235	0.000342487
125	0.95623234	0.04376766	0.000342365
126	0.955890036	0.044109964	0.000342242
127	0.955547856	0.044452144	0.000342119
128	0.955205797	0.044794203	0.000341997
129	0.954863861	0.045136139	0.000341875
130	0.954522048	0.045477952	0.000341752
131	0.954180357	0.045819643	0.00034163
132	0.953838788	0.046161212	0.000341508
133	0.953497342	0.046502658	0.000341385
134	0.953156018	0.046843982	0.000341263
135	0.952814816	0.047185184	0.000341141
136	0.952473736	0.047526264	0.000341019
137	0.952132778	0.047867222	0.000340897
138	0.951791942	0.048208058	0.000340775
139	0.951451228	0.048548772	0.000340653
140	0.951110637	0.048889363	0.000340531
141	0.950770167	0.049229833	0.000340409
142	0.950429819	0.049570181	0.000340287
143	0.950089593	0.049910407	0.000340165
144	0.949749488	0.050250512	0.000340043
145	0.949409506	0.050590494	0.000339922
146	0.949069645	0.050930355	0.0003398
147	0.948729906	0.051270094	0.000339678
148	0.948390288	0.051609712	0.000339557
149	0.948050792	0.051949208	0.000339435
150	0.947711418	0.052288582	0.000339314
151	0.947372164	0.052627836	0.000339192
152	0.947033033	0.052966967	0.000339071
153	0.946694023	0.053305977	0.000338949
154	0.946355134	0.053644866	0.000338828
155	0.946016366	0.053983634	0.000338707
156	0.94567772	0.05432228	0.000338586
157	0.945339195	0.054660805	0.000338464
158	0.945000791	0.054999209	0.000338343
159	0.944662509	0.055337491	0.000338222
160	0.944324347	0.055675653	0.000338101
161	0.943986306	0.056013694	0.00033798
162	0.943648387	0.056351613	0.000337859
163	0.943310588	0.056689412	0.000337738
164	0.942972911	0.057027089	0.000337617
165	0.942635354	0.057364646	0.000337496
166	0.942297918	0.057702082	0.000337376
167	0.941960603	0.058039397	0.000337255
168	0.941623408	0.058376592	0.000337134
169	0.941286335	0.058713665	0.000337013
170	0.940949382	0.059050618	0.000336893
171	0.940612549	0.059387451	0.000336772
172	0.940275837	0.059724163	0.000336652
173	0.939939246	0.060060754	0.000336531
174	0.939602775	0.060397225	0.000336411
175	0.939266425	0.060733575	0.00033629
176	0.938930195	0.061069805	0.00033617
177	0.938594085	0.061405915	0.000336049
178	0.938258096	0.061741904	0.000335929
179	0.937922227	0.062077773	0.000335809
180	0.937586478	0.062413522	0.000335689
181	0.93725085	0.06274915	0.000335569
182	0.936915341	0.063084659	0.000335448
183	0.936579953	0.063420047	0.000335328
184	0.936244685	0.063755315	0.000335208
185	0.935909536	0.064090464	0.000335088
186	0.935574508	0.064425492	0.000334968
187	0.9352396	0.0647604	0.000334848
188	0.934904811	0.065095189	0.000334729
189	0.934570142	0.065429858	0.000334609
190	0.934235594	0.065764406	0.000334489
191	0.933901165	0.066098835	0.000334369
192	0.933566855	0.066433145	0.00033425
193	0.933232666	0.066767334	0.00033413
194	0.932898595	0.067101405	0.00033401
195	0.932564645	0.067435355	0.000333891
196	0.932230814	0.067769186	0.000333771
197	0.931897103	0.068102897	0.000333652
198	0.931563511	0.068436489	0.000333532
199	0.931230038	0.068769962	0.000333413
200	0.930896685	0.069103315	0.000333294
201	0.930563451	0.069436549	0.000333174
202	0.930230337	0.069769663	0.000333055
203	0.929897341	0.070102659	0.000332936
204	0.929564465	0.070435535	0.000332817
205	0.929231708	0.070768292	0.000332697
206	0.92889907	0.07110093	0.000332578
207	0.928566552	0.071433448	0.000332459
208	0.928234152	0.071765848	0.00033234
209	0.927901871	0.072098129	0.000332221

210	0.927569709	0.072430291	0.000332102
211	0.927237666	0.072762334	0.000331983
212	0.926905742	0.073094258	0.000331865
213	0.926573937	0.073426063	0.000331746
214	0.926242251	0.073757749	0.000331627
215	0.925910683	0.074089317	0.000331508
216	0.925579234	0.074420766	0.00033139
217	0.925247904	0.074752096	0.000331271
218	0.924916692	0.075083308	0.000331152
219	0.924585599	0.075414401	0.000331034
220	0.924254624	0.075745376	0.000330915
221	0.923923768	0.076076232	0.000330797
222	0.92359303	0.07640697	0.000330679
223	0.923262411	0.076737589	0.00033056
224	0.92293191	0.07706809	0.000330442
225	0.922601527	0.077398473	0.000330324
226	0.922271263	0.077728737	0.000330205
227	0.921941117	0.078058883	0.000330087
228	0.921611089	0.078388911	0.000329969
229	0.921281179	0.078718821	0.000329851
230	0.920951387	0.079048613	0.000329733
231	0.920621713	0.079378287	0.000329615
232	0.920292158	0.079707842	0.000329497
233	0.91996272	0.08003728	0.000329379
234	0.9196334	0.0803666	0.000329261
235	0.919304198	0.080695802	0.000329143
236	0.918975114	0.081024886	0.000329025
237	0.918646148	0.081353852	0.000328907
238	0.918317299	0.081682701	0.00032879
239	0.917988568	0.082011432	0.000328672
240	0.917659955	0.082340045	0.000328554
241	0.91733146	0.08266854	0.000328437
242	0.917003082	0.082996918	0.000328319
243	0.916674822	0.083325178	0.000328202
244	0.916346679	0.083653321	0.000328084
245	0.916018653	0.083981347	0.000327967
246	0.915690746	0.084309254	0.000327849
247	0.915362955	0.084637045	0.000327732
248	0.915035282	0.084964718	0.000327615
249	0.914707726	0.085292274	0.000327497
250	0.914380287	0.085619713	0.00032738
251	0.914052966	0.085947034	0.000327263
252	0.913725761	0.086274239	0.000327146
253	0.913398674	0.086601326	0.000327029
254	0.913071704	0.086928296	0.000326912
255	0.912744851	0.087255149	0.000326795
256	0.912418115	0.087581885	0.000326678
257	0.912091496	0.087908504	0.000326561
258	0.911764994	0.088235006	0.000326444
259	0.911438609	0.088561391	0.000326327
260	0.91111234	0.08888766	0.00032621
261	0.910786189	0.089213811	0.000326093
262	0.910460154	0.089539846	0.000325977
263	0.910134236	0.089865764	0.00032586
264	0.909808434	0.090191566	0.000325743
265	0.909482749	0.090517251	0.000325627
266	0.909157181	0.090842819	0.00032551
267	0.908831729	0.091168271	0.000325393
268	0.908506394	0.091493606	0.000325277
269	0.908181175	0.091818825	0.000325161
270	0.907856073	0.092143927	0.000325044
271	0.907531087	0.092468913	0.000324928
272	0.907206217	0.092793783	0.000324811
273	0.906881464	0.093118536	0.000324695
274	0.906556827	0.093443173	0.000324579
275	0.906232306	0.093767694	0.000324463
276	0.905907901	0.094092099	0.000324347
277	0.905583613	0.094416387	0.000324231
278	0.90525944	0.09474056	0.000324114
279	0.904935384	0.095064616	0.000323998
280	0.904611443	0.095388557	0.000323882
281	0.904287619	0.095712381	0.000323767
282	0.90396391	0.09603609	0.000323651
283	0.903640317	0.096359683	0.000323535
284	0.903316841	0.096683159	0.000323419
285	0.90299348	0.09700652	0.000323303
286	0.902670234	0.097329766	0.000323187
287	0.902347105	0.097652895	0.000323072
288	0.902024091	0.097975909	0.000322956
289	0.901701192	0.098298808	0.00032284
290	0.90137841	0.09862159	0.000322725
291	0.901055743	0.098944257	0.000322609
292	0.900733191	0.099266809	0.000322494
293	0.900410755	0.099589245	0.000322378
294	0.900088434	0.099911566	0.000322263
295	0.899766229	0.100233771	0.000322148
296	0.899444138	0.100555862	0.000322032
297	0.899122164	0.100877836	0.000321917
298	0.898800304	0.101199696	0.000321802
299	0.89847856	0.10152144	0.000321687
300	0.898156931	0.101843069	0.000321572
301	0.897835417	0.102164583	0.000321456
302	0.897514018	0.102485982	0.000321341
303	0.897192734	0.102807266	0.000321226
304	0.896871565	0.103128435	0.000321111
305	0.896550512	0.103449488	0.000320996
306	0.896229573	0.103770427	0.000320881
307	0.895908749	0.104091251	0.000320767
308	0.895588039	0.104411961	0.000320652
309	0.895267445	0.104732555	0.000320537
310	0.894946965	0.105053035	0.000320422
311	0.894626601	0.105373399	0.000320308
312	0.89430635	0.10569365	0.000320193
313	0.893986215	0.106013785	0.000320078
314	0.893666194	0.106333806	0.000319964
315	0.893346287	0.106653713	0.000319849

316	0.893026495	0.106973505	0.000319735
317	0.892706818	0.107293182	0.00031962
318	0.892387255	0.107612745	0.000319506
319	0.892067806	0.107932194	0.000319391
320	0.891748472	0.108251528	0.000319277
321	0.891429252	0.108570748	0.000319163
322	0.891110147	0.108889853	0.000319049
323	0.890791155	0.109208845	0.000318934
324	0.890472278	0.109527722	0.00031882
325	0.890153515	0.109846485	0.000318706
326	0.889834866	0.110165134	0.000318592
327	0.889516331	0.110483669	0.000318478
328	0.88919791	0.11080209	0.000318364
329	0.888879603	0.111120397	0.00031825
330	0.88856141	0.11143859	0.000318136
331	0.888243331	0.111756669	0.000318022
332	0.887925366	0.112074634	0.000317908
333	0.887607515	0.112392485	0.000317794
334	0.887289777	0.112710223	0.000317681
335	0.886972153	0.113027847	0.000317567
336	0.886654643	0.113345357	0.000317453
337	0.886337247	0.113662753	0.00031734
338	0.886019964	0.113980036	0.000317226
339	0.885702794	0.114297206	0.000317113
340	0.885385739	0.114614261	0.000316999
341	0.885068796	0.114931204	0.000316886
342	0.884751968	0.115248032	0.000316772
343	0.884435252	0.115564748	0.000316659
344	0.88411865	0.11588135	0.000316545
345	0.883802162	0.116197838	0.000316432
346	0.883485786	0.116514214	0.000316319
347	0.883169524	0.116830476	0.000316206
348	0.882853375	0.117146625	0.000316092
349	0.882537339	0.117462661	0.000315979
350	0.882221417	0.117778583	0.000315866
351	0.881905607	0.118094393	0.000315753
352	0.881589911	0.118410089	0.00031564
353	0.881274327	0.118725673	0.000315527
354	0.880958857	0.119041143	0.000315414
355	0.880643499	0.119356501	0.000315301
356	0.880328255	0.119671745	0.000315188
357	0.880013123	0.119986877	0.000315075
358	0.879698104	0.120301896	0.000314963
359	0.879383198	0.120616802	0.00031485
360	0.879068404	0.120931596	0.000314737
361	0.878753723	0.121246277	0.000314625
362	0.878439155	0.121560845	0.000314512
363	0.8781247	0.1218753	0.000314399
364	0.877810356	0.122189644	0.000314287
365	0.877496126	0.122503874	0.000314174
366	0.877182008	0.122817992	0.000314062
367	0.876868002	0.123131998	0.000313949
368	0.876554109	0.123445891	0.000313837
369	0.876240329	0.123759671	0.000313725
370	0.87592666	0.12407334	0.000313612
371	0.875613104	0.124386896	0.0003135
372	0.87529966	0.12470034	0.000313388
373	0.874986328	0.125013672	0.000313276
374	0.874673109	0.125326891	0.000313163
375	0.874360001	0.125639999	0.000313051
376	0.874047006	0.125952994	0.000312939
377	0.873734123	0.126265877	0.000312827
378	0.873421351	0.126578649	0.000312715
379	0.873108692	0.126891308	0.000312603
380	0.872796144	0.127203856	0.000312491
381	0.872483709	0.127516291	0.00031238
382	0.872171385	0.127828615	0.000312268
383	0.871859173	0.128140827	0.000312156
384	0.871547073	0.128452927	0.000312044
385	0.871235085	0.128764915	0.000311933
386	0.870923208	0.129076792	0.000311821
387	0.870611443	0.129388557	0.000311709
388	0.870299789	0.129700211	0.000311598
389	0.869988247	0.130011753	0.000311486
390	0.869676817	0.130323183	0.000311375
391	0.869365498	0.130634502	0.000311263
392	0.869054291	0.130945709	0.000311152
393	0.868743195	0.131256805	0.00031104
394	0.86843221	0.13156779	0.000310929
395	0.868121337	0.131878663	0.000310818
396	0.867810574	0.132189426	0.000310706
397	0.867499924	0.132500076	0.000310595
398	0.867189384	0.132810616	0.000310484
399	0.866878955	0.133121045	0.000310373
400	0.866568638	0.133431362	0.000310262
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402	0.865948337	0.134051663	0.00031004
403	0.865638352	0.134361648	0.000309929
404	0.865328479	0.134671521	0.000309818
405	0.865018717	0.134981283	0.000309707
406	0.864709065	0.135290935	0.000309596
407	0.864399525	0.135600475	0.000309485
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410	0.863471568	0.136528432	0.000309153
411	0.86316247	0.13683753	0.000309042
412	0.862853483	0.137146517	0.000308932
413	0.862544607	0.137455393	0.000308821
414	0.862235841	0.137764159	0.000308711
415	0.861927186	0.138072814	0.0003086
416	0.861618641	0.138381359	0.00030849
417	0.861310206	0.138689794	0.000308379
418	0.861001882	0.138998118	0.000308269
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425	0.858846703	0.141153297	0.000307497
426	0.858539261	0.141460739	0.000307387
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428	0.857924707	0.142075293	0.000307167
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434	0.856083683	0.143916317	0.000306508
435	0.855777231	0.144222769	0.000306398
436	0.855470887	0.144529113	0.000306288
437	0.855164654	0.144835346	0.000306179
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444	0.853024086	0.146975914	0.000305412
445	0.852718728	0.147281272	0.000305303
446	0.852413479	0.147586521	0.000305194
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453	0.850279798	0.149720202	0.00030443
454	0.849975423	0.150024577	0.000304321
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457	0.84906295	0.15093705	0.000303994
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459	0.848455179	0.151544821	0.000303777
460	0.848151457	0.151848543	0.000303668
461	0.847847844	0.152152156	0.000303559
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473	0.844212948	0.155787052	0.000302258
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476	0.843306662	0.156693338	0.000301933
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478	0.842703012	0.157296988	0.000301717
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496	0.837289567	0.162710433	0.000299779
497	0.836989842	0.163010158	0.000299672
498	0.836690224	0.163309776	0.000299564
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539	0.824497795	0.175502205	0.000295199
540	0.824202649	0.175797351	0.000295093
541	0.823907609	0.176092391	0.000294988
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543	0.823317844	0.176682156	0.000294777
544	0.823023121	0.176976879	0.000294671
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546	0.82243399	0.17756601	0.00029446
547	0.822139582	0.177860418	0.000294355
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558	0.818908049	0.181091951	0.000293198
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566	0.816565823	0.183434177	0.000292359
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570	0.815397224	0.184602776	0.000291941
571	0.815105336	0.184894664	0.000291836
572	0.814813552	0.185186448	0.000291732
573	0.814521872	0.185478128	0.000291627
574	0.814230297	0.185769703	0.000291523
575	0.813938827	0.186061173	0.000291419
576	0.81364746	0.18635254	0.000291314
577	0.813356198	0.186643802	0.00029121
578	0.81306504	0.18693496	0.000291106
579	0.812773987	0.187226013	0.000291001
580	0.812483037	0.187516963	0.000290897
581	0.812192192	0.187807808	0.000290793
582	0.811901451	0.188098549	0.000290689
583	0.811610814	0.188389186	0.000290585
584	0.811320281	0.188679719	0.000290481
585	0.811029852	0.188970148	0.000290377
586	0.810739527	0.189260473	0.000290273
587	0.810449306	0.189550694	0.000290169
588	0.810159189	0.189840811	0.000290065
589	0.809869176	0.190130824	0.000289961
590	0.809579266	0.190420734	0.000289858
591	0.80928946	0.19071054	0.000289754
592	0.808999758	0.191000242	0.00028965
593	0.80871016	0.19128984	0.000289546
594	0.808420665	0.191579335	0.000289443
595	0.808131274	0.191868726	0.000289339
596	0.807841987	0.192158013	0.000289236
597	0.807552803	0.192447197	0.000289132
598	0.807263723	0.192736277	0.000289029
599	0.806974746	0.193025254	0.000288925
600	0.806685872	0.193314128	0.000288822
601	0.806397102	0.193602898	0.000288718
602	0.806108436	0.193891564	0.000288615
603	0.805819873	0.194180127	0.000288512
604	0.805531413	0.194468587	0.000288408
605	0.805243056	0.194756944	0.000288305
606	0.804954802	0.195045198	0.000288202
607	0.804666652	0.195333348	0.000288099
608	0.804378605	0.195621395	0.000287996
609	0.804090661	0.195909339	0.000287893
610	0.80380282	0.19619718	0.000287789
611	0.803515082	0.196484918	0.000287686
612	0.803227447	0.196772553	0.000287583
613	0.802939915	0.197060085	0.000287481
614	0.802652486	0.197347514	0.000287378
615	0.80236516	0.19763484	0.000287275
616	0.802077936	0.197922064	0.000287172
617	0.801790816	0.198209184	0.000287069
618	0.801503798	0.198496202	0.000286966
619	0.801216883	0.198783117	0.000286864
620	0.800930071	0.199069929	0.000286761
621	0.800643361	0.199356639	0.000286658
622	0.800356754	0.199643246	0.000286556
623	0.80007025	0.19992975	0.000286453
624	0.799783848	0.200216152	0.000286351
625	0.799497549	0.200502451	0.000286248
626	0.799211352	0.200788648	0.000286146
627	0.798925258	0.201074742	0.000286043
628	0.798639266	0.201360734	0.000285941
629	0.798353376	0.201646624	0.000285838
630	0.798067589	0.201932411	0.000285736
631	0.797781904	0.202218096	0.000285634
632	0.797496322	0.202503678	0.000285532
633	0.797210841	0.202789159	0.000285429

