

OSIsoft. **REGIONAL S SEMINAR S** A P A C The Power of Data

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PI Infrastructure Projects & Automated Meter Reading

Presented by lan Scott

Water Corporation

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AGENDA

Drinking Water Quality Reporting

System Capability Matrix & Forecasting

Automated Meter Reading Pilot for Kalgoorlie

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Water Corporation at a glance

- One of the Australia's largest water service providers
- State-wide responsibility
- Area of over 2.5 million km2
- World's largest water supply area
- +\$25 Billion Asset Base
- Serves population of 1.8 million
- More than 2,000 employees
- Annual revenue >\$1.5 Billion
- Capital program +\$900M /yr
- Water to 300 cities and towns
- Wastewater to 100 cities and towns



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REPORTING CRITICAL CONTROL POINT PERFORMANCE

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Background

- Maintain quality standards set by DoH across all water sources based on NHMRC 1996 guidelines.
- Implement CCP barrier techniques at supply systems
 - Catchment controls
 - Spot sampling
 - SCADA controlled treatment at CCP sites
- Over 120 schemes need governance reporting in place

Why we need CCP Management!



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Walpole Butlers Dam



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Case Study: Walpole



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Critical Control Points (CCPs)

- 'An activity, procedure or process at which control can be applied and which is essential to prevent a hazard or reduce it to an acceptable level'
- Critical Limit Breaches
 - Represent loss of control of the process;
 - Indicate the existence of a possible immediate health risk.

CCP's at the Water Corporation

ССР	Operational Parameter
Chlorination	Chlorine residual at the chlorinator (mg/L)
Ultra Violet Disinfection	UV dose (fluence) (mJ/cm ²)
Filtration	Turbidity at filter outlet (NTU)
Reverse Osmosis Desalination	Conductivity (mS/m)

Business Drivers

- Traditional CCP Management
 - Has been operational &/or automatic (eg 'Residual trim' capability of Chlorination units)
 - Vital to the protection of Public Health
 - From a governance perspective, provides only limited confidence in the safety of the water.
- Standardised retrospective CCP performance assessment required
 - Individual sites vs Corporate standards
 - To inform improved resource allocation decisions
 - Allow acceptable levels of risk to be determined

Chlorination Response Actions



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CCP– Performance Targets

Parameter	Minimum acceptable						1
	portornance			MrA		1	Mr
Chlorinator Critical Limit	98%	Target Range		ן טט ן			
Ultra Violet Disinfection Critical Limit	98%	↓.					
Conventional Filtration Critical Limit	99%	idual	đ			þ	
Membrane Filtration Critical limit	99%	ine Resi	kamping ı			Ramping	
		Chlor	Ľ.			_	
Chlorinator Target Limit	90%						
Ultra Violet Disinfection Target Limit	90%	Critical Limit					
Conventional Filtration Target Limit	95% (98% if filter to waste			Durra			
Membrane Filtration Target limit	98%		•	Pum	ping →	•	Pi



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Reporting Tool

- Must analyse performance when unit is supposed to be running. Ignore other data timeframes.
- Reports performance against target ranges and critical limits
 - As stipulated in the scheme Process Control Table (PCT) this was compiled based on existing operational best practice
 - Expressed as a % within specification
 - Number of alarms to have 'sounded' can also be presented

Solution Options

- Data indicates process follows a repeatable start/stop cycle - PI Batch????
- PI Batch built under manufacturing model. The theory is nothing happens until you turn on the machines.
- CCP water can be out of spec before process acts and will be excluded with PI Batch.

Solution Options cont..

- Existing data quality tool (PI-AANT) was built for data quality and aggregation purposes.
- Expand the tool to handle complex event process (CEP) calcs to output daily.
- Build tools to report daily outputs in ProcessBook and DataLink

Qualified User Daily Calc Data Raw Data Input Data Visualisation Tool inside PI Archive ProcessBook Hierarchy Server Details Data extracts and **PI-OLEDB** PI-AF PI-SDK calculation SQL Server results PI-ACE --PI-AF SDK **PI-AF SDK Business Logic** SQL OLEDB **GUI** Aggregation mapping for **AF Structure Engine Configuration** calculations Build Calculation settings Tool and flags for data errors **ADMIN Use Only**

Solution Architecture

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Solution: User Screens

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Locality Barrier Tool – Summary Page

The summary page shows at a glance the state of an entire region in a month.