634	0.796925463	0.203074537	0.000285327
635	0.796640187	0.203359813	0.000285225
636	0.796355013	0.203644987	0.000285123
637	0.796069941	0.203930059	0.000285021
638	0.795784971	0.204215029	0.000284919
639	0.795500104	0.204499896	0.000284817
640	0.795215338	0.204784662	0.000284715
641	0.794930674	0.205069326	0.000284613
642	0.794646112	0.205353888	0.000284511
643	0.794361652	0.205638348	0.000284409
644	0.794077293	0.205922707	0.000284307
645	0.793793037	0.206206963	0.000284206
646	0.793508882	0.206491118	0.000284104
647	0.793224829	0.206775171	0.000284002
648	0.792940878	0.207059122	0.000283901
649	0.792657028	0.207342972	0.000283799
650	0.79237328	0.20762672	0.000283697
651	0.792089634	0.207910366	0.000283596
652	0.791806089	0.208193911	0.000283494
653	0.791522645	0.208477355	0.000283393
654	0.791239303	0.208760697	0.000283291
655	0.790956063	0.209043937	0.00028319
656	0.790672923	0.209327077	0.000283089
657	0.790389886	0.209610114	0.000282987
658	0.790106949	0.209893051	0.000282886
659	0.789824114	0.210175886	0.000282785
660	0.78954138	0.21045862	0.000282683
661	0.789258747	0.210741253	0.000282582
662	0.788976215	0.211023785	0.000282481
663	0.788693785	0.211306215	0.00028238
664	0.788411456	0.211588544	0.000282279
665	0.788129227	0.211870773	0.000282178
666	0.7878471	0.2121529	0.000282077
667	0.787565074	0.212434926	0.000281976
668	0.787283149	0.212716851	0.000281875
669	0.787001324	0.212998676	0.000281774
670	0.786719601	0.213280399	0.000281673
671	0.786437978	0.213562022	0.000281572
672	0.786156456	0.213843544	0.000281471
673	0.785875035	0.214124965	0.000281371
674	0.785593715	0.214406285	0.00028127
675	0.785312495	0.214687505	0.000281169
676	0.785031376	0.214968624	0.000281069
677	0.784750358	0.215249642	0.000280968
678	0.78446944	0.21553056	0.000280867
679	0.784188623	0.215811377	0.000280767
680	0.783907906	0.216092094	0.000280666
681	0.78362729	0.21637271	0.000280566
682	0.783346775	0.216653225	0.000280465
683	0.783066359	0.216933641	0.000280365
684	0.782786044	0.217213956	0.000280265
685	0.78250583	0.21749417	0.000280164
686	0.782225716	0.217774284	0.000280064
687	0.781945702	0.218054298	0.000279964
688	0.781665788	0.218334212	0.000279864
689	0.781385974	0.218614026	0.000279763
690	0.781106261	0.218893739	0.000279663
691	0.780826648	0.219173352	0.000279563
692	0.780547134	0.219452866	0.000279463
693	0.780267721	0.219732279	0.000279363
694	0.779988408	0.220011592	0.000279263
695	0.779709195	0.220290805	0.000279163
696	0.779430082	0.220569918	0.000279063
697	0.779151069	0.220848931	0.000278963
698	0.778872156	0.221127844	0.000278863
699	0.778593342	0.221406658	0.000278764
700	0.778314628	0.221685372	0.000278664
701	0.778036014	0.221963986	0.000278564
702	0.7777575	0.2222425	0.000278464
703	0.777479086	0.222520914	0.000278365
704	0.777200771	0.222799229	0.000278265
705	0.776922556	0.223077444	0.000278165
706	0.77664444	0.22335556	0.000278066
707	0.776366424	0.223633576	0.000277966
708	0.776088508	0.223911492	0.000277867
709	0.775810691	0.224189309	0.000277767
710	0.775532973	0.224467027	0.000277668
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712	0.774977836	0.225022164	0.000277469
713	0.774700417	0.225299583	0.00027737
714	0.774423096	0.225576904	0.00027727
715	0.774145876	0.225854124	0.000277171
716	0.773868754	0.226131246	0.000277072
717	0.773591732	0.226408268	0.000276973
718	0.773314808	0.226685192	0.000276874
719	0.773037984	0.226962016	0.000276775
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721	0.772484633	0.227515367	0.000276576
722	0.772208106	0.227791894	0.000276477
723	0.771931678	0.228068322	0.000276378
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725	0.771379119	0.228620881	0.000276181
726	0.771102988	0.228897012	0.000276082
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731	0.769723814	0.230276186	0.000275588
732	0.769448275	0.230551725	0.000275489
733	0.769172835	0.230827165	0.000275391
734	0.768897494	0.231102506	0.000275292
735	0.768622251	0.231377749	0.000275194
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738	0.767797113	0.232202887	0.000274898
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742	0.766698308	0.233301692	0.000274505
743	0.766423852	0.233576148	0.000274406
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745	0.765875236	0.234124764	0.00027421
746	0.765601075	0.234398925	0.000274112
747	0.765327012	0.234672988	0.000274014
748	0.765053047	0.234946953	0.000273916
749	0.76477918	0.23522082	0.000273818
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751	0.764231741	0.235768259	0.000273622
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754	0.763411317	0.236588683	0.000273328
755	0.763138038	0.236861962	0.00027323
756	0.762864857	0.237135143	0.000273132
757	0.762591773	0.237408227	0.000273034
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786	0.754714738	0.245285262	0.000270214
787	0.754444572	0.245555428	0.000270117
788	0.754174503	0.245825497	0.000270021
789	0.753904531	0.246095469	0.000269924
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793	0.752825607	0.247174393	0.000269538
794	0.752556117	0.247443883	0.000269441
795	0.752286724	0.247713276	0.000269345
796	0.752017428	0.247982572	0.000269248
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799	0.751210116	0.248789884	0.000268959
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804	0.749866522	0.250133478	0.000268478
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808	0.748793377	0.251206623	0.000268094
809	0.748525331	0.251474669	0.000267998
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818	0.746117229	0.253882771	0.000267136
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822	0.745049449	0.254950551	0.000266754
823	0.744782743	0.255217257	0.000266658
824	0.744516133	0.255483867	0.000266563
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826	0.743983198	0.256016802	0.000266372
827	0.743716874	0.256283126	0.000266277
828	0.743450645	0.256549355	0.000266181
829	0.743184511	0.256815489	0.000266086
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834	0.741855272	0.258144728	0.00026561
835	0.741589709	0.258410291	0.000265515
836	0.741324242	0.258675758	0.00026542
837	0.741058869	0.258941131	0.000265325
838	0.740793592	0.259206408	0.00026523
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843	0.739468628	0.260531372	0.000264756
844	0.73920392	0.26079608	0.000264661
845	0.738939307	0.261060693	0.000264566

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847	0.738410364	0.261589636	0.000264377
848	0.738146035	0.261853965	0.000264282
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880	0.729737271	0.270262729	0.000261271
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885	0.728432083	0.271567917	0.000260804
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887	0.727910661	0.272089339	0.000260617
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889	0.727389613	0.272610387	0.000260431
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891	0.726868938	0.273131062	0.000260244
892	0.72660874	0.27339126	0.000260151
893	0.726348635	0.273651365	0.000260058
894	0.726088624	0.273911376	0.000259965
895	0.725828705	0.274171295	0.000259872
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897	0.725309147	0.274690853	0.000259686
898	0.725049508	0.274950492	0.000259593
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900	0.724530507	0.275469493	0.000259407
901	0.724271147	0.275728853	0.000259314
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913	0.72116605	0.27883395	0.000258203
914	0.720907893	0.279092107	0.00025811
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916	0.720391858	0.279608142	0.000257925
917	0.720133978	0.279866022	0.000257833
918	0.719876191	0.280123809	0.000257741
919	0.719618497	0.280381503	0.000257649
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921	0.719103384	0.280896616	0.000257464
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923	0.71858864	0.28141136	0.00025728
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926	0.717817215	0.282182785	0.000257004
927	0.717560258	0.282439742	0.000256912
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929	0.717046618	0.282953382	0.000256728
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932	0.716276849	0.283723151	0.000256452
933	0.716020442	0.283979558	0.00025636
934	0.715764128	0.284235872	0.000256269
935	0.715507905	0.284492095	0.000256177
936	0.715251774	0.284748226	0.000256085
937	0.714995735	0.285004265	0.000255993
938	0.714739788	0.285260212	0.000255902
939	0.714483932	0.285516068	0.00025581
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941	0.713972494	0.286027506	0.000255627
942	0.713716913	0.286283087	0.000255536
943	0.713461423	0.286538577	0.000255444
944	0.713206025	0.286793975	0.000255353
945	0.712950718	0.287049282	0.000255261
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947	0.712440378	0.287559622	0.000255079
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957	0.709894154	0.290105846	0.000254167
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1260	0.636911877	0.363088123	0.000228037
1261	0.636683881	0.363316119	0.000227955
1262	0.636455967	0.363544033	0.000227873
1263	0.636228134	0.363771866	0.000227792
1264	0.636000383	0.363999617	0.00022771
1265	0.635772713	0.364227287	0.000227629
1266	0.635545125	0.364454875	0.000227547
1267	0.635317619	0.364682381	0.000227466
1268	0.635090194	0.364909806	0.000227384
1269	0.63486285	0.36513715	0.000227303

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1271	0.634408406	0.365591594	0.00022714
1272	0.634181307	0.365818693	0.000227059
1273	0.633954288	0.366045712	0.000226978
1274	0.633727351	0.366272649	0.000226897
1275	0.633500495	0.366499505	0.000226815
1276	0.633273721	0.366726279	0.000226734
1277	0.633047027	0.366952973	0.000226653
1278	0.632820415	0.367179585	0.000226572
1279	0.632593884	0.367406116	0.000226491
1280	0.632367433	0.367632567	0.00022641
1281	0.632141064	0.367858936	0.000226329
1282	0.631914776	0.368085224	0.000226248
1283	0.631688569	0.368311431	0.000226167
1284	0.631462443	0.368537557	0.000226086
1285	0.631236398	0.368763602	0.000226005
1286	0.631010434	0.368989566	0.000225924
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1288	0.630558748	0.369441252	0.000225762
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1290	0.630107386	0.369892614	0.0002256
1291	0.629881826	0.370118174	0.00022552
1292	0.629656346	0.370343654	0.000225439
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1317	0.624045521	0.375954479	0.00022343
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1320	0.623375591	0.376624409	0.00022319
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1322	0.62292937	0.37707063	0.00022303
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1600	0.563912693	0.436087307	0.0002019
1601	0.563710828	0.436289172	0.000201828
1602	0.563509036	0.436490964	0.000201756
1603	0.563307317	0.436692683	0.000201684
1604	0.563105669	0.436894331	0.000201611
1605	0.562904094	0.437095906	0.000201539
1606	0.56270259	0.43729741	0.000201467
1607	0.562501159	0.437498841	0.000201395
1608	0.5622998	0.4377002	0.000201323
1609	0.562098513	0.437901487	0.000201251
1610	0.561897298	0.438102702	0.000201179
1611	0.561696156	0.438303844	0.000201107
1612	0.561495085	0.438504915	0.000201035
1613	0.561294086	0.438705914	0.000200963
1614	0.561093159	0.438906841	0.000200891
1615	0.560892304	0.439107696	0.000200819
1616	0.560691521	0.439308479	0.000200747
1617	0.56049081	0.43950919	0.000200675
1618	0.56029017	0.43970983	0.000200603
1619	0.560089603	0.439910397	0.000200532
1620	0.559889107	0.440110893	0.00020046
1621	0.559688683	0.440311317	0.000200388
1622	0.559488331	0.440511669	0.000200316
1623	0.55928805	0.44071195	0.000200245
1624	0.559087842	0.440912158	0.000200173
1625	0.558887705	0.441112295	0.000200101
1626	0.558687639	0.441312361	0.00020003
1627	0.558487645	0.441512355	0.000199958
1628	0.558287723	0.441712277	0.000199886
1629	0.558087872	0.441912128	0.000199815
1630	0.557888093	0.442111907	0.000199743
1631	0.557688385	0.442311615	0.000199672
1632	0.557488749	0.442511251	0.0001996
1633	0.557289185	0.442710815	0.000199529
1634	0.557089691	0.442910309	0.000199458
1635	0.556890269	0.443109731	0.000199386
1636	0.556690919	0.443309081	0.000199315
1637	0.55649164	0.44350836	0.000199243
1638	0.556292432	0.443707568	0.000199172
1639	0.556093296	0.443906704	0.000199101
1640	0.55589423	0.44410577	0.00019903
1641	0.555695237	0.444304763	0.000198958
1642	0.555496314	0.444503686	0.000198887
1643	0.555297462	0.444702538	0.000198816
1644	0.555098682	0.444901318	0.000198745
1645	0.554899973	0.445100027	0.000198674
1646	0.554701335	0.445298665	0.000198602
1647	0.554502768	0.445497232	0.000198531
1648	0.554304272	0.445695728	0.00019846
1649	0.554105848	0.445894152	0.000198389
1650	0.553907494	0.446092506	0.000198318
1651	0.553709211	0.446290789	0.000198247
1652	0.553510999	0.446489001	0.000198176
1653	0.553312859	0.446687141	0.000198105
1654	0.553114789	0.446885211	0.000198034
1655	0.55291679	0.44708321	0.000197964
1656	0.552718862	0.447281138	0.000197893
1657	0.552521005	0.447478995	0.000197822
1658	0.552323218	0.447676782	0.000197751
1659	0.552125503	0.447874497	0.00019768
1660	0.551927858	0.448072142	0.000197609
1661	0.551730284	0.448269716	0.000197539
1662	0.55153278	0.44846722	0.000197468
1663	0.551335348	0.448664652	0.000197397
1664	0.551137986	0.448862014	0.000197327
1665	0.550940694	0.449059306	0.000197256
1666	0.550743474	0.449256526	0.000197185
1667	0.550546324	0.449453676	0.000197115
1668	0.550349244	0.449650756	0.000197044
1669	0.550152235	0.449847765	0.000196974
1670	0.549955297	0.450044703	0.000196903
1671	0.549758429	0.450241571	0.000196833
1672	0.549561631	0.450438369	0.000196762
1673	0.549364904	0.450635096	0.000196692
1674	0.549168248	0.450831752	0.000196621
1675	0.548971661	0.451028339	0.000196551
1676	0.548775146	0.451224854	0.000196481
1677	0.5485787	0.4514213	0.00019641
1678	0.548382325	0.451617675	0.00019634
1679	0.54818602	0.45181398	0.00019627
1680	0.547989786	0.452010214	0.000196199
1681	0.547793621	0.452206379	0.000196129
1682	0.547597527	0.452402473	0.000196059
1683	0.547401503	0.452598497	0.000195989
1684	0.547205549	0.452794451	0.000195919
1685	0.547009666	0.452990334	0.000195849
1686	0.546813852	0.453186148	0.000195778
1687	0.546618109	0.453381891	0.000195708
1688	0.546422435	0.453577565	0.000195638
1689	0.546226832	0.453773168	0.000195568
1690	0.546031299	0.453968701	0.000195498
1691	0.545835836	0.454164164	0.000195428
1692	0.545640442	0.454359558	0.000195358
1693	0.545445119	0.454554881	0.000195288

1694	0.545249866	0.454750134	0.000195218
1695	0.545054682	0.454945318	0.000195149
1696	0.544859568	0.455140432	0.000195079
1697	0.544664525	0.455335475	0.000195009
1698	0.544469551	0.455530449	0.000194939
1699	0.544274646	0.455725354	0.000194869
1700	0.544079812	0.455920188	0.0001948
1701	0.543885047	0.456114953	0.00019473
1702	0.543690352	0.456309648	0.00019466
1703	0.543495727	0.456504273	0.00019459
1704	0.543301171	0.456698829	0.000194521
1705	0.543106685	0.456893315	0.000194451
1706	0.542912269	0.457087731	0.000194382
1707	0.542717922	0.457282078	0.000194312
1708	0.542523645	0.457476355	0.000194242
1709	0.542329438	0.457670562	0.000194173
1710	0.542135299	0.457864701	0.000194103
1711	0.541941231	0.458058769	0.000194034
1712	0.541747232	0.458252768	0.000193964
1713	0.541553302	0.458446698	0.000193895
1714	0.541359442	0.458640558	0.000193826
1715	0.541165651	0.458834349	0.000193756
1716	0.540971929	0.459028071	0.000193687
1717	0.540778277	0.459221723	0.000193617
1718	0.540584694	0.459415306	0.000193548
1719	0.540391181	0.459608819	0.000193479
1720	0.540197736	0.459802264	0.00019341
1721	0.540004361	0.459995639	0.00019334
1722	0.539811056	0.460188944	0.000193271
1723	0.539617819	0.460382181	0.000193202
1724	0.539424652	0.460575348	0.000193133
1725	0.539231553	0.460768447	0.000193064
1726	0.539038524	0.460961476	0.000192995
1727	0.538845564	0.461154436	0.000192926
1728	0.538652673	0.461347327	0.000192856
1729	0.538459851	0.461540149	0.000192787
1730	0.538267098	0.461732902	0.000192718
1731	0.538074414	0.461925586	0.000192649
1732	0.537881799	0.462118201	0.00019258
1733	0.537689253	0.462310747	0.000192512
1734	0.537496776	0.462503224	0.000192443
1735	0.537304368	0.462695632	0.000192374
1736	0.537112029	0.462887971	0.000192305
1737	0.536919759	0.463080241	0.000192236
1738	0.536727557	0.463272443	0.000192167
1739	0.536535424	0.463464576	0.000192098
1740	0.53634336	0.46365664	0.00019203
1741	0.536151365	0.463848635	0.000191961
1742	0.535959438	0.464040562	0.000191892
1743	0.53576758	0.46423242	0.000191823
1744	0.535575791	0.464424209	0.000191755
1745	0.535384071	0.464615929	0.000191686
1746	0.535192419	0.464807581	0.000191618
1747	0.535000836	0.464999164	0.000191549
1748	0.534809321	0.465190679	0.00019148
1749	0.534617875	0.465382125	0.000191412
1750	0.534426497	0.465573503	0.000191343
1751	0.534235188	0.465764812	0.000191275
1752	0.534043948	0.465956052	0.000191206
1753	0.533852775	0.466147225	0.000191138
1754	0.533661672	0.466338328	0.00019107
1755	0.533470636	0.466529364	0.000191001
1756	0.533279669	0.466720331	0.000190933
1757	0.533088771	0.466911229	0.000190864
1758	0.532897941	0.467102059	0.000190796
1759	0.532707179	0.467292821	0.000190728
1760	0.532516485	0.467483515	0.000190659
1761	0.53232586	0.46767414	0.000190591
1762	0.532135303	0.467864697	0.000190523
1763	0.531944814	0.468055186	0.000190455
1764	0.531754393	0.468245607	0.000190387
1765	0.531564041	0.468435959	0.000190318
1766	0.531373756	0.468626244	0.00019025
1767	0.53118354	0.46881646	0.000190182
1768	0.530993392	0.469006608	0.000190114
1769	0.530803311	0.469196689	0.000190046
1770	0.530613299	0.469386701	0.000189978
1771	0.530423355	0.469576645	0.00018991
1772	0.530233479	0.469766521	0.000189842
1773	0.530043671	0.469956329	0.000189774
1774	0.529853931	0.470146069	0.000189706
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1776	0.529474654	0.470525346	0.00018957
1777	0.529285118	0.470714882	0.000189503
1778	0.529095649	0.470904351	0.000189435
1779	0.528906248	0.471093752	0.000189367
1780	0.528716915	0.471283085	0.000189299
1781	0.52852765	0.47147235	0.000189231
1782	0.528338453	0.471661547	0.000189164
1783	0.528149323	0.471850677	0.000189096
1784	0.527960261	0.472039739	0.000189028
1785	0.527771267	0.472228733	0.000188961
1786	0.52758234	0.47241766	0.000188893
1787	0.527393481	0.472606519	0.000188825
1788	0.527204689	0.472795311	0.000188758
1789	0.527015965	0.472984035	0.00018869
1790	0.526827309	0.473172691	0.000188623
1791	0.52663872	0.47336128	0.000188555
1792	0.526450199	0.473549801	0.000188488
1793	0.526261745	0.473738255	0.00018842
1794	0.526073359	0.473926641	0.000188353
1795	0.52588504	0.47411496	0.000188285
1796	0.525696788	0.474303212	0.000188218
1797	0.525508604	0.474491396	0.00018815
1798	0.525320488	0.474679512	0.000188083
1799	0.525132438	0.474867562	0.000188016

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1801	0.524756541	0.475243459	0.000187881
1802	0.524568694	0.475431306	0.000187814
1803	0.524380914	0.475619086	0.000187747
1804	0.5241932	0.4758068	0.000187679
1805	0.524005555	0.475994445	0.000187612
1806	0.523817976	0.476182024	0.000187545
1807	0.523630464	0.476369536	0.000187478
1808	0.52344302	0.47655698	0.000187411
1809	0.523255643	0.476744357	0.000187344
1810	0.523068332	0.476931668	0.000187277
1811	0.522881089	0.477118911	0.00018721
1812	0.522693913	0.477306087	0.000187143
1813	0.522506804	0.477493196	0.000187076
1814	0.522319762	0.477680238	0.000187009
1815	0.522132786	0.477867214	0.000186942
1816	0.521945878	0.478054122	0.000186875
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1818	0.521572262	0.478427738	0.000186741
1819	0.521385555	0.478614445	0.000186674
1820	0.521198914	0.478801086	0.000186607
1821	0.52101234	0.47898766	0.000186541
1822	0.520825833	0.479174167	0.000186474
1823	0.520639392	0.479360608	0.000186407
1824	0.520453018	0.479546982	0.00018634
1825	0.520266711	0.479733289	0.000186274
1826	0.520080471	0.479919529	0.000186207
1827	0.519894298	0.480105702	0.00018614
1828	0.519708191	0.480291809	0.000186074
1829	0.51952215	0.48047785	0.000186007
1830	0.519336176	0.480663824	0.00018594
1831	0.519150269	0.480849731	0.000185874
1832	0.518964429	0.481035571	0.000185807
1833	0.518778654	0.481221346	0.000185741
1834	0.518592947	0.481407053	0.000185674
1835	0.518407306	0.481592694	0.000185608
1836	0.518221731	0.481778269	0.000185541
1837	0.518036223	0.481963777	0.000185475
1838	0.517850781	0.482149219	0.000185409
1839	0.517665405	0.482334595	0.000185342
1840	0.517480096	0.482519904	0.000185276
1841	0.517294854	0.482705146	0.00018521
1842	0.517109677	0.482890323	0.000185143
1843	0.516924567	0.483075433	0.000185077
1844	0.516739523	0.483260477	0.000185011
1845	0.516554545	0.483445455	0.000184945
1846	0.516369634	0.483630366	0.000184878
1847	0.516184789	0.483815211	0.000184812
1848	0.51600001	0.48399999	0.000184746
1849	0.515815297	0.484184703	0.00018468
1850	0.51563065	0.48436935	0.000184614
1851	0.515446069	0.484553931	0.000184548
1852	0.515261554	0.484738446	0.000184482
1853	0.515077106	0.484922894	0.000184416
1854	0.514892723	0.485107277	0.00018435
1855	0.514708407	0.485291593	0.000184284
1856	0.514524156	0.485475844	0.000184218
1857	0.514339971	0.485660029	0.000184152
1858	0.514155853	0.485844147	0.000184086
1859	0.5139718	0.4860282	0.00018402
1860	0.513787813	0.486212187	0.000183954
1861	0.513603892	0.486396108	0.000183888
1862	0.513420037	0.486579963	0.000183822
1863	0.513236247	0.486763753	0.000183756
1864	0.513052524	0.486947476	0.000183691
1865	0.512868866	0.487131134	0.000183625
1866	0.512685274	0.487314726	0.000183559
1867	0.512501748	0.487498252	0.000183494
1868	0.512318287	0.487681713	0.000183428
1869	0.512134892	0.487865108	0.000183362
1870	0.511951563	0.488048437	0.000183297
1871	0.511768299	0.488231701	0.000183231
1872	0.511585101	0.488414899	0.000183165
1873	0.511401968	0.488598032	0.0001831
1874	0.511218901	0.488781099	0.000183034
1875	0.5110359	0.4889641	0.000182969
1876	0.510852964	0.489147036	0.000182903
1877	0.510670093	0.489329907	0.000182838
1878	0.510487288	0.489512712	0.000182772
1879	0.510304549	0.489695451	0.000182707
1880	0.510121875	0.489878125	0.000182641
1881	0.509939266	0.490060734	0.000182576
1882	0.509756723	0.490243277	0.000182511
1883	0.509574245	0.490425755	0.000182445
1884	0.509391832	0.490608168	0.00018238
1885	0.509209484	0.490790516	0.000182315
1886	0.509027202	0.490972798	0.00018225
1887	0.508844985	0.491155015	0.000182184
1888	0.508662834	0.491337166	0.000182119
1889	0.508480747	0.491519253	0.000182054
1890	0.508298726	0.491701274	0.000181989
1891	0.50811677	0.49188323	0.000181924
1892	0.507934879	0.492065121	0.000181858
1893	0.507753053	0.492246947	0.000181793
1894	0.507571292	0.492428708	0.000181728
1895	0.507389597	0.492610403	0.000181663
1896	0.507207966	0.492792034	0.000181598
1897	0.5070264	0.4929736	0.000181533
1898	0.5068449	0.4931551	0.000181468
1899	0.506663464	0.493336536	0.000181403
1900	0.506482093	0.493517907	0.000181338
1901	0.506300787	0.493699213	0.000181273
1902	0.506119547	0.493880453	0.000181208
1903	0.505938371	0.494061629	0.000181144
1904	0.505757259	0.494242741	0.000181079
1905	0.505576213	0.494423787	0.000181014

1906	0.505395232	0.494604768	0.000180949
1907	0.505214315	0.494785685	0.000180884
1908	0.505033463	0.494966537	0.00018082
1909	0.504852676	0.495147324	0.000180755
1910	0.504671953	0.495328047	0.00018069
1911	0.504491295	0.495508705	0.000180625
1912	0.504310702	0.495689298	0.000180561
1913	0.504130174	0.495869826	0.000180496
1914	0.50394971	0.49605029	0.000180432
1915	0.50376931	0.49623069	0.000180367
1916	0.503588976	0.496411024	0.000180302
1917	0.503408705	0.496591295	0.000180238
1918	0.5032285	0.4967715	0.000180173
1919	0.503048359	0.496951641	0.000180109
1920	0.502868282	0.497131718	0.000180044
1921	0.50268827	0.49731173	0.00017998
1922	0.502508322	0.497491678	0.000179916
1923	0.502328439	0.497671561	0.000179851
1924	0.50214862	0.49785138	0.000179787
1925	0.501968865	0.498031135	0.000179722
1926	0.501789175	0.498210825	0.000179658
1927	0.501609549	0.498390451	0.000179594
1928	0.501429988	0.498570012	0.000179529
1929	0.50125049	0.49874951	0.000179465
1930	0.501071057	0.498928943	0.000179401
1931	0.500891689	0.499108311	0.000179337
1932	0.500712384	0.499287616	0.000179273
1933	0.500533144	0.499466856	0.000179208
1934	0.500353967	0.499646033	0.000179144
1935	0.500174855	0.499825145	0.00017908
1936	0.499995807	0.500004193	0.000179016
1937	0.499816823	0.500183177	0.000178952
1938	0.499637903	0.500362097	0.000178888
1939	0.499459048	0.500540952	0.000178824
1940	0.499280256	0.500719744	0.00017876
1941	0.499101528	0.500898472	0.000178696
1942	0.498922864	0.501077136	0.000178632
1943	0.498744265	0.501255735	0.000178568
1944	0.498565729	0.501434271	0.000178504
1945	0.498387257	0.501612743	0.00017844
1946	0.498208849	0.501791151	0.000178376
1947	0.498030504	0.501969496	0.000178312
1948	0.497852224	0.502147776	0.000178248
1949	0.497674007	0.502325993	0.000178185
1950	0.497495855	0.502504145	0.000178121
1951	0.497317766	0.502682234	0.000178057
1952	0.49713974	0.50286026	0.000177993
1953	0.496961779	0.503038221	0.00017793
1954	0.496783881	0.503216119	0.000177866
1955	0.496606047	0.503393953	0.000177802
1956	0.496428276	0.503571724	0.000177739
1957	0.49625057	0.50374943	0.000177675
1958	0.496072926	0.503927074	0.000177611
1959	0.495895347	0.504104653	0.000177548
1960	0.495717831	0.504282169	0.000177484
1961	0.495540378	0.504459622	0.000177421
1962	0.495362989	0.504637011	0.000177357
1963	0.495185664	0.504814336	0.000177294
1964	0.495008402	0.504991598	0.00017723
1965	0.494831203	0.505168797	0.000177167
1966	0.494654068	0.505345932	0.000177103
1967	0.494476996	0.505523004	0.00017704
1968	0.494299988	0.505700012	0.000176977
1969	0.494123043	0.505876957	0.000176913
1970	0.493946161	0.506053839	0.00017685
1971	0.493769343	0.506230657	0.000176787
1972	0.493592588	0.506407412	0.000176723
1973	0.493415896	0.506584104	0.00017666
1974	0.493239268	0.506760732	0.000176597
1975	0.493062703	0.506937297	0.000176534
1976	0.492886201	0.507113799	0.00017647
1977	0.492709762	0.507290238	0.000176407
1978	0.492533386	0.507466614	0.000176344
1979	0.492357073	0.507642927	0.000176281
1980	0.492180824	0.507819176	0.000176218
1981	0.492004638	0.507995362	0.000176155
1982	0.491828514	0.508171486	0.000176092
1983	0.491652454	0.508347546	0.000176029
1984	0.491476457	0.508523543	0.000175966
1985	0.491300523	0.508699477	0.000175903
1986	0.491124651	0.508875349	0.00017584
1987	0.490948843	0.509051157	0.000175777
1988	0.490773098	0.509226902	0.000175714
1989	0.490597415	0.509402585	0.000175651
1990	0.490421796	0.509578204	0.000175588
1991	0.490246239	0.509753761	0.000175525
1992	0.490070745	0.509929255	0.000175462
1993	0.489895314	0.510104686	0.0001754
1994	0.489719946	0.510280054	0.000175337
1995	0.48954464	0.51045536	0.000175274
1996	0.489369398	0.510630602	0.000175211
1997	0.489194218	0.510805782	0.000175149
1998	0.4890191	0.5109809	0.000175086
1999	0.488844046	0.511155954	0.000175023
2000	0.488669054	0.511330946	0.000174961
2001	0.488494125	0.511505875	0.000174898
2002	0.488319258	0.511680742	0.000174835
2003	0.488144454	0.511855546	0.000174773
2004	0.487969713	0.512030287	0.00017471
2005	0.487795034	0.512204966	0.000174648
2006	0.487620417	0.512379583	0.000174585
2007	0.487445863	0.512554137	0.000174523
2008	0.487271372	0.512728628	0.00017446
2009	0.487096943	0.512903057	0.000174398
2010	0.486922577	0.513077423	0.000174335
2011	0.486748273	0.513251727	0.000174273

2012	0.486574031	0.513425969	0.00017421
2013	0.486399852	0.513600148	0.000174148
2014	0.486225735	0.513774265	0.000174086
2015	0.48605168	0.51394832	0.000174023
2016	0.485877688	0.514122312	0.000173961
2017	0.485703758	0.514296242	0.000173899
2018	0.48552989	0.51447011	0.000173837
2019	0.485356084	0.514643916	0.000173774
2020	0.485182341	0.514817659	0.000173712
2021	0.48500866	0.51499134	0.00017365
2022	0.484835041	0.515164959	0.000173588
2023	0.484661484	0.515338516	0.000173526
2024	0.48448799	0.51551201	0.000173464
2025	0.484314557	0.515685443	0.000173402
2026	0.484141187	0.515858813	0.000173339
2027	0.483967878	0.516032122	0.000173277
2028	0.483794632	0.516205368	0.000173215
2029	0.483621447	0.516378553	0.000173153
2030	0.483448325	0.516551675	0.000173091
2031	0.483275265	0.516724735	0.000173029
2032	0.483102266	0.516897734	0.000172967
2033	0.48292933	0.51707067	0.000172906
2034	0.482756455	0.517243545	0.000172844
2035	0.482583642	0.517416358	0.000172782
2036	0.482410891	0.517589109	0.00017272
2037	0.482238202	0.517761798	0.000172658
2038	0.482065575	0.517934425	0.000172596
2039	0.48189301	0.51810699	0.000172535
2040	0.481720506	0.518279494	0.000172473
2041	0.481548064	0.518451936	0.000172411
2042	0.481375684	0.518624316	0.000172349
2043	0.481203366	0.518796634	0.000172288
2044	0.481031109	0.518968891	0.000172226
2045	0.480858914	0.519141086	0.000172164
2046	0.48068678	0.51931322	0.000172103
2047	0.480514709	0.519485291	0.000172041
2048	0.480342698	0.519657302	0.000171979
2049	0.48017075	0.51982925	0.000171918
2050	0.479998863	0.520001137	0.000171856
2051	0.479827037	0.520172963	0.000171795
2052	0.479655273	0.520344727	0.000171733
2053	0.47948357	0.52051643	0.000171672
2054	0.479311929	0.520688071	0.00017161
2055	0.47914035	0.52085965	0.000171549
2056	0.478968831	0.521031169	0.000171488
2057	0.478797374	0.521202626	0.000171426
2058	0.478625979	0.521374021	0.000171365
2059	0.478454645	0.521545355	0.000171303
2060	0.478283372	0.521716628	0.000171242
2061	0.47811216	0.52188784	0.000171181
2062	0.47794101	0.52205899	0.00017112
2063	0.477769921	0.522230079	0.000171058
2064	0.477598894	0.522401106	0.000170997
2065	0.477427927	0.522572073	0.000170936
2066	0.477257022	0.522742978	0.000170875
2067	0.477086178	0.522913822	0.000170814
2068	0.476915395	0.523084605	0.000170752
2069	0.476744673	0.523255327	0.000170691
2070	0.476574012	0.523425988	0.00017063
2071	0.476403413	0.523596587	0.000170569
2072	0.476232874	0.523767126	0.000170508
2073	0.476062397	0.523937603	0.000170447
2074	0.47589198	0.52410802	0.000170386
2075	0.475721625	0.524278375	0.000170325
2076	0.475551331	0.524448669	0.000170264
2077	0.475381097	0.524618903	0.000170203
2078	0.475210924	0.524789076	0.000170142
2079	0.475040813	0.524959187	0.000170081
2080	0.474870762	0.525129238	0.00017002
2081	0.474700772	0.525299228	0.000169959
2082	0.474530843	0.525469157	0.000169899
2083	0.474360975	0.525639025	0.000169838
2084	0.474191168	0.525808832	0.000169777
2085	0.474021421	0.525978579	0.000169716
2086	0.473851735	0.526148265	0.000169655
2087	0.47368211	0.52631789	0.000169595
2088	0.473512546	0.526487454	0.000169534
2089	0.473343042	0.526656958	0.000169473
2090	0.473173599	0.526826401	0.000169413
2091	0.473004217	0.526995783	0.000169352
2092	0.472834895	0.527165105	0.000169291
2093	0.472665634	0.527334366	0.000169231
2094	0.472496433	0.527503567	0.00016917
2095	0.472327294	0.527672706	0.00016911
2096	0.472158214	0.527841786	0.000169049
2097	0.471989195	0.528010805	0.000168989
2098	0.471820237	0.528179763	0.000168928
2099	0.471651339	0.528348661	0.000168868
2100	0.471482502	0.528517498	0.000168807
2101	0.471313725	0.528686275	0.000168747
2102	0.471145008	0.528854992	0.000168686
2103	0.470976352	0.529023648	0.000168626
2104	0.470807756	0.529192244	0.000168566
2105	0.470639221	0.529360779	0.000168505
2106	0.470470746	0.529529254	0.000168445
2107	0.470302331	0.529697669	0.000168385
2108	0.470133976	0.529866024	0.000168324
2109	0.469965682	0.530034318	0.000168264
2110	0.469797448	0.530202552	0.000168204
2111	0.469629274	0.530370726	0.000168144
2112	0.469461161	0.530538839	0.000168083
2113	0.469293107	0.530706893	0.000168023
2114	0.469125114	0.530874886	0.000167963
2115	0.468957181	0.531042819	0.000167903
2116	0.468789308	0.531210692	0.000167843
2117	0.468621495	0.531378505	0.000167783

2118	0.468453742	0.531546258	0.000167723
2119	0.46828605	0.53171395	0.000167663
2120	0.468118417	0.531881583	0.000167603
2121	0.467950844	0.532049156	0.000167543
2122	0.467783331	0.532216669	0.000167483
2123	0.467615879	0.532384121	0.000167423
2124	0.467448486	0.532551514	0.000167363
2125	0.467281153	0.532718847	0.000167303
2126	0.46711388	0.53288612	0.000167243
2127	0.466946667	0.533053333	0.000167183
2128	0.466779513	0.533220487	0.000167123
2129	0.46661242	0.53338758	0.000167064
2130	0.466445386	0.533554614	0.000167004
2131	0.466278412	0.533721588	0.000166944
2132	0.466111498	0.533888502	0.000166884
2133	0.465944644	0.534055356	0.000166824
2134	0.465777849	0.534222151	0.000166765
2135	0.465611115	0.534388885	0.000166705
2136	0.465444439	0.534555561	0.000166645
2137	0.465277824	0.534722176	0.000166586
2138	0.465111268	0.534888732	0.000166526
2139	0.464944772	0.535055228	0.000166466
2140	0.464778335	0.535221665	0.000166407
2141	0.464611958	0.535388042	0.000166347
2142	0.464445641	0.535554359	0.000166288
2143	0.464279383	0.535720617	0.000166228
2144	0.464113184	0.535886816	0.000166169
2145	0.463947045	0.536052955	0.000166109
2146	0.463780966	0.536219034	0.00016605
2147	0.463614946	0.536385054	0.00016599
2148	0.463448985	0.536551015	0.000165931
2149	0.463283084	0.536716916	0.000165872
2150	0.463117242	0.536882758	0.000165812
2151	0.462951459	0.537048541	0.000165753
2152	0.462785736	0.537214264	0.000165693
2153	0.462620073	0.537379927	0.000165634
2154	0.462454468	0.537545532	0.000165575
2155	0.462288923	0.537711077	0.000165516
2156	0.462123437	0.537876563	0.000165456
2157	0.46195801	0.53804199	0.000165397
2158	0.461792643	0.538207357	0.000165338
2159	0.461627334	0.538372666	0.000165279
2160	0.461462085	0.538537915	0.00016522
2161	0.461296895	0.538703105	0.00016516
2162	0.461131765	0.538868235	0.000165101
2163	0.460966693	0.539033307	0.000165042
2164	0.46080168	0.53919832	0.000164983
2165	0.460636727	0.539363273	0.000164924
2166	0.460471832	0.539528168	0.000164865
2167	0.460306997	0.539693003	0.000164806
2168	0.46014222	0.53985778	0.000164747
2169	0.459977503	0.540022497	0.000164688
2170	0.459812844	0.540187156	0.000164629
2171	0.459648245	0.540351755	0.00016457
2172	0.459483704	0.540516296	0.000164511
2173	0.459319222	0.540680778	0.000164452
2174	0.459154799	0.540845201	0.000164393
2175	0.458990435	0.541009565	0.000164335
2176	0.45882613	0.54117387	0.000164276
2177	0.458661884	0.541338116	0.000164217
2178	0.458497696	0.541502304	0.000164158
2179	0.458333567	0.541666433	0.000164099
2180	0.458169497	0.541830503	0.000164041
2181	0.458005486	0.541994514	0.000163982
2182	0.457841533	0.542158467	0.000163923
2183	0.45767764	0.54232236	0.000163865
2184	0.457513804	0.542486196	0.000163806
2185	0.457350028	0.542649972	0.000163747
2186	0.45718631	0.54281369	0.000163689
2187	0.45702265	0.54297735	0.00016363
2188	0.45685905	0.54314095	0.000163571
2189	0.456695507	0.543304493	0.000163513
2190	0.456532024	0.543467976	0.000163454
2191	0.456368599	0.543631401	0.000163396
2192	0.456205232	0.543794768	0.000163337
2193	0.456041924	0.543958076	0.000163279
2194	0.455878674	0.544121326	0.00016322
2195	0.455715483	0.544284517	0.000163162
2196	0.45555235	0.54444765	0.000163104
2197	0.455389276	0.544610724	0.000163045
2198	0.45522626	0.54477374	0.000162987
2199	0.455063302	0.544936698	0.000162929
2200	0.454900402	0.545099598	0.00016287
2201	0.454737561	0.545262439	0.000162812
2202	0.454574779	0.545425221	0.000162754
2203	0.454412054	0.545587946	0.000162695
2204	0.454249388	0.545750612	0.000162637
2205	0.45408678	0.54591322	0.000162579
2206	0.45392423	0.54607577	0.000162521
2207	0.453761738	0.546238262	0.000162463
2208	0.453599305	0.546400695	0.000162404
2209	0.45343693	0.54656307	0.000162346
2210	0.453274612	0.546725388	0.000162288
2211	0.453112353	0.546887647	0.00016223
2212	0.452950152	0.547049848	0.000162172
2213	0.452788009	0.547211991	0.000162114
2214	0.452625925	0.547374075	0.000162056
2215	0.452463898	0.547536102	0.000161998
2216	0.452301929	0.547698071	0.00016194
2217	0.452140018	0.547859982	0.000161882
2218	0.451978165	0.548021835	0.000161824
2219	0.45181637	0.54818363	0.000161766
2220	0.451654633	0.548345367	0.000161708
2221	0.451492954	0.548507046	0.00016165
2222	0.451331332	0.548668668	0.000161592
2223	0.451169769	0.548830231	0.000161535