Users select a region and month to generate the summary

The CCPs for a Locality are aligned in columns against the District. Each box shows the worst KPI status for the CCP.

Hovering over a locality shows its results for the month.

Clicking on a Locality moves to the Detail Page with the Locality displayed.

Locality Barrier Tool – Detail Page

The Detail page shows the data from a single CCP in graphical and numeric forms.



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Locality Barrier Tool – Detail Page -Trends



The top trend shows a trace of time within target limits as a daily percentage.

This trend will also show daily differences between the SCADA alarm set points and the WSP limits

The bottom trend shows the CCP value (blue), the critical (red) and target (yellow) WSP limits, and the time when the CCP is operating (green).

Users can zoom and pan both trends, and the date ranges are kept synchronised.

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Locality Barrier Tool – Detail Page -Controls

Tree Structure					
Augusta Bridgetown Manjimup Or Manjimup	esidual_Inlet				The navigation tree allows users to move between CCPs
UV_Dose			~		
Comments				2	
Add Browse					
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Results -01-Jul-10 to 01-Aug	F10				
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Time Below Critical Limit	0d 1h 10m 30s (0.5%)	5%	0.1%		
R Time Above Target Limit	1d 2h 56m 29s (11.6%)	5%	0.1%		This name displays the numerical
📀 Time Below Target Limit	0d 7h 46m 31s (3.4%)	5%	0.1%		require for the date displayed on the
G Time Active	9d 15h 25m 46s (31.1%)				results for the data displayed on the
G SCADA Critical High Count	0	8	4		graphs
G SCADA Critical Low Count	0	8	4		
G SCADA Target High Count	0	8	4		
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Locality Barrier Tool – Reporting

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Expected Benefits: Operational

- Immediate alignment of the field operational targets with the reported targets (from the PCT)
- An improved understanding of existing Process Control Point performance e.g. Free Chlorine residuals in the reticulation
- Focus on alarms why are they not triggering/responding when they should?
 - Alarm delays?

Expected Benefits: Process Improvements

- UV Disinfection system audit
 - Effectiveness of the operational and capital mitigation activities suggested by the audit can be measured.
- Chlorination inspection and upgrade program
 - Potential for targeting of on-site inspections & influencing prioritisation of funding for upgrades
 - Validation of the improved performance of upgraded chlorinators
- Enhanced understanding of associated issues
 - Variability in feedback loop times
 - Inactivated/ Disregarded alarms
 - Alarm response
 - Configuration management

Expected Benefits: Managerial

- Availability of improved information for water quality governance committees.
 - Enables presentation of the 'real' level of water quality risk in a clear, internally consistent manner.
 - Standardisation of management of critical water quality barriers.
- Facilitates better management decisions
 - Accept the risk; or
 - Spend to mitigate it

Conclusion

- Target is to deliver 'safe' water to customers 100% of the time
 - Requires that the operational knowledge that has controlled the scheme for many years be conveyed to management.
 - Requires that asset capability be fully understood
- Retrospective CCP reporting can be a crucial tool in effective management of water quality risks, through:
 - Enabling enhanced operator vigilance
 - Accurately informing management of existing public health risks
 - Aiding prioritisation of capital upgrades
 - Validating the effectiveness of CCP performance improvement measures.
 - Driving continuous improvement



Growth/Capacity Monitoring & Reporting

System Capability Forecasting

Current Situation

Generally;

- We monitor and report our growth/capacity information in an ad-hoc and manual manner
- Inconsistent and multiple data sources exist
- There is no single source of the "truth" re data and assumptions.
- There are knowledge capability gaps for people undertaking the necessary tasks to manage the area of growth and demand of our schemes.
- Corporate Accountability Framework There appears to be no one point of accountability or responsibility for the scheme growth and demand management in the Corporation.
- The periods for analysis and/or data capture are not clear.
- Lack of clarity in how we manage scheme growth and demand translates in to deficient or inconsistent engagement with external parties.

Business Drivers

Failure to change will lead to;

- Duplication of effort for analysis. Wasted effort.
- Inconsistencies of information may be transferred into external reporting. We lose credibility with stakeholders and breaching compliance limits. (eg. DoW, DoH, DEC)
- Spending money in the wrong areas.
- Loss of corporate knowledge if information is not captured for the future.
- Poor planning timelines and increases to fast track projects.
- Multiple methodologies for forecasting.
- We will reduce our capacity to deliver services our customers.
- We will lose the opportunity to manage our human resources better and to move from a reactive (Based on history & incidents) to proactive (Based on forecasting & planning into the future) environment.