2224	0.451008263	0.548991737	0.000161477
2225	0.450846816	0.549153184	0.000161419
2226	0.450685426	0.549314574	0.000161361
2227	0.450524093	0.549475907	0.000161303
2228	0.450362819	0.549637181	0.000161246
2229	0.450201602	0.549798398	0.000161188
2230	0.450040443	0.549959557	0.00016113
2231	0.449879342	0.550120658	0.000161073
2232	0.449718298	0.550281702	0.000161015
2233	0.449557312	0.550442688	0.000160957
2234	0.449396384	0.550603616	0.0001609
2235	0.449235513	0.550764487	0.000160842
2236	0.4490747	0.5509253	0.000160784
2237	0.448913944	0.551086056	0.000160727
2238	0.448753246	0.551246754	0.000160669
2239	0.448592605	0.551407395	0.000160612
2240	0.448432022	0.551567978	0.000160554
2241	0.448271497	0.551728503	0.000160497
2242	0.448111029	0.551888971	0.000160439
2243	0.447950618	0.552049382	0.000160382
2244	0.447790265	0.552209735	0.000160325
2245	0.447629969	0.552370031	0.000160267
2246	0.44746973	0.55253027	0.00016021
2247	0.447309549	0.552690451	0.000160152
2248	0.447149426	0.552850574	0.000160095
2249	0.446989359	0.553010641	0.000160038
2250	0.44682935	0.55317065	0.000159981
2251	0.446669398	0.553330602	0.000159923
2252	0.446509503	0.553490497	0.000159866
2253	0.446349666	0.553650334	0.000159809
2254	0.446189886	0.553810114	0.000159752
2255	0.446030163	0.553969837	0.000159694
2256	0.445870497	0.554129503	0.000159637
2257	0.445710889	0.554289111	0.00015958
2258	0.445551337	0.554448663	0.000159523
2259	0.445391843	0.554608157	0.000159466
2260	0.445232405	0.554767595	0.000159409
2261	0.445073025	0.554926975	0.000159352
2262	0.444913702	0.555086298	0.000159295
2263	0.444754436	0.555245564	0.000159238
2264	0.444595227	0.555404773	0.000159181
2265	0.444436075	0.555563925	0.000159124
2266	0.44427698	0.55572302	0.000159067
2267	0.444117941	0.555882059	0.00015901
2268	0.44395896	0.55604104	0.000158953
2269	0.443800036	0.556199964	0.000158896
2270	0.443641168	0.556358832	0.000158839
2271	0.443482358	0.556517642	0.000158782
2272	0.443323604	0.556676396	0.000158725
2273	0.443164907	0.556835093	0.000158669
2274	0.443006267	0.556993733	0.000158612
2275	0.442847684	0.557152316	0.000158555
2276	0.442689157	0.557310843	0.000158498
2277	0.442530687	0.557469313	0.000158441
2278	0.442372274	0.557627726	0.000158385
2279	0.442213918	0.557786082	0.000158328
2280	0.442055618	0.557944382	0.000158271
2281	0.441897375	0.558102625	0.000158215
2282	0.441739189	0.558260811	0.000158158
2283	0.441581059	0.558418941	0.000158101
2284	0.441422986	0.558577014	0.000158045
2285	0.441264969	0.558735031	0.000157988
2286	0.441107009	0.558892991	0.000157932
2287	0.440949106	0.559050894	0.000157875
2288	0.440791259	0.559208741	0.000157819
2289	0.440633469	0.559366531	0.000157762
2290	0.440475735	0.559524265	0.000157706
2291	0.440318057	0.559681943	0.000157649
2292	0.440160436	0.559839564	0.000157593
2293	0.440002872	0.559997128	0.000157536
2294	0.439845364	0.560154636	0.00015748
2295	0.439687912	0.560312088	0.000157424
2296	0.439530516	0.560469484	0.000157367
2297	0.439373177	0.560626823	0.000157311
2298	0.439215894	0.560784106	0.000157255
2299	0.439058668	0.560941332	0.000157198
2300	0.438901498	0.561098502	0.000157142
2301	0.438744384	0.561255616	0.000157086
2302	0.438587326	0.561412674	0.00015703
2303	0.438430325	0.561569675	0.000156973
2304	0.438273379	0.561726621	0.000156917
2305	0.43811649	0.56188351	0.000156861
2306	0.437959657	0.562040343	0.000156805
2307	0.437802881	0.562197119	0.000156749
2308	0.43764616	0.56235384	0.000156693
2309	0.437489495	0.562510505	0.000156637
2310	0.437332887	0.562667113	0.00015658
2311	0.437176335	0.562823665	0.000156524
2312	0.437019838	0.562980162	0.000156468
2313	0.436863398	0.563136602	0.000156412
2314	0.436707014	0.563292986	0.000156356
2315	0.436550685	0.563449315	0.0001563
2316	0.436394413	0.563605587	0.000156244
2317	0.436238196	0.563761804	0.000156188
2318	0.436082036	0.563917964	0.000156133
2319	0.435925931	0.564074069	0.000156077
2320	0.435769882	0.564230118	0.000156021
2321	0.435613889	0.564386111	0.000155965
2322	0.435457952	0.564542048	0.000155909
2323	0.435302071	0.564697929	0.000155853
2324	0.435146246	0.564853754	0.000155798
2325	0.434990476	0.565009524	0.000155742
2326	0.434834762	0.565165238	0.000155686
2327	0.434679104	0.565320896	0.00015563
2328	0.434523502	0.565476498	0.000155575
2329	0.434367955	0.565632045	0.000155519

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2331	0.434057028	0.565942972	0.000155408
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2333	0.433746325	0.566253675	0.000155296
2334	0.433591056	0.566408944	0.000155241
2335	0.433435843	0.566564157	0.000155185
2336	0.433280686	0.566719314	0.00015513
2337	0.433125584	0.566874416	0.000155074
2338	0.432970538	0.567029462	0.000155019
2339	0.432815547	0.567184453	0.000154963
2340	0.432660611	0.567339389	0.000154908
2341	0.432505732	0.567494268	0.000154852
2342	0.432350907	0.567649093	0.000154797
2343	0.432196138	0.567803862	0.000154741
2344	0.432041424	0.567958576	0.000154686
2345	0.431886766	0.568113234	0.000154631
2346	0.431732163	0.568267837	0.000154575
2347	0.431577616	0.568422384	0.00015452
2348	0.431423124	0.568576876	0.000154465
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2353	0.430651492	0.569348508	0.000154188
2354	0.430497331	0.569502669	0.000154133
2355	0.430343226	0.569656774	0.000154078
2356	0.430189175	0.569810825	0.000154023
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2358	0.42988124	0.57011876	0.000153912
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2361	0.429419751	0.570580249	0.000153747
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2365	0.428805202	0.571194798	0.000153527
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2371	0.427885027	0.572114973	0.000153198
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2381	0.426355789	0.573644211	0.00015265
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2383	0.426050597	0.573949403	0.000152541
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2388	0.425288575	0.574711425	0.000152268
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2391	0.424832016	0.575167984	0.000152105
2392	0.424679938	0.575320062	0.00015205
2393	0.424527915	0.575472085	0.000151996
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2401	0.423313688	0.576686312	0.000151561
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2419	0.420594361	0.579405639	0.000150587
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2425	0.419691806	0.580308194	0.000150264
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2428	0.419241255	0.580758745	0.000150103
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2430	0.418941157	0.581058843	0.000149996
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2458	0.414762263	0.585237737	0.000148499
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2462	0.41416869	0.58583131	0.000148287
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2636	0.389154051	0.610845949	0.000139331
2637	0.389014745	0.610985255	0.000139281
2638	0.388875489	0.611124511	0.000139231
2639	0.388736283	0.611263717	0.000139181
2640	0.388597127	0.611402873	0.000139131
2641	0.38845802	0.61154198	0.000139082
2642	0.388318964	0.611681036	0.000139032
2643	0.388179957	0.611820043	0.000138982
2644	0.388041	0.611959	0.000138932
2645	0.387902092	0.612097908	0.000138882
2646	0.387763235	0.612236765	0.000138833
2647	0.387624427	0.612375573	0.000138783

2648	0.387485669	0.612514331	0.000138733
2649	0.38734696	0.61265304	0.000138684
2650	0.387208301	0.612791699	0.000138634
2651	0.387069692	0.612930308	0.000138584
2652	0.386931132	0.613068868	0.000138535
2653	0.386792622	0.613207378	0.000138485
2654	0.386654162	0.613345838	0.000138436
2655	0.386515751	0.613484249	0.000138386
2656	0.38637739	0.61362261	0.000138337
2657	0.386239078	0.613760922	0.000138287
2658	0.386100815	0.613899185	0.000138238
2659	0.385962603	0.614037397	0.000138188
2660	0.385824439	0.614175561	0.000138139
2661	0.385686325	0.614313675	0.000138089
2662	0.385548261	0.614451739	0.00013804
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2664	0.38527228	0.61472772	0.000137941
2665	0.385134364	0.614865636	0.000137892
2666	0.384996497	0.615003503	0.000137842
2667	0.38485868	0.61514132	0.000137793
2668	0.384720911	0.615279089	0.000137744
2669	0.384583193	0.615416807	0.000137694
2670	0.384445523	0.615554477	0.000137645
2671	0.384307903	0.615692097	0.000137596
2672	0.384170332	0.615829668	0.000137546
2673	0.38403281	0.61596719	0.000137497
2674	0.383895337	0.616104663	0.000137448
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2676	0.38362054	0.61637946	0.00013735
2677	0.383483215	0.616516785	0.0001373
2678	0.383345939	0.616654061	0.000137251
2679	0.383208713	0.616791287	0.000137202
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2681	0.382934407	0.617065593	0.000137104
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2683	0.382660297	0.617339703	0.000137006
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2687	0.382112666	0.617887334	0.00013681
2688	0.381975881	0.618024119	0.000136761
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2975	0.34467483	0.65532517	0.0001234056
2976	0.344551447	0.655448553	0.0001233614
2977	0.344428107	0.655571893	0.0001233173
2978	0.344304812	0.655695188	0.0001232731
2979	0.344181561	0.655818439	0.0001232290
2980	0.344058354	0.655941646	0.0001231849
2981	0.343935191	0.656064809	0.0001231408
2982	0.343812073	0.656187927	0.0001230967
2983	0.343688998	0.656311002	0.0001230527
2984	0.343565967	0.656434033	0.0001230086
2985	0.343442981	0.656557019	0.0001229646
2986	0.343320038	0.656679962	0.0001229206
2987	0.34319714	0.65680286	0.0001228766
2988	0.343074285	0.656925715	0.0001228326
2989	0.342951474	0.657048526	0.0001227886
2990	0.342828708	0.657171292	0.0001227446
2991	0.342705985	0.657294015	0.0001227007
2992	0.342583306	0.657416694	0.0001226568
2993	0.342460672	0.657539328	0.0001226129
2994	0.342338081	0.657661919	0.0001225690
2995	0.342215534	0.657784466	0.0001225251
2996	0.34209303	0.65790697	0.0001224812
2997	0.341970571	0.658029429	0.0001224374
2998	0.341848156	0.658151844	0.0001223936
2999	0.341725784	0.658274216	0.0001223498
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3001	0.341481172	0.658518828	0.0001222622
3002	0.341358932	0.658641068	0.0001222184
3003	0.341236735	0.658763265	0.0001221747
3004	0.341114582	0.658885418	0.0001221309
3005	0.340992473	0.659007527	0.0001220872
3006	0.340870408	0.659129592	0.0001220435
3007	0.340748386	0.659251614	0.0001219998
3008	0.340626408	0.659373592	0.0001219561
3009	0.340504474	0.659495526	0.0001219125
3010	0.340382583	0.659617417	0.0001218688
3011	0.340260736	0.659739264	0.0001218252
3012	0.340138933	0.659861067	0.0001217816
3013	0.340017173	0.659982827	0.0001217380
3014	0.339895457	0.660104543	0.0001216944
3015	0.339773784	0.660226216	0.0001216509
3016	0.339652155	0.660347845	0.0001216073
3017	0.33953057	0.66046943	0.0001215638
3018	0.339409028	0.660590972	0.0001215203
3019	0.339287529	0.660712471	0.0001214768
3020	0.339166074	0.660833926	0.0001214333
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3027	0.338317105	0.661682895	0.0001211293
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3031	0.337832935	0.662167065	0.0001209560
3032	0.3377712	0.662288	0.0001209127
3033	0.337591109	0.662408891	0.0001208694
3034	0.337470262	0.662529738	0.0001208261
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3036	0.337228696	0.662771304	0.0001207396
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3041	0.336625538	0.663374462	0.0001205237
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3061	0.334223674	0.665776326	0.0001196637
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3082	0.331720159	0.668279841	0.0001187674
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3297	0.307143239	0.692856761	0.0001099680
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3311	0.305607539	0.694392461	0.0001094182
3312	0.30549814	0.69450186	0.0001093790
3313	0.305388781	0.694611219	0.0001093398
3314	0.30527946	0.69472054	0.0001093007
3315	0.305170179	0.694829821	0.0001092616
3316	0.305060937	0.694939063	0.0001092225
3317	0.304951734	0.695048266	0.0001091834
3318	0.304842571	0.695157429	0.0001091443
3319	0.304733446	0.695266554	0.0001091052
3320	0.30462436	0.69537564	0.0001090662
3321	0.304515313	0.695484687	0.0001090271
3322	0.304406306	0.695593694	0.0001089881
3323	0.304297337	0.695702663	0.0001089491
3324	0.304188408	0.695811592	0.0001089101
3325	0.304079517	0.695920483	0.0001088711
3326	0.303970666	0.696029334	0.0001088321
3327	0.303861853	0.696138147	0.0001087931
3328	0.303753079	0.696246921	0.0001087542
3329	0.303644345	0.696355655	0.0001087153
3330	0.303535649	0.696464351	0.0001086764
3331	0.303426992	0.696573008	0.0001086375
3332	0.303318374	0.696681626	0.0001085986
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3334	0.303101254	0.696898746	0.0001085208
3335	0.302992753	0.697007247	0.0001084820
3336	0.30288429	0.69711571	0.0001084431
3337	0.302775867	0.697224133	0.0001084043
3338	0.302667482	0.697332518	0.0001083655
3339	0.302559136	0.697440864	0.0001083267
3340	0.302450828	0.697549172	0.0001082880
3341	0.30234256	0.69765744	0.0001082492
3342	0.30223433	0.69776567	0.0001082104
3343	0.302126139	0.697873861	0.0001081717
3344	0.302017987	0.697982013	0.0001081330
3345	0.301909873	0.698090127	0.0001080943
3346	0.301801798	0.698198202	0.0001080556
3347	0.301693762	0.698306238	0.0001080169
3348	0.301585764	0.698414236	0.0001079782
3349	0.301477805	0.698522195	0.0001079396
3350	0.301369885	0.698630115	0.0001079009
3351	0.301262003	0.698737997	0.0001078623
3352	0.30115416	0.69884584	0.0001078237
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3357	0.300615524	0.699384476	0.0001076308
3358	0.300507913	0.699492087	0.0001075923
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3361	0.300185309	0.699814691	0.0001074768
3362	0.300077851	0.699922149	0.0001074383
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3366	0.299648406	0.700351594	0.0001072846
3367	0.29954114	0.70045886	0.0001072462
3368	0.299433913	0.700566087	0.0001072078
3369	0.299326725	0.700673275	0.0001071694
3370	0.299219574	0.700780426	0.0001071311
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3646	0.271065377	0.728934623	0.0000970509
3647	0.270968343	0.729031657	0.0000970161
3648	0.270871344	0.729128656	0.0000969814
3649	0.27077438	0.72922562	0.0000969467
3650	0.270677451	0.729322549	0.0000969120

APPENDIX E

TEMPERATURE AND HUMIDITY RAW DATA

Temperature and Humidity readings for the month of January 2009 at site Barratta Ba1 at 9455.0m (BM270W1)

Time	Day	Hour	Button #	Reading °C	%RH
01/01/2009 12:59:00 AM	1/1/2009	0	1	26.209	66.535
01/01/2009 1:59:00 AM	1/1/2009	1	1	25.709	65.877
01/01/2009 2:59:00 AM	1/1/2009	2	1	25.709	67.093
01/01/2009 3:59:00 AM	1/1/2009	3	1	25.709	67.093
01/01/2009 4:59:00 AM	1/1/2009	4	1	25.209	67.045
01/01/2009 5:59:00 AM	1/1/2009	5	1	25.209	67.045
01/01/2009 6:59:00 AM	1/1/2009	6	1	25.209	68.858
01/01/2009 7:59:00 AM	1/1/2009	7	1	25.709	68.905
01/01/2009 8:59:00 AM	1/1/2009	8	1	26.209	70.155
01/01/2009 9:59:00 AM	1/1/2009	9	1	28.209	72.707
01/01/2009 10:59:00 AM	1/1/2009	10	1	31.205	69.526
01/01/2009 11:59:00 AM	1/1/2009	11	1	33.202	64.927
01/01/2009 12:59:00 PM	1/1/2009	12	1	31.205	67.712
01/01/2009 1:59:00 PM	1/1/2009	13	1	32.703	66.695
01/01/2009 2:59:00 PM	1/1/2009	14	1	33.701	66.836
01/01/2009 3:59:00 PM	1/1/2009	15	1	36.195	64.753
01/01/2009 4:59:00 PM	1/1/2009	16	1	34.2	62.595
01/01/2009 5:59:00 PM	1/1/2009	17	1	31.205	64.045
01/01/2009 6:59:00 PM	1/1/2009	18	1	29.707	65.088
01/01/2009 7:59:00 PM	1/1/2009	19	1	27.709	66.69
01/01/2009 8:59:00 PM	1/1/2009	20	1	27.209	67.244
01/01/2009 9:59:00 PM	1/1/2009	21	1	26.209	67.747
01/01/2009 10:59:00 PM	1/1/2009	22	1	25.709	68.303
01/01/2009 11:59:00 PM	1/1/2009	23	1	25.709	68.303
02/01/2009 12:59:00 AM	2/1/2009	0	1	25.709	68.905
02/01/2009 1:59:00 AM	2/1/2009	1	1	24.709	70.014
02/01/2009 2:59:00 AM	2/1/2009	2	1	24.209	69.97
02/01/2009 3:59:00 AM	2/1/2009	3	1	24.209	70.569
02/01/2009 4:59:00 AM	2/1/2009	4	1	24.209	70.526
02/01/2009 5:59:00 AM	2/1/2009	5	1	24.209	71.122
02/01/2009 6:59:00 AM	2/1/2009	6	1	24.709	71.761
02/01/2009 7:59:00 AM	2/1/2009	7	1	25.709	71.853
02/01/2009 8:59:00 AM	2/1/2009	8	1	28.209	73.298
02/01/2009 9:59:00 AM	2/1/2009	9	1	31.705	71.349
02/01/2009 10:59:00 AM	2/1/2009	10	1	35.697	66.523
02/01/2009 11:59:00 AM	2/1/2009	11	1	36.694	63.592
02/01/2009 12:59:00 PM	2/1/2009	12	1	37.691	63.753
02/01/2009 1:59:00 PM	2/1/2009	13	1	39.186	60.868
02/01/2009 2:59:00 PM	2/1/2009	14	1	39.186	61.499
02/01/2009 3:59:00 PM	2/1/2009	15	1	39.685	59.687
02/01/2009 4:59:00 PM	2/1/2009	16	1	37.193	59.282
02/01/2009 5:59:00 PM	2/1/2009	17	1	34.2	61.973
02/01/2009 6:59:00 PM	2/1/2009	18	1	31.705	64.109
02/01/2009 7:59:00 PM	2/1/2009	19	1	30.207	65.76
02/01/2009 8:59:00 PM	2/1/2009	20	1	28.708	67.408
02/01/2009 9:59:00 PM	2/1/2009	21	1	28.209	67.958
02/01/2009 10:59:00 PM	2/1/2009	22	1	26.709	68.402
02/01/2009 11:59:00 PM	2/1/2009	23	1	25.709	70.106
03/01/2009 12:59:00 AM	3/1/2009	0	1	25.209	69.46
03/01/2009 1:59:00 AM	3/1/2009	1	1	24.709	70.612
03/01/2009 2:59:00 AM	3/1/2009	2	1	24.209	70.526
03/01/2009 3:59:00 AM	3/1/2009	3	1	24.209	71.717
03/01/2009 4:59:00 AM	3/1/2009	4	1	24.209	71.122
03/01/2009 5:59:00 AM	3/1/2009	5	1	24.209	71.717
03/01/2009 6:59:00 AM	3/1/2009	6	1	25.709	75.979
03/01/2009 7:59:00 AM	3/1/2009	7	1	29.707	76.413
03/01/2009 8:59:00 AM	3/1/2009	8	1	31.205	72.476
03/01/2009 9:59:00 AM	3/1/2009	9	1	34.2	71.105
03/01/2009 10:59:00 AM	3/1/2009	10	1	37.193	67.377
03/01/2009 11:59:00 AM	3/1/2009	11	1	38.19	65.697
03/01/2009 12:59:00 PM	3/1/2009	12	1	40.183	64.805
03/01/2009 1:59:00 PM	3/1/2009	13	1	41.179	63.108

03/01/2009 2:59:00 PM	3/1/2009	14	1	42.175	60.126
03/01/2009 3:59:00 PM	3/1/2009	15	1	32.703	59.893
03/01/2009 4:59:00 PM	3/1/2009	16	1	29.707	65.699
03/01/2009 5:59:00 PM	3/1/2009	17	1	28.209	68.562
03/01/2009 6:59:00 PM	3/1/2009	18	1	27.709	69.711
03/01/2009 7:59:00 PM	3/1/2009	19	1	26.709	70.205
03/01/2009 8:59:00 PM	3/1/2009	20	1	25.709	70.663
03/01/2009 9:59:00 PM	3/1/2009	21	1	24.709	71.762
03/01/2009 10:59:00 PM	3/1/2009	22	1	24.709	72.948
03/01/2009 11:59:00 PM	3/1/2009	23	1	24.209	72.905
04/01/2009 12:59:00 AM	4/1/2009	0	1	24.209	72.905
04/01/2009 1:59:00 AM	4/1/2009	1	1	24.709	72.356
04/01/2009 2:59:00 AM	4/1/2009	2	1	24.209	72.312
04/01/2009 3:59:00 AM	4/1/2009	3	1	24.209	72.905
04/01/2009 4:59:00 AM	4/1/2009	4	1	23.709	72.863
04/01/2009 5:59:00 AM	4/1/2009	5	1	23.709	73.455
04/01/2009 6:59:00 AM	4/1/2009	6	1	24.209	75.261
04/01/2009 7:59:00 AM	4/1/2009	7	1	27.709	78.507
04/01/2009 8:59:00 AM	4/1/2009	8	1	30.207	75.89
04/01/2009 9:59:00 AM	4/1/2009	9	1	32.204	72.611
04/01/2009 10:59:00 AM	4/1/2009	10	1	34.2	70.505
04/01/2009 11:59:00 AM	4/1/2009	11	1	35.198	68.887
04/01/2009 12:59:00 PM	4/1/2009	12	1	36.195	67.214
04/01/2009 1:59:00 PM	4/1/2009	13	1	37.691	65.613
04/01/2009 2:59:00 PM	4/1/2009	14	1	33.202	63.694
04/01/2009 3:59:00 PM	4/1/2009	15	1	34.699	64.526
04/01/2009 4:59:00 PM	4/1/2009	16	1	30.706	66.432
04/01/2009 5:59:00 PM	4/1/2009	17	1	28.708	68.014
04/01/2009 6:59:00 PM	4/1/2009	18	1	27.209	69.657
04/01/2009 7:59:00 PM	4/1/2009	19	1	26.709	70.205
04/01/2009 8:59:00 PM	4/1/2009	20	1	26.209	70.712
04/01/2009 9:59:00 PM	4/1/2009	21	1	26.209	70.71
04/01/2009 10:59:00 PM	4/1/2009	22	1	26.209	70.71
04/01/2009 11:59:00 PM	4/1/2009	23	1	25.709	71.258
05/01/2009 12:59:00 AM	5/1/2009	0	1	25.709	71.854
05/01/2009 1:59:00 AM	5/1/2009	1	1	25.209	71.807
05/01/2009 2:59:00 AM	5/1/2009	2	1	24.709	72.356
05/01/2009 3:59:00 AM	5/1/2009	3	1	24.209	71.122
05/01/2009 4:59:00 AM	5/1/2009	4	1	24.209	72.905
05/01/2009 5:59:00 AM	5/1/2009	5	1	23.709	72.271
05/01/2009 6:59:00 AM	5/1/2009	6	1	25.209	74.174
05/01/2009 7:59:00 AM	5/1/2009	7	1	26.209	74.269
05/01/2009 8:59:00 AM	5/1/2009	8	1	29.707	76.414
05/01/2009 9:59:00 AM	5/1/2009	9	1	32.204	73.206
05/01/2009 10:59:00 AM	5/1/2009	10	1	34.699	69.416
05/01/2009 11:59:00 AM	5/1/2009	11	1	36.195	67.214
05/01/2009 12:59:00 PM	5/1/2009	12	1	38.19	66.931
05/01/2009 1:59:00 PM	5/1/2009	13	1	40.183	64.181
05/01/2009 2:59:00 PM	5/1/2009	14	1	41.677	63.2
05/01/2009 3:59:00 PM	5/1/2009	15	1	40.681	62.389
05/01/2009 4:59:00 PM	5/1/2009	16	1	39.186	60.868
05/01/2009 5:59:00 PM	5/1/2009	17	1	36.694	62.97
05/01/2009 6:59:00 PM	5/1/2009	18	1	33.202	63.075
05/01/2009 7:59:00 PM	5/1/2009	19	1	30.706	66.432
05/01/2009 8:59:00 PM	5/1/2009	20	1	28.708	66.193
05/01/2009 9:59:00 PM	5/1/2009	21	1	27.209	68.454
05/01/2009 10:59:00 PM	5/1/2009	22	1	26.709	69.004
05/01/2009 11:59:00 PM	5/1/2009	23	1	26.209	69.555
06/01/2009 12:59:00 AM	6/1/2009	0	1	26.209	70.155
06/01/2009 1:59:00 AM	6/1/2009	1	1	25.709	69.507
06/01/2009 2:59:00 AM	6/1/2009	2	1	25.209	69.46
06/01/2009 3:59:00 AM	6/1/2009	3	1	24.709	70.612
06/01/2009 4:59:00 AM	6/1/2009	4	1	24.709	69.972
06/01/2009 5:59:00 AM	6/1/2009	5	1	24.209	71.122
06/01/2009 6:59:00 AM	6/1/2009	6	1	25.209	72.401

06/01/2009 7:59:00 AM	6/1/2009	7	1	27.709	73.834
06/01/2009 8:59:00 AM	6/1/2009	8	1	29.707	72.881
06/01/2009 9:59:00 AM	6/1/2009	9	1	33.202	69.799
06/01/2009 10:59:00 AM	6/1/2009	10	1	35.697	64.676
06/01/2009 11:59:00 AM	6/1/2009	11	1	37.193	64.293
06/01/2009 12:59:00 PM	6/1/2009	12	1	38.19	63.836
06/01/2009 1:59:00 PM	6/1/2009	13	1	39.685	60.321
06/01/2009 2:59:00 PM	6/1/2009	14	1	39.186	61.499
06/01/2009 3:59:00 PM	6/1/2009	15	1	41.677	60.671
06/01/2009 4:59:00 PM	6/1/2009	16	1	38.688	62.043
06/01/2009 5:59:00 PM	6/1/2009	17	1	37.691	61.252
06/01/2009 6:59:00 PM	6/1/2009	18	1	32.204	63.558
06/01/2009 7:59:00 PM	6/1/2009	19	1	29.707	65.088
06/01/2009 8:59:00 PM	6/1/2009	20	1	28.209	66.745
06/01/2009 9:59:00 PM	6/1/2009	21	1	27.709	67.903
06/01/2009 10:59:00 PM	6/1/2009	22	1	27.209	68.454
06/01/2009 11:59:00 PM	6/1/2009	23	1	26.709	69.004
07/01/2009 12:59:00 AM	7/1/2009	0	1	26.709	69.004
07/01/2009 1:59:00 AM	7/1/2009	1	1	26.209	70.155
07/01/2009 2:59:00 AM	7/1/2009	2	1	25.209	69.46
07/01/2009 3:59:00 AM	7/1/2009	3	1	24.709	69.414
07/01/2009 4:59:00 AM	7/1/2009	4	1	24.709	70.014
07/01/2009 5:59:00 AM	7/1/2009	5	1	24.209	69.97
07/01/2009 6:59:00 AM	7/1/2009	6	1	26.709	74.362
07/01/2009 7:59:00 AM	7/1/2009	7	1	30.706	74.191
07/01/2009 8:59:00 AM	7/1/2009	8	1	33.202	71.559
07/01/2009 9:59:00 AM	7/1/2009	9	1	36.195	68.436
07/01/2009 10:59:00 AM	7/1/2009	10	1	38.19	65.078
07/01/2009 11:59:00 AM	7/1/2009	11	1	39.685	62.841
07/01/2009 12:59:00 PM	7/1/2009	12	1	40.681	61.758
07/01/2009 1:59:00 PM	7/1/2009	13	1	43.171	59.672
07/01/2009 2:59:00 PM	7/1/2009	14	1	40.681	57.304
07/01/2009 3:59:00 PM	7/1/2009	15	1	39.685	59.687
07/01/2009 4:59:00 PM	7/1/2009	16	1	39.186	58.968
07/01/2009 5:59:00 PM	7/1/2009	17	1	37.193	59.282
07/01/2009 6:59:00 PM	7/1/2009	18	1	32.204	62.94
07/01/2009 7:59:00 PM	7/1/2009	19	1	29.707	65.088
07/01/2009 8:59:00 PM	7/1/2009	20	1	28.209	66.745
07/01/2009 9:59:00 PM	7/1/2009	21	1	27.709	67.297
07/01/2009 10:59:00 PM	7/1/2009	22	1	26.709	67.798
07/01/2009 11:59:00 PM	7/1/2009	23	1	26.209	68.954
08/01/2009 12:59:00 AM	8/1/2009	0	1	26.209	70.753
08/01/2009 1:59:00 AM	8/1/2009	1	1	25.709	69.507
08/01/2009 2:59:00 AM	8/1/2009	2	1	25.709	70.106
08/01/2009 3:59:00 AM	8/1/2009	3	1	25.209	69.46
08/01/2009 4:59:00 AM	8/1/2009	4	1	25.209	71.255
08/01/2009 5:59:00 AM	8/1/2009	5	1	25.209	71.212
08/01/2009 6:59:00 AM	8/1/2009	6	1	26.209	72.495
08/01/2009 7:59:00 AM	8/1/2009	7	1	29.208	74.593
08/01/2009 8:59:00 AM	8/1/2009	8	1	30.207	72.348
08/01/2009 9:59:00 AM	8/1/2009	9	1	31.205	73.663
08/01/2009 10:59:00 AM	8/1/2009	10	1	34.2	74.683
08/01/2009 11:59:00 AM	8/1/2009	11	1	35.697	72.539
08/01/2009 12:59:00 PM	8/1/2009	12	1	36.694	69.733
08/01/2009 1:59:00 PM	8/1/2009	13	1	35.198	68.887
08/01/2009 2:59:00 PM	8/1/2009	14	1	34.699	71.226
08/01/2009 3:59:00 PM	8/1/2009	15	1	34.699	71.787
08/01/2009 4:59:00 PM	8/1/2009	16	1	31.705	71.353
08/01/2009 5:59:00 PM	8/1/2009	17	1	27.709	72.654
08/01/2009 6:59:00 PM	8/1/2009	18	1	26.209	76.031
08/01/2009 7:59:00 PM	8/1/2009	19	1	25.709	78.308
08/01/2009 8:59:00 PM	8/1/2009	20	1	25.709	78.886
08/01/2009 9:59:00 PM	8/1/2009	21	1	25.709	79.462
08/01/2009 10:59:00 PM	8/1/2009	22	1	25.709	81.182
08/01/2009 11:59:00 PM	8/1/2009	23	1	25.209	79.416

09/01/2009 12:59:00 AM	9/1/2009	0	1	25.209	79.416
09/01/2009 1:59:00 AM	9/1/2009	1	1	25.209	79.991
09/01/2009 2:59:00 AM	9/1/2009	2	1	24.709	79.947
09/01/2009 3:59:00 AM	9/1/2009	3	1	24.709	79.372
09/01/2009 4:59:00 AM	9/1/2009	4	1	24.209	79.905
09/01/2009 5:59:00 AM	9/1/2009	5	1	24.709	79.947
09/01/2009 6:59:00 AM	9/1/2009	6	1	25.709	83.454
09/01/2009 7:59:00 AM	9/1/2009	7	1	27.709	84.22
09/01/2009 8:59:00 AM	9/1/2009	8	1	29.208	82.694
09/01/2009 9:59:00 AM	9/1/2009	9	1	32.204	84.791
09/01/2009 10:59:00 AM	9/1/2009	10	1	33.701	81.028
09/01/2009 11:59:00 AM	9/1/2009	11	1	36.195	80.285
09/01/2009 12:59:00 PM	9/1/2009	12	1	37.691	76.453
09/01/2009 1:59:00 PM	9/1/2009	13	1	37.691	77.633
09/01/2009 2:59:00 PM	9/1/2009	14	1	38.19	74.167
09/01/2009 3:59:00 PM	9/1/2009	15	1	36.694	74.499
09/01/2009 4:59:00 PM	9/1/2009	16	1	35.198	72.462
09/01/2009 5:59:00 PM	9/1/2009	17	1	31.705	74.915
09/01/2009 6:59:00 PM	9/1/2009	18	1	30.207	77.645
09/01/2009 7:59:00 PM	9/1/2009	19	1	29.208	78.681
09/01/2009 8:59:00 PM	9/1/2009	20	1	28.209	79.719
09/01/2009 9:59:00 PM	9/1/2009	21	1	27.709	79.664
09/01/2009 10:59:00 PM	9/1/2009	22	1	27.209	80.185
09/01/2009 11:59:00 PM	9/1/2009	23	1	26.209	82.368
10/01/2009 12:59:00 AM	10/1/2009	0	1	25.709	80.61
10/01/2009 1:59:00 AM	10/1/2009	1	1	25.209	81.707
10/01/2009 2:59:00 AM	10/1/2009	2	1	24.209	82.191
10/01/2009 3:59:00 AM	10/1/2009	3	1	23.709	82.719
10/01/2009 4:59:00 AM	10/1/2009	4	1	23.709	82.719
10/01/2009 5:59:00 AM	10/1/2009	5	1	23.209	83.813
10/01/2009 6:59:00 AM	10/1/2009	6	1	24.209	85.014
10/01/2009 7:59:00 AM	10/1/2009	7	1	25.709	87.374
10/01/2009 8:59:00 AM	10/1/2009	8	1	28.708	89.895
10/01/2009 9:59:00 AM	10/1/2009	9	1	31.205	86.894
10/01/2009 10:59:00 AM	10/1/2009	10	1	34.2	85.1
10/01/2009 11:59:00 AM	10/1/2009	11	1	36.694	83.255
10/01/2009 12:59:00 PM	10/1/2009	12	1	38.19	81.23
10/01/2009 1:59:00 PM	10/1/2009	13	1	38.19	78.313
10/01/2009 2:59:00 PM	10/1/2009	14	1	34.699	74.171
10/01/2009 3:59:00 PM	10/1/2009	15	1	32.703	76.817
10/01/2009 4:59:00 PM	10/1/2009	16	1	33.202	82.099
10/01/2009 5:59:00 PM	10/1/2009	17	1	31.705	80.734
10/01/2009 6:59:00 PM	10/1/2009	18	1	29.707	81.044
10/01/2009 7:59:00 PM	10/1/2009	19	1	28.209	82.578
10/01/2009 8:59:00 PM	10/1/2009	20	1	27.209	83.602
10/01/2009 9:59:00 PM	10/1/2009	21	1	26.209	84.066
10/01/2009 10:59:00 PM	10/1/2009	22	1	25.709	85.143
10/01/2009 11:59:00 PM	10/1/2009	23	1	25.209	86.217
11/01/2009 12:59:00 AM	11/1/2009	0	1	25.209	86.217
11/01/2009 1:59:00 AM	11/1/2009	1	1	24.709	86.174
11/01/2009 2:59:00 AM	11/1/2009	2	1	24.209	87.246
11/01/2009 3:59:00 AM	11/1/2009	3	1	23.209	87.172
11/01/2009 4:59:00 AM	11/1/2009	4	1	22.708	86.581
11/01/2009 5:59:00 AM	11/1/2009	5	1	22.708	88.246
11/01/2009 6:59:00 AM	11/1/2009	6	1	23.709	90.513
11/01/2009 7:59:00 AM	11/1/2009	7	1	26.709	93.483
11/01/2009 8:59:00 AM	11/1/2009	8	1	31.205	92.945
11/01/2009 9:59:00 AM	11/1/2009	9	1	33.701	92.239
11/01/2009 10:59:00 AM	11/1/2009	10	1	35.697	87.606
11/01/2009 11:59:00 AM	11/1/2009	11	1	36.195	86.572
11/01/2009 12:59:00 PM	11/1/2009	12	1	36.694	83.826
11/01/2009 1:59:00 PM	11/1/2009	13	1	37.193	84.489
11/01/2009 2:59:00 PM	11/1/2009	14	1	37.193	81.621
11/01/2009 3:59:00 PM	11/1/2009	15	1	36.195	80.285
11/01/2009 4:59:00 PM	11/1/2009	16	1	34.699	80.611

11/01/2009 5:59:00 PM	11/1/2009	17	1	32.204	81.951
11/01/2009 6:59:00 PM	11/1/2009	18	1	30.207	83.386
11/01/2009 7:59:00 PM	11/1/2009	19	1	28.209	84.838
11/01/2009 8:59:00 PM	11/1/2009	20	1	26.709	85.799
11/01/2009 9:59:00 PM	11/1/2009	21	1	26.209	86.865
11/01/2009 10:59:00 PM	11/1/2009	22	1	25.709	89.032
11/01/2009 11:59:00 PM	11/1/2009	23	1	25.209	89.537
12/01/2009 12:59:00 AM	12/1/2009	0	1	25.209	90.085
12/01/2009 1:59:00 AM	12/1/2009	1	1	25.209	90.632
12/01/2009 2:59:00 AM	12/1/2009	2	1	24.709	89.495
12/01/2009 3:59:00 AM	12/1/2009	3	1	24.709	91.136
12/01/2009 4:59:00 AM	12/1/2009	4	1	24.709	90.59
12/01/2009 5:59:00 AM	12/1/2009	5	1	24.709	90.59
12/01/2009 6:59:00 AM	12/1/2009	6	1	25.209	92.264
12/01/2009 7:59:00 AM	12/1/2009	7	1	25.209	90.632
12/01/2009 8:59:00 AM	12/1/2009	8	1	25.209	90.632
12/01/2009 9:59:00 AM	12/1/2009	9	1	25.209	91.178
12/01/2009 10:59:00 AM	12/1/2009	10	1	26.209	92.354
12/01/2009 11:59:00 AM	12/1/2009	11	1	25.709	90.13
12/01/2009 12:59:00 PM	12/1/2009	12	1	25.709	91.766
12/01/2009 1:59:00 PM	12/1/2009	13	1	26.209	91.268
12/01/2009 2:59:00 PM	12/1/2009	14	1	27.209	90.823
12/01/2009 3:59:00 PM	12/1/2009	15	1	27.209	89.728
12/01/2009 4:59:00 PM	12/1/2009	16	1	25.709	87.928
12/01/2009 5:59:00 PM	12/1/2009	17	1	24.209	89.455
12/01/2009 6:59:00 PM	12/1/2009	18	1	23.709	90.513
12/01/2009 7:59:00 PM	12/1/2009	19	1	23.209	91.568
12/01/2009 8:59:00 PM	12/1/2009	20	1	23.209	92.652
12/01/2009 9:59:00 PM	12/1/2009	21	1	22.708	91.535
12/01/2009 10:59:00 PM	12/1/2009	22	1	22.208	93.129
12/01/2009 11:59:00 PM	12/1/2009	23	1	22.208	93.668
13/01/2009 12:59:00 AM	13/1/2009	0	1	22.208	92.589
13/01/2009 1:59:00 AM	13/1/2009	1	1	22.208	94.205
13/01/2009 2:59:00 AM	13/1/2009	2	1	22.208	93.668
13/01/2009 3:59:00 AM	13/1/2009	3	1	22.208	92.589
13/01/2009 4:59:00 AM	13/1/2009	4	1	21.708	92.561
13/01/2009 5:59:00 AM	13/1/2009	5	1	21.708	93.102
13/01/2009 6:59:00 AM	13/1/2009	6	1	22.208	93.668
13/01/2009 7:59:00 AM	13/1/2009	7	1	22.708	93.698
13/01/2009 8:59:00 AM	13/1/2009	8	1	23.209	94.802
13/01/2009 9:59:00 AM	13/1/2009	9	1	24.209	94.338
13/01/2009 10:59:00 AM	13/1/2009	10	1	24.709	92.763
13/01/2009 11:59:00 AM	13/1/2009	11	1	25.209	93.344
13/01/2009 12:59:00 PM	13/1/2009	12	1	25.209	92.805
13/01/2009 1:59:00 PM	13/1/2009	13	1	25.209	91.721
13/01/2009 2:59:00 PM	13/1/2009	14	1	25.209	92.805
13/01/2009 3:59:00 PM	13/1/2009	15	1	26.209	92.354
13/01/2009 4:59:00 PM	13/1/2009	16	1	26.709	91.861
13/01/2009 5:59:00 PM	13/1/2009	17	1	25.709	91.766
13/01/2009 6:59:00 PM	13/1/2009	18	1	24.709	91.68
13/01/2009 7:59:00 PM	13/1/2009	19	1	24.209	93.263
13/01/2009 8:59:00 PM	13/1/2009	20	1	24.209	92.724
13/01/2009 9:59:00 PM	13/1/2009	21	1	23.709	92.687
13/01/2009 10:59:00 PM	13/1/2009	22	1	23.209	93.73
13/01/2009 11:59:00 PM	13/1/2009	23	1	23.209	93.192
14/01/2009 12:59:00 AM	14/1/2009	0	1	23.209	93.192
14/01/2009 1:59:00 AM	14/1/2009	1	1	23.209	94.267
14/01/2009 2:59:00 AM	14/1/2009	2	1	23.209	94.267
14/01/2009 3:59:00 AM	14/1/2009	3	1	23.209	94.267
14/01/2009 4:59:00 AM	14/1/2009	4	1	23.209	97.458
14/01/2009 5:59:00 AM	14/1/2009	5	1	23.709	95.37
14/01/2009 6:59:00 AM	14/1/2009	6	1	23.709	95.903
14/01/2009 7:59:00 AM	14/1/2009	7	1	24.209	95.939
14/01/2009 8:59:00 AM	14/1/2009	8	1	26.209	96.639
14/01/2009 9:59:00 AM	14/1/2009	9	1	26.209	95.043