Whole of Project Aims

To overcome our existing challenges we need;

- Better clarity of roles and responsibilities
- "One-Best-Way" of undertaking the task of managing supply/demand of our schemes
- Focus on growth/capacity (Capability) of the supply and demands of our schemes for the long term
- To get ahead of the game become proactive instead of reactive. (Requires a change of culture)
- To understand all information relating to growth, consumption and peaks.
- To streamline and speed up delivery of information as current forms of forecasting and performance monitoring are labour intensive and mainly adhoc.
- Acceptance and use of a corporate system (application) that is robust and standardised that can deliver relevant information consistently in a repeatable and transparent manner and is available for use by all.

Wastewater PS KPI Forecasting



- Provides Capability Mangers/OC/Planners a quick view of longterm performance of each asset.
- These KPI's are not monitored by SCADA.
- Each site is analysed using the same method "one best way".
- Predictive forecasting when design limits will be reached to identify planning or capital expenditure timing.

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Summary

Scheme Growth



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Borefield Abstraction Reports

Water Year Start												
1/10/2010												
	1/10/2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011
Borefield Flows (Mth)	38613	42732	56655	36646	45881	54195	46944	33306	20925	9516	50236	30231
Cumulative Flows	38613	81345	138000	174646	220527	274722	321666	354972	375897	385413	435649	465880
Cumulative + Prediction	29775	81345	138000	174646	220527	274722	321666	354972	375897	385413	435649	465880
Previous Year	29775	33942	34083	67367	35341	70765	53577	8370	46721	27857	27099	40000
Previous Year Cumulative	29775	63717	97800	165167	200508	271273	324850	333220	379941	407798	434897	474897
Seasonally Adjusted Licence	37619	42883	43062	85114	44651	89407	67691	10575	59029	35195	34238	50537
Adjusted Lic Cumulative	37619	80502	123564	208677	253328	342735	410426	421001	480030	515225	549463	600000
Licence Amount	50000	100000	150000	200000	250000	300000	350000	400000	450000	500000	550000	600000
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Increment in Borefield Flows	1.30	1.11	1.33	0.65	1.25	1.18	0.87	0.71	0.63	0.45	5.28	0.60
Data Validated (put "OK" if manually checked)											ок	
Within threshold or checked manually?	ОК	ОК	ОК	OK	OK	ОК	ОК	ОК	ОК	OK	OK	OK
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% of Licence Used (Cumulative) :	102.6%	101.0%	111.7%	83.1%	87.1%	80.2%	78.4%	84.3%	78.3%	74.8%	79.3%	//.0%
% of Licence Used (Mth Totals) :	102.6%	99.6%	131.6%	43.1%	102.8%	60.6%	69.4%	315.0%	35.4%	27.0%	146.7%	59.8%
KL's Used of Licence to Date :	0.0%											

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Borefield Abstraction Graphs



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SCF Context Diagram



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Architecture Diagram



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AF Structure – Site Level

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🗃 Abstraction			AssetClass		W_BORE_SITE				
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AF Structure – Measurement Level

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			ReportingMeasure	Water Level Pumped AHD							
			ReportingMeasureInde	ex 32	SELECT ReportingMeasureIndex FROM SCFTrig						
		3	Water Level Rest AHD	5.598 m	A=AHD;L=Length of Airline;W=Gauge Rest Read						
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Emmi Di Kainfall			ReportingMeasure	Water Level Rest AHD							
🗄 🗇 Cane River			ReportingMeasureInde	ex 33	SELECT ReportingMeasureIndex FROM SCFTrig.						

SCM Main Screen

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BURRUP SEAWATER SCHEME	OPS	PA	+	0	0	0	0	0	0	0	120	0	o	0	Projects	SWPP	Assets	SCF	
CAMBALLIN	OPS	PA	+	0	0	o	0	o	12	o	o	25	5	0	Projects	SWPP	Assets	SCF	
DAMPIER	OPS	PA	+	o	44	o	o	o	90 ^{PL}	140 ^{PL}	0	o	o	0	Projects	SWPP	Assets	SCF	
DERBY	OPS	PA	+	o	8	16	0	8	110 ^{PL}	0	90	20	20	12 ^{PL}	Projects	SWPP	Assets	SCF	
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HALLS CREEK	OPS	PA	+	o	8	0	0	90	110	0	20	50	40	0	Projects	SWPP	Assets	SCF	
HARDING DAM	OPS	PA	+	0	0	o	o	0	115 ^{PL}	0	100	1	o	0	Projects	SWPP	Assets	SCF	
KARRATHA	OPS	PA	+	0	32	0	70	0	110	110	0	5	12	0	Projects	SWPP	Assets	SCF	