14/01/2009 10:59:00 AM	14/1/2009	10	1	26.709	97.216
14/01/2009 11:59:00 AM	14/1/2009	11	1	26.709	93.483
14/01/2009 12:59:00 PM	14/1/2009	12	1	26.209	96.639
14/01/2009 1:59:00 PM	14/1/2009	13	1	26.709	92.403
14/01/2009 2:59:00 PM	14/1/2009	14	1	27.209	96.738
14/01/2009 3:59:00 PM	14/1/2009	15	1	27.209	94.072
14/01/2009 4:59:00 PM	14/1/2009	16	1	26.709	94.021
14/01/2009 5:59:00 PM	14/1/2009	17	1	26.709	94.021
14/01/2009 6:59:00 PM	14/1/2009	18	1	26.209	94.508
14/01/2009 7:59:00 PM	14/1/2009	19	1	25.709	93.926
14/01/2009 8:59:00 PM	14/1/2009	20	1	25.209	94.419
14/01/2009 9:59:00 PM	14/1/2009	21	1	24.709	95.446
14/01/2009 10:59:00 PM	14/1/2009	22	1	24.709	95.446
14/01/2009 11:59:00 PM	14/1/2009	23	1	24.709	97.038
15/01/2009 12:59:00 AM	15/1/2009	0	1	24.709	94.912
15/01/2009 1:59:00 AM	15/1/2009	1	1	24.209	95.407
15/01/2009 2:59:00 AM	15/1/2009	2	1	24.209	95.407
15/01/2009 3:59:00 AM	15/1/2009	3	1	24.209	95.939
15/01/2009 4:59:00 AM	15/1/2009	4	1	24.209	96.47
15/01/2009 5:59:00 AM	15/1/2009	5	1	24.209	95.407
15/01/2009 6:59:00 AM	15/1/2009	6	1	24.209	95.939
15/01/2009 7:59:00 AM	15/1/2009	7	1	24.709	97.566
15/01/2009 8:59:00 AM	15/1/2009	8	1	26.209	97.168
15/01/2009 9:59:00 AM	15/1/2009	9	1	27.709	97.321
15/01/2009 10:59:00 AM	15/1/2009	10	1	29.707	97.029
15/01/2009 11:59:00 AM	15/1/2009	11	1	30.706	94.494
15/01/2009 12:59:00 PM	15/1/2009	12	1	31.705	94.098
15/01/2009 1:59:00 PM	15/1/2009	13	1	31.205	93.486
15/01/2009 2:59:00 PM	15/1/2009	14	1	31.705	95.709
15/01/2009 3:59:00 PM	15/1/2009	15	1	32.204	90.361
15/01/2009 4:59:00 PM	15/1/2009	16	1	32.204	93.632
15/01/2009 5:59:00 PM	15/1/2009	17	1	31.205	88.008
15/01/2009 6:59:00 PM	15/1/2009	18	1	28.209	89.837
15/01/2009 7:59:00 PM	15/1/2009	19	1	26.709	90.772
15/01/2009 8:59:00 PM	15/1/2009	20	1	25.709	91.766
15/01/2009 9:59:00 PM	15/1/2009	21	1	25.709	93.388
15/01/2009 10:59:00 PM	15/1/2009	22	1	25.209	93.344
15/01/2009 11:59:00 PM	15/1/2009	23	1	25.209	93.882
16/01/2009 12:59:00 AM	16/1/2009	0	1	24.709	94.377
16/01/2009 1:59:00 AM	16/1/2009	1	1	24.709	93.841
16/01/2009 2:59:00 AM	16/1/2009	2	1	24.709	94.912
16/01/2009 3:59:00 AM	16/1/2009	3	1	24.209	94.338
16/01/2009 4:59:00 AM	16/1/2009	4	1	24.209	93.801
16/01/2009 5:59:00 AM	16/1/2009	5	1	24.209	94.873
16/01/2009 6:59:00 AM	16/1/2009	6	1	25.209	97.079
16/01/2009 7:59:00 AM	16/1/2009	7	1	27.709	97.321
16/01/2009 8:59:00 AM	16/1/2009	8	1	29.707	96.499
16/01/2009 9:59:00 AM	16/1/2009	9	1	30.207	96.564
16/01/2009 10:59:00 AM	16/1/2009	10	1	31.705	95.709
16/01/2009 11:59:00 AM	16/1/2009	11	1	34.2	96.643
16/01/2009 12:59:00 PM	16/1/2009	12	1	32.703	90.437
16/01/2009 1:59:00 PM	16/1/2009	13	1	33.701	93.87
16/01/2009 2:59:00 PM	16/1/2009	14	1	34.699	93.498
16/01/2009 3:59:00 PM	16/1/2009	15	1	35.198	87.518
16/01/2009 4:59:00 PM	16/1/2009	16	1	32.703	91.534
16/01/2009 5:59:00 PM	16/1/2009	17	1	31.705	89.186
16/01/2009 6:59:00 PM	16/1/2009	18	1	29.208	87.747
16/01/2009 7:59:00 PM	16/1/2009	19	1	27.709	90.33
16/01/2009 8:59:00 PM	16/1/2009	20	1	27.209	91.912
16/01/2009 9:59:00 PM	16/1/2009	21	1	26.709	91.861
16/01/2009 10:59:00 PM	16/1/2009	22	1	26.209	93.434
16/01/2009 11:59:00 PM	16/1/2009	23	1	25.709	93.388
17/01/2009 12:59:00 AM	17/1/2009	0	1	25.709	93.388
17/01/2009 1:59:00 AM	17/1/2009	1	1	25.209	93.882
17/01/2009 2:59:00 AM	17/1/2009	2	1	25.209	93.882

17/01/2009 3:59:00 AM	17/1/2009	3	1	25.209	94.419
17/01/2009 4:59:00 AM	17/1/2009	4	1	25.209	93.882
17/01/2009 5:59:00 AM	17/1/2009	5	1	25.209	94.419
17/01/2009 6:59:00 AM	17/1/2009	6	1	25.209	95.487
17/01/2009 7:59:00 AM	17/1/2009	7	1	25.709	95.531
17/01/2009 8:59:00 AM	17/1/2009	8	1	27.209	97.267
17/01/2009 9:59:00 AM	17/1/2009	9	1	31.705	96.243
17/01/2009 10:59:00 AM	17/1/2009	10	1	34.699	96.731
17/01/2009 11:59:00 AM	17/1/2009	11	1	36.694	97.107
17/01/2009 12:59:00 PM	17/1/2009	12	1	38.19	93.623
17/01/2009 1:59:00 PM	17/1/2009	13	1	40.183	90.182
17/01/2009 2:59:00 PM	17/1/2009	14	1	39.186	88.846
17/01/2009 3:59:00 PM	17/1/2009	15	1	37.193	86.193
17/01/2009 4:59:00 PM	17/1/2009	16	1	34.699	78.29
17/01/2009 5:59:00 PM	17/1/2009	17	1	29.208	84.955
17/01/2009 6:59:00 PM	17/1/2009	18	1	27.709	89.232
17/01/2009 7:59:00 PM	17/1/2009	19	1	26.709	91.317
17/01/2009 8:59:00 PM	17/1/2009	20	1	26.209	92.354
17/01/2009 9:59:00 PM	17/1/2009	21	1	25.709	92.849
17/01/2009 10:59:00 PM	17/1/2009	22	1	25.709	93.388
17/01/2009 11:59:00 PM	17/1/2009	23	1	25.209	93.344
18/01/2009 12:59:00 AM	18/1/2009	0	1	24.709	93.303
18/01/2009 1:59:00 AM	18/1/2009	1	1	24.709	93.841
18/01/2009 2:59:00 AM	18/1/2009	2	1	24.209	93.801
18/01/2009 3:59:00 AM	18/1/2009	3	1	23.709	93.226
18/01/2009 4:59:00 AM	18/1/2009	4	1	23.709	93.765
18/01/2009 5:59:00 AM	18/1/2009	5	1	23.209	93.73
18/01/2009 6:59:00 AM	18/1/2009	6	1	24.709	97.566
18/01/2009 7:59:00 AM	18/1/2009	7	1	27.209	97.267
18/01/2009 8:59:00 AM	18/1/2009	8	1	29.707	95.966
18/01/2009 9:59:00 AM	18/1/2009	9	1	31.705	95.709
18/01/2009 10:59:00 AM	18/1/2009	10	1	33.701	94.95
18/01/2009 11:59:00 AM	18/1/2009	11	1	36.195	95.396
18/01/2009 12:59:00 PM	18/1/2009	12	1	36.694	91.677
18/01/2009 1:59:00 PM	18/1/2009	13	1	36.195	90.479
18/01/2009 2:59:00 PM	18/1/2009	14	1	34.699	82.908
18/01/2009 3:59:00 PM	18/1/2009	15	1	29.707	86.696
18/01/2009 4:59:00 PM	18/1/2009	16	1	28.209	89.287
18/01/2009 5:59:00 PM	18/1/2009	17	1	28.708	91.535
18/01/2009 6:59:00 PM	18/1/2009	18	1	27.709	90.876
18/01/2009 7:59:00 PM	18/1/2009	19	1	26.709	90.772
18/01/2009 8:59:00 PM	18/1/2009	20	1	25.709	91.222
18/01/2009 9:59:00 PM	18/1/2009	21	1	24.709	91.68
18/01/2009 10:59:00 PM	18/1/2009	22	1	24.209	91.64
18/01/2009 11:59:00 PM	18/1/2009	23	1	23.709	92.145
19/01/2009 12:59:00 AM	19/1/2009	0	1	23.209	92.652
19/01/2009 1:59:00 AM	19/1/2009	1	1	22.708	92.619
19/01/2009 2:59:00 AM	19/1/2009	2	1	22.708	93.698
19/01/2009 3:59:00 AM	19/1/2009	3	1	22.708	94.235
19/01/2009 4:59:00 AM	19/1/2009	4	1	22.708	93.698
19/01/2009 5:59:00 AM	19/1/2009	5	1	22.708	94.235
19/01/2009 6:59:00 AM	19/1/2009	6	1	24.709	97.038
19/01/2009 7:59:00 AM	19/1/2009	7	1	27.209	97.267
19/01/2009 8:59:00 AM	19/1/2009	8	1	30.207	97.095
19/01/2009 9:59:00 AM	19/1/2009	9	1	31.205	96.702
19/01/2009 10:59:00 AM	19/1/2009	10	1	29.707	92.201
19/01/2009 11:59:00 AM	19/1/2009	11	1	32.204	92.548
19/01/2009 12:59:00 PM	19/1/2009	12	1	34.2	92.868
19/01/2009 1:59:00 PM	19/1/2009	13	1	35.198	89.191
19/01/2009 2:59:00 PM	19/1/2009	14	1	36.195	87.134
19/01/2009 3:59:00 PM	19/1/2009	15	1	37.193	84.489
19/01/2009 4:59:00 PM	19/1/2009	16	1	37.193	81.621
19/01/2009 5:59:00 PM	19/1/2009	17	1	35.198	80.693
19/01/2009 6:59:00 PM	19/1/2009	18	1	31.205	80.665
19/01/2009 7:59:00 PM	19/1/2009	19	1	28.708	83.768

19/01/2009 8:59:00 PM	19/1/2009	20	1	27.209	84.729
19/01/2009 9:59:00 PM	19/1/2009	21	1	26.209	86.308
19/01/2009 10:59:00 PM	19/1/2009	22	1	25.209	86.217
19/01/2009 11:59:00 PM	19/1/2009	23	1	24.209	87.801
20/01/2009 12:59:00 AM	20/1/2009	0	1	23.709	88.315
20/01/2009 1:59:00 AM	20/1/2009	1	1	23.209	88.831
20/01/2009 2:59:00 AM	20/1/2009	2	1	22.708	88.798
20/01/2009 3:59:00 AM	20/1/2009	3	1	22.208	89.317
20/01/2009 4:59:00 AM	20/1/2009	4	1	21.708	89.288
20/01/2009 5:59:00 AM	20/1/2009	5	1	21.708	89.837
20/01/2009 6:59:00 AM	20/1/2009	6	1	23.209	94.267
20/01/2009 7:59:00 AM	20/1/2009	7	1	26.209	95.577
20/01/2009 8:59:00 AM	20/1/2009	8	1	29.707	95.966
20/01/2009 9:59:00 AM	20/1/2009	9	1	31.205	93.486
20/01/2009 10:59:00 AM	20/1/2009	10	1	33.701	89.492
20/01/2009 11:59:00 AM	20/1/2009	11	1	35.198	88.634
20/01/2009 12:59:00 PM	20/1/2009	12	1	35.697	86.482
20/01/2009 1:59:00 PM	20/1/2009	13	1	36.195	83.736
20/01/2009 2:59:00 PM	20/1/2009	14	1	37.193	83.919
20/01/2009 3:59:00 PM	20/1/2009	15	1	37.193	79.882
20/01/2009 4:59:00 PM	20/1/2009	16	1	37.193	79.882
20/01/2009 5:59:00 PM	20/1/2009	17	1	34.699	78.29
20/01/2009 6:59:00 PM	20/1/2009	18	1	33.202	78.64
20/01/2009 7:59:00 PM	20/1/2009	19	1	29.707	80.471
20/01/2009 8:59:00 PM	20/1/2009	20	1	27.709	80.812
20/01/2009 9:59:00 PM	20/1/2009	21	1	26.709	84.678
20/01/2009 10:59:00 PM	20/1/2009	22	1	26.209	85.75
20/01/2009 11:59:00 PM	20/1/2009	23	1	25.709	85.143
21/01/2009 12:59:00 AM	21/1/2009	0	1	25.209	85.658
21/01/2009 1:59:00 AM	21/1/2009	1	1	24.709	86.174
21/01/2009 2:59:00 AM	21/1/2009	2	1	24.209	85.574
21/01/2009 3:59:00 AM	21/1/2009	3	1	23.709	86.652
21/01/2009 4:59:00 AM	21/1/2009	4	1	23.209	86.616
21/01/2009 5:59:00 AM	21/1/2009	5	1	23.209	86.616
21/01/2009 6:59:00 AM	21/1/2009	6	1	23.709	89.966
21/01/2009 7:59:00 AM	21/1/2009	7	1	27.209	94.608
21/01/2009 8:59:00 AM	21/1/2009	8	1	31.205	93.486
21/01/2009 9:59:00 AM	21/1/2009	9	1	33.202	90.515
21/01/2009 10:59:00 AM	21/1/2009	10	1	35.198	86.395
21/01/2009 11:59:00 AM	21/1/2009	11	1	36.694	84.397
21/01/2009 12:59:00 PM	21/1/2009	12	1	37.193	80.463
21/01/2009 1:59:00 PM	21/1/2009	13	1	38.19	81.23
21/01/2009 2:59:00 PM	21/1/2009	14	1	38.19	80.067
21/01/2009 3:59:00 PM	21/1/2009	15	1	39.685	78.602
21/01/2009 4:59:00 PM	21/1/2009	16	1	39.186	76.733
21/01/2009 5:59:00 PM	21/1/2009	17	1	37.691	75.862
21/01/2009 6:59:00 PM	21/1/2009	18	1	32.703	75.644
21/01/2009 7:59:00 PM	21/1/2009	19	1	29.707	78.742
21/01/2009 8:59:00 PM	21/1/2009	20	1	28.708	80.924
21/01/2009 9:59:00 PM	21/1/2009	21	1	27.209	80.758
21/01/2009 10:59:00 PM	21/1/2009	22	1	26.709	81.849
21/01/2009 11:59:00 PM	21/1/2009	23	1	26.209	83.501
22/01/2009 12:59:00 AM	22/1/2009	0	1	25.709	82.888
22/01/2009 1:59:00 AM	22/1/2009	1	1	25.709	84.019
22/01/2009 2:59:00 AM	22/1/2009	2	1	25.209	83.973
22/01/2009 3:59:00 AM	22/1/2009	3	1	25.209	83.973
22/01/2009 4:59:00 AM	22/1/2009	4	1	25.209	83.973
22/01/2009 5:59:00 AM	22/1/2009	5	1	25.709	84.582
22/01/2009 6:59:00 AM	22/1/2009	6	1	25.709	84.019
22/01/2009 7:59:00 AM	22/1/2009	7	1	27.209	86.966
22/01/2009 8:59:00 AM	22/1/2009	8	1	31.205	90.217
22/01/2009 9:59:00 AM	22/1/2009	9	1	33.701	86.708
22/01/2009 10:59:00 AM	22/1/2009	10	1	35.697	80.778
22/01/2009 11:59:00 AM	22/1/2009	11	1	36.195	81.441
22/01/2009 12:59:00 PM	22/1/2009	12	1	37.193	79.882

22/01/2009 1:59:00 PM	22/1/2009	13	1	37.691	78.22
22/01/2009 2:59:00 PM	22/1/2009	14	1	36.694	77.454
22/01/2009 3:59:00 PM	22/1/2009	15	1	36.694	75.686
22/01/2009 4:59:00 PM	22/1/2009	16	1	34.2	75.867
22/01/2009 5:59:00 PM	22/1/2009	17	1	32.703	77.401
22/01/2009 6:59:00 PM	22/1/2009	18	1	30.207	78.805
22/01/2009 7:59:00 PM	22/1/2009	19	1	28.708	80.351
22/01/2009 8:59:00 PM	22/1/2009	20	1	27.709	81.954
22/01/2009 9:59:00 PM	22/1/2009	21	1	26.709	82.418
22/01/2009 10:59:00 PM	22/1/2009	22	1	26.209	83.501
22/01/2009 11:59:00 PM	22/1/2009	23	1	26.209	84.066
23/01/2009 12:59:00 AM	23/1/2009	0	1	26.209	84.629
23/01/2009 1:59:00 AM	23/1/2009	1	1	25.709	86.261
23/01/2009 2:59:00 AM	23/1/2009	2	1	26.209	85.19
23/01/2009 3:59:00 AM	23/1/2009	3	1	26.209	85.19
23/01/2009 4:59:00 AM	23/1/2009	4	1	25.709	84.019
23/01/2009 5:59:00 AM	23/1/2009	5	1	25.209	85.098
23/01/2009 6:59:00 AM	23/1/2009	6	1	25.209	86.217
23/01/2009 7:59:00 AM	23/1/2009	7	1	25.209	85.658
23/01/2009 8:59:00 AM	23/1/2009	8	1	25.709	86.819
23/01/2009 9:59:00 AM	23/1/2009	9	1	26.209	87.421
23/01/2009 10:59:00 AM	23/1/2009	10	1	27.209	86.966
23/01/2009 11:59:00 AM	23/1/2009	11	1	27.709	87.019
23/01/2009 12:59:00 PM	23/1/2009	12	1	29.208	87.192
23/01/2009 1:59:00 PM	23/1/2009	13	1	29.707	85.578
23/01/2009 2:59:00 PM	23/1/2009	14	1	30.706	85.707
23/01/2009 3:59:00 PM	23/1/2009	15	1	32.204	86.478
23/01/2009 4:59:00 PM	23/1/2009	16	1	34.699	87.432
23/01/2009 5:59:00 PM	23/1/2009	17	1	34.699	81.763
23/01/2009 6:59:00 PM	23/1/2009	18	1	33.202	80.376
23/01/2009 7:59:00 PM	23/1/2009	19	1	30.207	82.25
23/01/2009 8:59:00 PM	23/1/2009	20	1	28.708	83.768
23/01/2009 9:59:00 PM	23/1/2009	21	1	27.209	86.966
23/01/2009 10:59:00 PM	23/1/2009	22	1	26.709	86.358
23/01/2009 11:59:00 PM	23/1/2009	23	1	26.209	86.308
24/01/2009 12:59:00 AM	24/1/2009	0	1	25.709	87.374
24/01/2009 1:59:00 AM	24/1/2009	1	1	25.209	87.329
24/01/2009 2:59:00 AM	24/1/2009	2	1	25.209	87.329
24/01/2009 3:59:00 AM	24/1/2009	3	1	25.209	87.884
24/01/2009 4:59:00 AM	24/1/2009	4	1	25.209	88.436
24/01/2009 5:59:00 AM	24/1/2009	5	1	24.709	87.287
24/01/2009 6:59:00 AM	24/1/2009	6	1	24.209	88.354
24/01/2009 7:59:00 AM	24/1/2009	7	1	24.709	87.841
24/01/2009 8:59:00 AM	24/1/2009	8	1	25.209	90.085
24/01/2009 9:59:00 AM	24/1/2009	9	1	27.209	91.368
24/01/2009 10:59:00 AM	24/1/2009	10	1	29.707	91.112
24/01/2009 11:59:00 AM	24/1/2009	11	1	32.703	90.986
24/01/2009 12:59:00 PM	24/1/2009	12	1	35.697	88.165
24/01/2009 1:59:00 PM	24/1/2009	13	1	38.19	86.386
24/01/2009 2:59:00 PM	24/1/2009	14	1	38.19	85.251
24/01/2009 3:59:00 PM	24/1/2009	15	1	40.681	80.566
24/01/2009 4:59:00 PM	24/1/2009	16	1	39.685	78.013
24/01/2009 5:59:00 PM	24/1/2009	17	1	34.699	80.611
24/01/2009 6:59:00 PM	24/1/2009	18	1	31.705	83.02
24/01/2009 7:59:00 PM	24/1/2009	19	1	30.207	83.952
24/01/2009 8:59:00 PM	24/1/2009	20	1	28.209	84.838
24/01/2009 9:59:00 PM	24/1/2009	21	1	26.709	85.239
24/01/2009 10:59:00 PM	24/1/2009	22	1	25.709	86.819
24/01/2009 11:59:00 PM	24/1/2009	23	1	25.209	87.884
25/01/2009 12:59:00 AM	25/1/2009	0	1	25.209	87.884
25/01/2009 1:59:00 AM	25/1/2009	1	1	24.709	88.394
25/01/2009 2:59:00 AM	25/1/2009	2	1	24.709	88.394
25/01/2009 3:59:00 AM	25/1/2009	3	1	24.709	88.394
25/01/2009 4:59:00 AM	25/1/2009	4	1	24.709	88.945
25/01/2009 5:59:00 AM	25/1/2009	5	1	24.709	88.945

25/01/2009 6:59:00 AM	25/1/2009	6	1	25.209	88.987
25/01/2009 7:59:00 AM	25/1/2009	7	1	25.709	90.13
25/01/2009 8:59:00 AM	25/1/2009	8	1	26.709	90.225
25/01/2009 9:59:00 AM	25/1/2009	9	1	26.209	88.528
25/01/2009 10:59:00 AM	25/1/2009	10	1	26.709	90.225
25/01/2009 11:59:00 AM	25/1/2009	11	1	27.709	89.782
25/01/2009 12:59:00 PM	25/1/2009	12	1	29.208	88.301
25/01/2009 1:59:00 PM	25/1/2009	13	1	30.207	87.873
25/01/2009 2:59:00 PM	25/1/2009	14	1	32.204	89.259
25/01/2009 3:59:00 PM	25/1/2009	15	1	33.701	88.383
25/01/2009 4:59:00 PM	25/1/2009	16	1	30.706	83.451
25/01/2009 5:59:00 PM	25/1/2009	17	1	30.706	85.145
25/01/2009 6:59:00 PM	25/1/2009	18	1	29.208	85.516
25/01/2009 7:59:00 PM	25/1/2009	19	1	27.709	85.904
25/01/2009 8:59:00 PM	25/1/2009	20	1	26.709	86.915
25/01/2009 9:59:00 PM	25/1/2009	21	1	26.209	88.528
25/01/2009 10:59:00 PM	25/1/2009	22	1	25.709	87.928
25/01/2009 11:59:00 PM	25/1/2009	23	1	25.209	88.987
26/01/2009 12:59:00 AM	26/1/2009	0	1	25.209	89.537
26/01/2009 1:59:00 AM	26/1/2009	1	1	25.209	90.085
26/01/2009 2:59:00 AM	26/1/2009	2	1	25.209	90.085
26/01/2009 3:59:00 AM	26/1/2009	3	1	25.209	88.987
26/01/2009 4:59:00 AM	26/1/2009	4	1	24.709	89.495
26/01/2009 5:59:00 AM	26/1/2009	5	1	24.709	90.043
26/01/2009 6:59:00 AM	26/1/2009	6	1	25.209	90.085
26/01/2009 7:59:00 AM	26/1/2009	7	1	26.209	92.895
26/01/2009 8:59:00 AM	26/1/2009	8	1	29.707	94.362
26/01/2009 9:59:00 AM	26/1/2009	9	1	31.705	94.098
26/01/2009 10:59:00 AM	26/1/2009	10	1	34.699	91.313
26/01/2009 11:59:00 AM	26/1/2009	11	1	36.195	89.37
26/01/2009 12:59:00 PM	26/1/2009	12	1	37.691	87.417
26/01/2009 1:59:00 PM	26/1/2009	13	1	37.691	86.854
26/01/2009 2:59:00 PM	26/1/2009	14	1	35.198	83.563
26/01/2009 3:59:00 PM	26/1/2009	15	1	32.703	84.3
26/01/2009 4:59:00 PM	26/1/2009	16	1	29.707	83.323
26/01/2009 5:59:00 PM	26/1/2009	17	1	27.709	85.344
26/01/2009 6:59:00 PM	26/1/2009	18	1	26.209	87.421
26/01/2009 7:59:00 PM	26/1/2009	19	1	25.709	88.481
26/01/2009 8:59:00 PM	26/1/2009	20	1	25.209	88.436
26/01/2009 9:59:00 PM	26/1/2009	21	1	24.709	90.043
26/01/2009 10:59:00 PM	26/1/2009	22	1	24.709	90.043
26/01/2009 11:59:00 PM	26/1/2009	23	1	24.709	90.59
27/01/2009 12:59:00 AM	27/1/2009	0	1	24.709	90.59
27/01/2009 1:59:00 AM	27/1/2009	1	1	24.709	90.043
27/01/2009 2:59:00 AM	27/1/2009	2	1	24.709	90.59
27/01/2009 3:59:00 AM	27/1/2009	3	1	24.709	90.59
27/01/2009 4:59:00 AM	27/1/2009	4	1	24.709	90.59
27/01/2009 5:59:00 AM	27/1/2009	5	1	24.209	90.55
27/01/2009 6:59:00 AM	27/1/2009	6	1	24.709	91.136
27/01/2009 7:59:00 AM	27/1/2009	7	1	26.209	93.434
27/01/2009 8:59:00 AM	27/1/2009	8	1	27.209	91.912
27/01/2009 9:59:00 AM	27/1/2009	9	1	28.708	93.161
27/01/2009 10:59:00 AM	27/1/2009	10	1	31.205	92.945
27/01/2009 11:59:00 AM	27/1/2009	11	1	32.703	88.781
27/01/2009 12:59:00 PM	27/1/2009	12	1	34.2	91.228
27/01/2009 1:59:00 PM	27/1/2009	13	1	35.198	86.957
27/01/2009 2:59:00 PM	27/1/2009	14	1	36.195	88.255
27/01/2009 3:59:00 PM	27/1/2009	15	1	33.202	83.809
27/01/2009 4:59:00 PM	27/1/2009	16	1	31.205	86.335
27/01/2009 5:59:00 PM	27/1/2009	17	1	29.707	86.696
27/01/2009 6:59:00 PM	27/1/2009	18	1	26.709	85.799
27/01/2009 7:59:00 PM	27/1/2009	19	1	25.709	87.374
27/01/2009 8:59:00 PM	27/1/2009	20	1	25.209	88.987
27/01/2009 9:59:00 PM	27/1/2009	21	1	24.709	90.043
27/01/2009 10:59:00 PM	27/1/2009	22	1	24.209	90.55

27/01/2009 11:59:00 PM	27/1/2009	23	1	24.209	91.096
28/01/2009 12:59:00 AM	28/1/2009	0	1	24.209	91.096
28/01/2009 1:59:00 AM	28/1/2009	1	1	24.209	91.096
28/01/2009 2:59:00 AM	28/1/2009	2	1	23.709	91.603
28/01/2009 3:59:00 AM	28/1/2009	3	1	23.709	90.513
28/01/2009 4:59:00 AM	28/1/2009	4	1	23.709	91.058
28/01/2009 5:59:00 AM	28/1/2009	5	1	23.209	91.023
28/01/2009 6:59:00 AM	28/1/2009	6	1	23.709	93.226
28/01/2009 7:59:00 AM	28/1/2009	7	1	26.209	96.109
28/01/2009 8:59:00 AM	28/1/2009	8	1	27.709	95.196
28/01/2009 9:59:00 AM	28/1/2009	9	1	29.707	93.284
28/01/2009 10:59:00 AM	28/1/2009	10	1	32.204	94.172
28/01/2009 11:59:00 AM	28/1/2009	11	1	32.703	87.67
28/01/2009 12:59:00 PM	28/1/2009	12	1	30.706	82.884
28/01/2009 1:59:00 PM	28/1/2009	13	1	27.209	85.29
28/01/2009 2:59:00 PM	28/1/2009	14	1	25.709	87.928
28/01/2009 3:59:00 PM	28/1/2009	15	1	25.709	91.222
28/01/2009 4:59:00 PM	28/1/2009	16	1	26.709	90.772
28/01/2009 5:59:00 PM	28/1/2009	17	1	26.209	90.176
28/01/2009 6:59:00 PM	28/1/2009	18	1	25.209	90.632
28/01/2009 7:59:00 PM	28/1/2009	19	1	24.709	91.136
28/01/2009 8:59:00 PM	28/1/2009	20	1	24.209	91.64
28/01/2009 9:59:00 PM	28/1/2009	21	1	23.709	92.687
28/01/2009 10:59:00 PM	28/1/2009	22	1	23.709	92.687
28/01/2009 11:59:00 PM	28/1/2009	23	1	23.709	92.687
29/01/2009 12:59:00 AM	29/1/2009	0	1	23.709	92.687
29/01/2009 1:59:00 AM	29/1/2009	1	1	23.209	92.652
29/01/2009 2:59:00 AM	29/1/2009	2	1	23.209	92.652
29/01/2009 3:59:00 AM	29/1/2009	3	1	23.209	93.192
29/01/2009 4:59:00 AM	29/1/2009	4	1	23.209	93.73
29/01/2009 5:59:00 AM	29/1/2009	5	1	23.209	93.192
29/01/2009 6:59:00 AM	29/1/2009	6	1	23.709	94.837
29/01/2009 7:59:00 AM	29/1/2009	7	1	25.209	96.019
29/01/2009 8:59:00 AM	29/1/2009	8	1	26.209	95.577
29/01/2009 9:59:00 AM	29/1/2009	9	1	27.709	94.661
29/01/2009 10:59:00 AM	29/1/2009	10	1	29.208	94.835
29/01/2009 11:59:00 AM	29/1/2009	11	1	29.707	91.657
29/01/2009 12:59:00 PM	29/1/2009	12	1	30.207	92.266
29/01/2009 1:59:00 PM	29/1/2009	13	1	26.209	88.528
29/01/2009 2:59:00 PM	29/1/2009	14	1	26.209	92.354
29/01/2009 3:59:00 PM	29/1/2009	15	1	27.209	92.995
29/01/2009 4:59:00 PM	29/1/2009	16	1	29.208	92.681
29/01/2009 5:59:00 PM	29/1/2009	17	1	27.709	85.904
29/01/2009 6:59:00 PM	29/1/2009	18	1	25.709	90.13
29/01/2009 7:59:00 PM	29/1/2009	19	1	25.209	91.721
29/01/2009 8:59:00 PM	29/1/2009	20	1	24.709	92.222
29/01/2009 9:59:00 PM	29/1/2009	21	1	24.209	94.338
29/01/2009 10:59:00 PM	29/1/2009	22	1	24.209	92.724
29/01/2009 11:59:00 PM	29/1/2009	23	1	23.709	93.226
30/01/2009 12:59:00 AM	30/1/2009	0	1	23.709	93.765
30/01/2009 1:59:00 AM	30/1/2009	1	1	23.709	93.765
30/01/2009 2:59:00 AM	30/1/2009	2	1	23.709	93.765
30/01/2009 3:59:00 AM	30/1/2009	3	1	23.709	93.765
30/01/2009 4:59:00 AM	30/1/2009	4	1	23.709	93.226
30/01/2009 5:59:00 AM	30/1/2009	5	1	23.209	93.192
30/01/2009 6:59:00 AM	30/1/2009	6	1	23.209	93.73
30/01/2009 7:59:00 AM	30/1/2009	7	1	23.709	93.765
30/01/2009 8:59:00 AM	30/1/2009	8	1	23.209	94.802
30/01/2009 9:59:00 AM	30/1/2009	9	1	24.209	95.939
30/01/2009 10:59:00 AM	30/1/2009	10	1	24.209	94.873
30/01/2009 11:59:00 AM	30/1/2009	11	1	24.209	94.338
30/01/2009 12:59:00 PM	30/1/2009	12	1	24.709	94.912
30/01/2009 1:59:00 PM	30/1/2009	13	1	25.709	94.462
30/01/2009 2:59:00 PM	30/1/2009	14	1	25.709	94.462
30/01/2009 3:59:00 PM	30/1/2009	15	1	26.209	95.043

30/01/2009 4:59:00 PM	30/1/2009	16	1	25.709	93.926
30/01/2009 5:59:00 PM	30/1/2009	17	1	26.209	94.508
30/01/2009 6:59:00 PM	30/1/2009	18	1	25.709	94.462
30/01/2009 7:59:00 PM	30/1/2009	19	1	25.209	93.882
30/01/2009 8:59:00 PM	30/1/2009	20	1	25.209	93.882
30/01/2009 9:59:00 PM	30/1/2009	21	1	25.209	93.882
30/01/2009 10:59:00 PM	30/1/2009	22	1	25.209	93.882
30/01/2009 11:59:00 PM	30/1/2009	23	1	24.709	93.841
31/01/2009 12:59:00 AM	31/1/2009	0	1	24.709	93.841
31/01/2009 1:59:00 AM	31/1/2009	1	1	24.709	93.303
31/01/2009 2:59:00 AM	31/1/2009	2	1	24.709	93.841
31/01/2009 3:59:00 AM	31/1/2009	3	1	24.709	94.377
31/01/2009 4:59:00 AM	31/1/2009	4	1	24.209	94.338
31/01/2009 5:59:00 AM	31/1/2009	5	1	24.209	94.338
31/01/2009 6:59:00 AM	31/1/2009	6	1	24.209	94.338
31/01/2009 7:59:00 AM	31/1/2009	7	1	26.209	97.696
31/01/2009 8:59:00 AM	31/1/2009	8	1	27.709	97.321
31/01/2009 9:59:00 AM	31/1/2009	9	1	29.208	95.904
31/01/2009 10:59:00 AM	31/1/2009	10	1	29.707	93.824
31/01/2009 11:59:00 AM	31/1/2009	11	1	31.205	91.858
31/01/2009 12:59:00 PM	31/1/2009	12	1	30.706	92.333
31/01/2009 1:59:00 PM	31/1/2009	13	1	31.705	91.93
31/01/2009 2:59:00 PM	31/1/2009	14	1	31.705	90.837
31/01/2009 3:59:00 PM	31/1/2009	15	1	30.706	90.696
31/01/2009 4:59:00 PM	31/1/2009	16	1	29.707	91.657
31/01/2009 5:59:00 PM	31/1/2009	17	1	27.709	88.681
31/01/2009 6:59:00 PM	31/1/2009	18	1	26.209	89.628
31/01/2009 7:59:00 PM	31/1/2009	19	1	25.209	91.178
31/01/2009 8:59:00 PM	31/1/2009	20	1	24.709	92.222
31/01/2009 9:59:00 PM	31/1/2009	21	1	24.209	92.724
31/01/2009 10:59:00 PM	31/1/2009	22	1	23.709	93.226
31/01/2009 11:59:00 PM	31/1/2009	23	1	23.709	94.301

APPENDIX F

TEMPERATURE AND HUMIDITY STATISTICS

STATISTICS BY BUTTON

Button #	1
Day	(All)

	Data							
Hour	Average of Reading °C	Max of Reading °C	Min of Reading °C	StdDev of Reading °C	Average of %RH	Max of %RH	Min of %RH	StdDev of %RH
0	19.38	27.21	6.67	4.78	66.08	98.58	38.95	14.72
1	18.94	27.21	6.16	4.88	66.24	97.57	40.81	14.81
2	18.54	27.21	5.16	4.99	66.37	98.05	39.66	14.76
3	18.22	26.71	5.16	5.10	66.53	98.05	40.76	14.76
4	17.97	26.21	4.66	5.15	66.64	97.57	41.47	14.78
5	17.74	26.21	4.15	5.24	66.75	98.05	41.59	14.72
6	18.07	27.71	3.65	5.54	67.54	98.45	41.00	15.20
7	21.26	30.71	8.17	4.99	68.23	100.31	39.40	15.98
8	24.91	35.20	14.19	4.14	66.90	101.16	35.09	16.59
9	27.90	37.69	18.70	3.74	64.88	100.18	30.78	17.24
10	30.18	40.18	21.71	3.59	62.84	99.82	25.26	17.45
11	31.57	41.68	23.21	3.49	61.12	99.05	29.74	17.18
12	32.55	42.18	23.71	3.49	60.01	99.04	28.46	17.12
13	33.43	43.17	24.71	3.66	59.00	98.70	27.28	17.10
14	34.07	44.17	23.71	3.92	58.56	98.37	27.23	16.86
15	33.82	46.65	23.71	4.17	58.44	96.16	25.56	16.36
16	32.32	44.66	22.21	4.12	59.38	96.16	26.87	15.85
17	29.18	41.18	21.21	4.08	61.35	97.18	30.55	14.81
18	25.82	35.20	18.20	3.65	63.24	96.06	32.85	13.95
19	23.92	31.21	14.70	3.64	64.27	96.55	36.76	14.11
20	22.50	29.71	12.19	3.90	64.87	96.59	37.24	14.26
21	21.40	29.21	10.18	4.15	65.39	97.04	38.45	14.39
22	20.54	28.21	8.67	4.39	65.74	97.04	38.36	14.56
23	19.87	27.71	7.67	4.58	65.93	98.09	39.62	14.64
Grand Total	24.75	46.65	3.65	7.29	64.01	101.16	25.26	15.83

STATISTICS BY BUTTON

Button #	2
Day	(All)

	Data							
Hour	Average of Reading °C	Max of Reading °C	Min of Reading °C	StdDev of Reading °C	Average of %RH	Max of %RH	Min of %RH	StdDev of %RH
0	19.58	26.70	7.15	4.31	72.45	98.66	45.01	11.05
1	19.23	26.70	6.14	4.39	73.05	99.19	46.38	10.83
2	18.91	26.20	6.64	4.41	73.66	98.61	47.02	10.61
3	18.71	25.70	6.64	4.41	74.34	99.19	46.45	10.39
4	18.57	25.70	6.64	4.35	74.99	99.19	47.02	10.19
5	18.46	25.70	5.13	4.39	75.63	99.11	48.88	9.89
6	18.91	27.70	5.13	4.69	76.16	98.66	50.09	9.87
7	21.21	33.19	8.15	4.94	76.37	99.19	49.04	10.12
8	24.08	38.18	13.68	4.80	74.42	99.39	38.65	11.42
9	27.01	39.17	17.19	4.48	70.45	98.17	31.68	12.80
10	29.63	42.65	20.20	4.27	66.47	98.22	28.43	13.96
11	31.39	44.64	22.20	4.07	63.03	97.36	26.39	14.43
12	32.49	46.63	23.70	4.19	60.73	97.04	24.39	14.82
13	32.97	48.12	24.20	4.35	59.45	97.63	23.84	15.31
14	33.14	49.61	24.20	4.45	58.86	97.19	23.95	15.65
15	32.44	47.12	23.20	4.35	59.31	97.78	19.67	15.77
16	30.85	42.65	22.20	4.20	60.95	97.61	25.09	15.26
17	28.29	40.17	21.20	3.93	63.54	98.49	30.35	14.11
18	25.48	34.19	18.19	3.46	66.37	97.78	34.09	13.11
19	23.62	30.70	14.68	3.46	68.19	98.75	37.92	12.42
20	22.27	29.20	12.17	3.61	69.47	98.70	40.95	11.92
21	21.27	28.20	10.16	3.81	70.53	98.70	40.72	11.64
22	20.52	27.70	8.66	3.99	71.37	99.19	43.20	11.34
23	19.97	27.20	7.65	4.16	71.96	99.19	43.71	11.18
Grand Total	24.54	49.61	5.13	6.84	68.82	99.39	19.67	13.84

STATISTICS BY BUTTON

Button #	3
Day	(All)

	Data							
Hour	**Average of Reading °C**	**Max of Reading °C**	**Min of Reading °C**	**StdDev of Reading °C**	**Average of %RH**	**Max of %RH**	**Min of %RH**	**StdDev of %RH**
0	20.17	27.65	7.61	4.39	73.59	97.91	57.67	11.41
1	19.83	27.15	6.60	4.48	73.64	97.82	57.78	11.42
2	19.48	27.15	7.11	4.52	73.72	98.87	58.89	11.44
3	19.25	26.65	6.60	4.52	73.75	98.35	57.64	11.45
4	19.09	26.65	6.60	4.49	73.71	98.92	57.64	11.53
5	18.98	26.65	5.10	4.55	73.66	98.87	58.23	11.65
6	20.06	31.64	5.60	5.20	73.24	98.23	56.16	11.75
7	22.98	34.14	9.62	5.31	71.46	98.87	53.93	11.90
8	25.56	38.13	14.63	4.89	69.98	97.29	52.13	12.34
9	27.96	38.63	17.64	4.37	68.19	96.80	49.86	12.85
10	30.01	40.62	21.15	3.91	66.65	96.95	27.53	13.67
11	31.47	40.62	22.65	3.61	65.57	97.30	36.10	13.96
12	32.40	42.11	23.15	3.63	64.89	97.38	39.45	14.06
13	32.70	42.11	25.15	3.74	64.79	98.20	44.31	14.05
14	32.53	43.11	23.15	3.77	65.46	96.60	45.11	13.89
15	31.62	43.11	22.65	3.55	66.72	97.24	45.85	13.71
16	30.04	39.62	21.65	3.22	68.37	97.83	46.43	12.97
17	27.60	37.63	21.15	3.06	70.32	97.24	50.43	12.16
18	25.39	31.64	18.14	2.93	71.61	97.17	52.54	11.78
19	23.91	29.65	15.13	3.11	72.22	97.29	55.88	11.65
20	22.79	29.15	12.63	3.44	72.73	97.53	56.65	11.51
21	21.84	28.65	10.62	3.73	73.11	98.31	57.78	11.39
22	21.15	28.15	9.62	4.00	73.37	97.78	57.12	11.35
23	20.61	28.15	8.11	4.21	73.52	97.96	57.86	11.40
Grand Total	24.89	43.11	5.10	6.40	70.59	98.92	27.53	12.75

STATISTICS BY BUTTON

Button #	4
Day	(All)

	Data							
Hour	**Average of Reading °C**	**Max of Reading °C**	**Min of Reading °C**	**StdDev of Reading °C**	**Average of %RH**	**Max of %RH**	**Min of %RH**	**StdDev of %RH**
0	19.55	27.66	7.62	4.54	75.26	107.05	49.11	12.67
1	19.01	26.66	7.12	4.71	75.86	107.05	49.01	12.52
2	18.62	26.66	6.12	4.82	76.33	107.13	50.37	12.24
3	18.30	26.16	5.11	4.87	76.79	107.54	51.58	12.08
4	18.08	26.16	4.11	4.90	77.21	107.54	51.62	11.91
5	17.87	26.16	3.61	4.98	77.67	107.63	51.62	11.70
6	18.74	29.16	4.61	5.38	78.43	107.57	51.47	11.78
7	22.97	32.65	9.63	5.05	76.86	105.75	51.17	11.27
8	27.47	40.63	14.14	5.63	73.90	104.57	50.64	11.98
9	31.09	45.62	19.65	6.02	70.07	106.42	34.97	13.97
10	33.67	48.11	22.66	6.26	66.39	106.10	30.05	15.73
11	35.32	49.60	23.66	6.19	63.33	107.74	28.98	16.84
12	36.11	50.59	25.16	6.15	61.54	107.35	25.48	17.32
13	36.35	51.09	24.66	6.10	60.12	107.24	21.98	17.70
14	36.15	52.58	24.66	6.22	59.55	106.31	19.11	18.25
15	35.11	51.09	23.66	6.06	59.68	106.06	18.36	18.40
16	33.16	49.60	23.66	5.47	60.86	105.29	20.13	17.67
17	29.91	44.12	21.66	4.46	63.54	105.83	26.03	16.35
18	26.62	33.65	18.65	3.30	67.60	104.74	39.13	14.49
19	24.54	30.65	16.15	3.18	69.89	106.21	41.19	13.85
20	23.03	29.66	14.14	3.35	71.62	105.67	44.05	13.51
21	21.87	28.66	11.14	3.71	72.84	106.67	45.46	13.36
22	20.89	27.66	10.13	4.05	73.84	106.64	46.62	13.12
23	20.13	27.66	8.13	4.36	74.64	106.64	47.89	12.83
Grand Total	26.03	52.58	3.61	8.51	70.16	107.74	18.36	15.80

STATISTICS BY BUTTON

Button #	5
Day	(All)

	Data							
Hour	Average of Reading °C	Max of Reading °C	Min of Reading °C	StdDev of Reading °C	Average of %RH	Max of %RH	Min of %RH	StdDev of %RH
0	20.20	27.72	8.16	4.18	75.31	106.48	37.34	15.83
1	19.65	27.22	7.66	4.35	75.79	106.48	38.49	15.61
2	19.16	26.72	7.66	4.53	76.27	105.98	39.04	15.36
3	18.78	26.22	6.15	4.61	76.69	106.03	40.60	15.07
4	18.52	26.22	5.14	4.66	77.19	105.98	41.95	14.79
5	18.34	26.22	4.13	4.74	77.63	105.64	42.69	14.55
6	18.52	27.72	4.13	5.21	78.20	105.98	43.96	14.36
7	19.81	31.72	4.63	6.05	79.04	106.48	43.89	14.17
8	22.39	35.21	7.66	6.15	79.91	106.01	48.66	13.87
9	25.40	38.69	11.68	5.78	79.10	105.64	48.46	14.04
10	28.17	40.68	16.20	5.18	76.78	106.53	38.24	15.42
11	30.39	42.17	19.71	4.64	74.02	105.60	33.27	16.80
12	31.86	41.18	21.72	4.22	71.28	104.98	34.65	17.58
13	32.76	42.17	22.72	4.17	68.90	105.27	32.63	17.96
14	33.17	42.67	24.22	4.21	68.16	105.37	29.17	18.56
15	32.98	43.16	23.22	4.05	68.02	105.32	28.50	18.76
16	31.93	42.17	22.72	3.82	68.44	104.87	28.45	18.53
17	29.89	37.70	21.72	3.28	69.40	104.98	27.78	18.15
18	27.32	34.71	20.72	2.82	70.52	104.68	29.52	17.45
19	25.26	31.72	19.21	2.67	71.67	105.10	29.42	17.04
20	23.80	30.22	16.70	2.88	72.74	105.14	31.99	16.80
21	22.68	29.22	14.19	3.22	73.57	105.22	33.87	16.51
22	21.74	28.22	11.18	3.57	74.15	105.18	34.34	16.29
23	20.90	27.72	10.17	3.92	74.78	105.60	36.04	16.06
Grand Total	24.73	43.16	4.13	6.87	74.06	106.53	27.78	16.69

STATISTICS BY BUTTON

Button #	6
Day	(All)

	Data							
Hour	Average of Reading °C	Max of Reading °C	Min of Reading °C	StdDev of Reading °C	Average of %RH	Max of %RH	Min of %RH	StdDev of %RH
0	18.74	27.15	5.07	4.94	65.95	93.51	21.40	11.93
1	18.07	27.15	4.07	5.19	66.53	93.51	23.24	11.74
2	17.52	26.65	3.06	5.37	67.10	93.41	25.12	11.57
3	17.08	26.15	2.56	5.53	67.61	94.43	27.69	11.40
4	16.72	26.15	2.05	5.65	68.12	93.89	30.90	11.20
5	16.46	26.15	1.55	5.81	68.48	93.55	30.79	11.09
6	16.83	27.15	1.04	6.24	68.15	93.92	30.86	11.09
7	19.65	31.64	4.57	6.03	66.06	93.38	26.56	11.96
8	23.38	35.13	9.60	5.22	64.03	92.86	22.81	12.67
9	26.81	38.12	15.63	4.55	60.92	92.86	21.83	13.43
10	29.58	41.10	20.14	4.18	57.78	93.52	20.69	14.10
11	31.51	43.09	22.65	3.96	55.31	93.05	17.30	14.52
12	32.72	42.60	23.65	3.94	53.69	93.68	16.80	14.79
13	33.60	43.59	24.65	4.01	52.00	92.10	14.79	15.01
14	33.82	44.09	24.15	4.05	51.69	92.10	14.84	15.64
15	33.33	43.59	23.65	4.11	52.15	92.59	14.74	15.93
16	32.04	42.60	22.65	3.97	53.57	92.25	15.36	15.80
17	29.08	40.11	20.64	3.53	56.84	92.97	17.15	14.91
18	26.13	33.64	18.14	3.14	59.34	93.14	18.80	14.16
19	24.18	30.64	14.12	3.21	60.85	93.01	22.59	13.68
20	22.77	29.64	11.11	3.59	62.06	93.09	24.04	13.17
21	21.57	28.65	9.10	3.96	63.18	93.95	22.53	12.78
22	20.49	27.65	7.59	4.35	64.22	93.47	22.32	12.45
23	19.56	27.65	6.08	4.66	65.15	93.47	22.81	12.22
Grand Total	24.23	44.09	1.04	7.71	61.28	94.43	14.74	14.46

APPENDIX G

COST BENEFIT ANALYSIS

SUNWATER
BUSINESS CASE FOR ENHANCEMENTS

Service Contract	BHWSS	**Segment**	Metered Outlets		
Project Name	Investigation of Life Cycle Management of	**Reference No.**			
Explanation of business case	A cost benefit analysis of setting up a system whereby one operator can oversee the entire fleet of EM meters in the BHWSS. (Ajenti)				
Prepared by	Steven Shears	**Position**	Technical Officer	**Date**	01-Sep-09

Financial outputs	Unit	Total
Net present value	$	**(224,749)**
Payback period	Years	**-**
Benfit cost ratio	Ratio	**-0.57 : 1**

Financial inputs

Year ended 30 June			1 2009	2 2010	3 2011	4 2012	5 2013	6 2014	7 2015	8 2016	9 2017	10 2018	11 2019	12 2020	13 2021	14 2022	15 2023	16 2024	17 2025	18 2026	19 2027	20 2028
Financial costs																						
Initial Costs (Ajenti)	$	**(197,642)**	(197,642)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ongoing costs	$	**(197,087)**	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	-	-	-	-	-
	$	**-**																-	-	-	-	-
Total cost	$	**(394,729)**	(210,781)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	-	-	-	-	-
Financial benefits																						
Quarterly meter read	$	**102,832**	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	-	-	-	-	-
MAR Cost	$	**38,014**	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534		-	-	-	-
	$	**-**																-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total benefit	$	**140,846**	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	-	-	-	-	-

Workings																						
Discount rate (Pre-tax)	%	11.50																				
Discount factor	Factor	0.973	0.873	0.783	0.702	0.630	0.565	0.506	0.454	0.407	0.365	0.328	0.294	0.264	0.236	0.212	0.190	0.171	0.153	0.137	0.123
Inflation rate	%	2.50																				
Inflation index	Index	100.00	102.50	105.06	107.69	110.38	113.14	115.97	118.87	121.84	124.89	128.01	131.21	134.49	137.85	141.30	144.83	148.45	152.16	155.97	159.87
Valuation cashflow stream	$	(201,392)	(3,843)	(3,939)	(4,038)	(4,139)	(4,242)	(4,348)	(4,457)	(4,568)	(4,682)	(4,800)	(4,920)	(5,042)	(5,169)	(5,298)	-	-	-	-	-
Discounted cashflow stream	$	(195,985)	(3,354)	(3,083)	(2,835)	(2,606)	(2,395)	(2,202)	(2,024)	(1,861)	(1,711)	(1,573)	(1,446)	(1,329)	(1,222)	(1,123)	-	-	-	-	-
Payback amount	$	(201,392)	(205,235)	(209,174)	(213,212)	(217,350)	(221,592)	(225,940)	(230,397)	(234,966)	(239,648)	(244,447)	(249,367)	(254,410)	(259,578)	(264,876)	(264,876)	(264,876)	(264,876)	(264,876)	(264,876)
Year of payback	Year		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUNWATER
BUSINESS CASE FOR ENHANCEMENTS

Service Contract	BHWSS	**Segment**	Metered Outlets
Project Name	Investigation of Life Cycle Management of	**Reference No.**	
Explanation of business case	A cost benefit analysis of setting up a system whereby one operator can oversee the entire fleet of EM meters in the BHWSS. (RAT)		
Prepared by	Steven Shears	**Position**	Technical Officer
Date	01-Sep-09		

Financial outputs	Unit	Total
Net present value	$	**(249,736)**
Payback period	Years	**-**
Benfit cost ratio	Ratio	**-0.61 : 1**

Financial inputs

Year ended 30 June			1 2009	2 2010	3 2011	4 2012	5 2013	6 2014	7 2015	8 2016	9 2017	10 2018	11 2019	12 2020	13 2021	14 2022	15 2023	16 2024	17 2025	18 2026	19 2027	20 2028
Financial costs																						
Initial Costs (RAT)	$	**(238,242)**	(238,242)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ongoing costs	$	**(171,887)**	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	-	-	-	-	-
	$	**-**																-	-	-	-	-
Total cost	$	**(410,129)**	(249,701)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	-	-	-	-	-
Financial benefits																						
Quarterly meter read	$	**102,832**	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	-	-	-	-	-
MAR Cost	$	**38,014**	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534		-	-	-	-
	$	**-**																	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total benefit	$	**140,846**	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	9,390	-	-	-	-	-

Workings																					
Discount rate (Pre-tax)	%	11.50																			
Discount factor	Factor	0.973	0.873	0.783	0.702	0.630	0.565	0.506	0.454	0.407	0.365	0.328	0.294	0.264	0.236	0.212	0.190	0.171	0.153	0.137	0.123
Inflation rate	%	2.50																			
Inflation index	Index	100.00	102.50	105.06	107.69	110.38	113.14	115.97	118.87	121.84	124.89	128.01	131.21	134.49	137.85	141.30	144.83	148.45	152.16	155.97	159.87
Valuation cashflow stream	$	(240,312)	(2,121)	(2,174)	(2,228)	(2,284)	(2,341)	(2,400)	(2,460)	(2,521)	(2,584)	(2,649)	(2,715)	(2,783)	(2,853)	(2,924)	-	-	-	-	-
Discounted cashflow stream	$	(233,860)	(1,851)	(1,702)	(1,564)	(1,438)	(1,322)	(1,215)	(1,117)	(1,027)	(944)	(868)	(798)	(734)	(674)	(620)	-	-	-	-	-
Payback amount	$	(240,312)	(242,433)	(244,607)	(246,835)	(249,120)	(251,461)	(253,861)	(256,321)	(258,842)	(261,426)	(264,075)	(266,790)	(269,574)	(272,426)	(275,350)	(275,350)	(275,350)	(275,350)	(275,350)	(275,350)
Year of payback	Year		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX H

UPDATED COST BENEFIT ANALYSIS

SUNWATER
BUSINESS CASE FOR ENHANCEMENTS

Service Contract	BHWSS	**Segment**	Metered Outlets
Project Name	Investigation of Life Cycle Management of	**Reference No.**	
Explanation of business case	A cost benefit analysis of setting up a system whereby one operator can oversee the entire fleet of EM meters in the BHWSS. (Ajenti)		
Prepared by	Steven Shears	**Position**	Technical Officer
Date	01-Sep-09		

Financial outputs	Unit	Total
Net present value	$	**(51,853)**
Payback period	Years	**11**
Benfit cost ratio	Ratio	**-0.13 : 1**

Financial inputs

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year ended 30 June			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Financial costs																						
Initial Costs (Ajenti)	$	**(197,642)**	(197,642)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ongoing costs	$	**(197,087)**	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	-	-	-	-	-
	$	**-**																-	-	-	-	-
Total cost	$	**(394,729)**	(210,781)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	(13,139)	-	-	-	-	-
Financial benefits																						
Quarterly meter read	$	**102,832**	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	-	-	-	-	-
MAR Cost	$	**38,014**	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534		-	-	-	-
Intangible Benefits	$	**300,000**	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total benefit	$	**440,846**	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	-	-	-	-	-

Workings

Discount rate (Pre-tax)	%		11.50																			
Discount factor	Factor		0.973	0.873	0.783	0.702	0.630	0.565	0.506	0.454	0.407	0.365	0.328	0.294	0.264	0.236	0.212	0.190	0.171	0.153	0.137	0.123
Inflation rate	%		2.50																			
Inflation index	Index		100.00	102.50	105.06	107.69	110.38	113.14	115.97	118.87	121.84	124.89	128.01	131.21	134.49	137.85	141.30	144.83	148.45	152.16	155.97	159.87
Valuation cashflow stream	$		(181,392)	16,657	17,073	17,500	17,938	18,386	18,846	19,317	19,800	20,295	20,802	21,322	21,855	22,402	22,962	-	-	-	-	-
Discounted cashflow stream	$		(176,522)	14,538	13,364	12,286	11,294	10,382	9,544	8,774	8,066	7,415	6,816	6,266	5,760	5,295	4,868	-	-	-	-	-
Payback amount	$		(181,392)	(164,735)	(147,661)	(130,161)	(112,224)	(93,838)	(74,992)	(55,675)	(35,875)	(15,580)	5,222	26,544	48,399	70,801	93,763	93,763	93,763	93,763	93,763	93,763
Year of payback	Year			-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-

SUNWATER
BUSINESS CASE FOR ENHANCEMENTS

Service Contract	BHWSS	**Segment**	Metered Outlets
Project Name	Investigation of Life Cycle Management of	**Reference No.**	
Explanation of business case	A cost benefit analysis of setting up a system whereby one operator can oversee the entire fleet of EM meters in the BHWSS. (RAT)		
Prepared by	Steven Shears	**Position**	Technical Officer
Date	01-Sep-09		

Financial outputs	Unit	Total
Net present value	$	**(76,840)**
Payback period	Years	**12**
Benfit cost ratio	Ratio	**-0.19 : 1**

Financial inputs

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year ended 30 June			**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Financial costs																						
Initial Costs (RAT)	$	**(238,242)**	(238,242)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ongoing costs	$	**(171,887)**	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	-	-	-	-	-
	$	**-**																-	-	-	-	-
Total cost	$	**(410,129)**	(249,701)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	(11,459)	-	-	-	-	-
Financial benefits																						
Quarterly meter read	$	**102,832**	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	6,855	-	-	-	-	-
MAR Cost	$	**38,014**	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534		-	-	-	-
Intangible benefits	$	**300,000**	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total benefit	$	**440,846**	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	29,390	-	-	-	-	-

Workings

Discount rate (Pre-tax)	%		11.50																			
Discount factor	Factor		0.973	0.873	0.783	0.702	0.630	0.565	0.506	0.454	0.407	0.365	0.328	0.294	0.264	0.236	0.212	0.190	0.171	0.153	0.137	0.123
Inflation rate	%		2.50																			
Inflation index	Index		100.00	102.50	105.06	107.69	110.38	113.14	115.97	118.87	121.84	124.89	128.01	131.21	134.49	137.85	141.30	144.83	148.45	152.16	155.97	159.87
Valuation cashflow stream	$		(220,312)	18,379	18,838	19,309	19,792	20,287	20,794	21,314	21,847	22,393	22,953	23,527	24,115	24,718	25,335	-	-	-	-	-
Discounted cashflow stream	$		(214,397)	16,041	14,746	13,556	12,462	11,456	10,531	9,681	8,900	8,181	7,521	6,914	6,356	5,843	5,371	-	-	-	-	-
Payback amount	$		(220,312)	(201,933)	(183,094)	(163,785)	(143,993)	(123,706)	(102,912)	(81,598)	(59,752)	(37,359)	(14,406)	9,121	33,235	57,953	83,288	83,288	83,288	83,288	83,288	83,288
Year of payback	Year			-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-