Scheme Overview



SCF Asset Forecast



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SCF Asset Forecast



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Expected Benefits

- Proactive, early identification of emerging issues
- Removes arguments around data and methods of analysis.
- Ability to plan and budget for other than capital solutions (Optioneering)
- Improved justification of system risks and mitigation and/or project timing
- Reduced turn-around time of planning after removing the need for data gathering and review before commencement of planning.
- Reporting of exceptions will provide a focus on emerging risks and issues for Asset Managers based on measures rather than gut feel.
- Consistency for growth and demand management will provide the transparency, clarity and justification required for good decision making.
- We will be able to supply reports related to growth and demand in a timely manner with minimal effort and therefore support other agencies with information sharing.
- The process and tools will support planning and acquisition with timing triggers.

Overview of EverBlu and AMR/AMI

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Business Drivers

- Major OSH risk to personnel reading meters
- Add value to customers to inform them of leakage
- Cost of delivering water ~5x \$/kL than Perth
- Infrastructure upgrades in x\$10M
- Energy usage is one of the largest for Water Corp

Reading Meters Manually

The reader would stand on the back of a truck and look over the fence to read the meters

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Reading Meters Manually

Dogs inside the properties made it difficult to read over the fence and more dangerous to actually enter the property

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The Potential Cost of a Leak in Kalgoorlie

Litres per Hour	Litres per week	Litres per month	Litres per year	Weekly cost	Monthly cost	Annual cost
5	840	3,600	43,800	\$1.19	\$4.77	\$52.45
10	1,680	7,200	87,600	\$2.38	\$8.34	\$104.90
20	3,360	14,400	175,200	\$3.58	\$16.69	\$217.18
40	6,720	28,800	350,400	\$8.34	\$34.57	\$548.15
60	10,080	43,200	525,600	\$11.92	\$51.26	\$1,054
100	16,800	72,000	876,000	\$20.26	\$85.82	\$2,812
200	33,600	144,000	1,752,000	\$40.53	\$171.25	\$8,217

Residential water use - on the lowest tiers without other usage

Project Overview

- Automated meter reading (AMR) technologies were considered
- A trial to install pulse capable meters and cybles on every property (13,500 meter) in Kalgoorlie-Boulder began in 2011
- Joint funding through the federal government and Water Corp
- AMR is simply a meter reading capability, normally a walk by or drive by application
- We can identify properties which have a continuous flow and the volume of that flow
- We advise the customer of the possible leak to have it quickly repaired
- The intention is to make significant water savings by providing customers with more information, so they can better understand their water use and associated costs

Solution Overview

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Current Status

- Itron chosen as the vendor using EverBlu system
- 13,200 meters with cybles/pulse replaced since January 2011
- Primarily new meters have been installed
- 17 Access Point sites
- 450 Collectors
- Project handover due for 30 June 2012

EverBlu

- The EverBlu software is provided by Itron
- It allows us to manage the system and meter data
- We can view usage history and see where alarms were triggered i.e. constant flow
- Routes are created for walk-by reading
- It is stored on one PC in Kalgoorlie and on two virtual work stations. I.e. only 3 people can use it at once
- You must get systems access to use a virtual work station

Key Features - Performance

- Index reliability is key
 - Cyble detection is clearly the market reference for multi sensing incremental encoder technology
 - > 4 M units in field since 1996
- Battery lifetime
 - 15 years (min 98,3%) depending on working hour configuration
- Compact
 - Radio meter could be screwed in small pits / meter boundary boxes
- Reading distance
 - 1.5 km Line of sight reading distance
 - Itron radio "chip on board" design, radio link margin > 120dBm

EverBlu Software

Using EverBlu Software, operators can get graphical analysis of the meter data Alerts related to blocked meters, abnormal network usage and leakages are reported

Detecting Reticulation Use - Monthly

EverBlu Software 2.2.1.0 SE				
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Detecting Internal Leaks - Monthly

EverBlu Software 2.2.1.0 SE		- 2 3
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- 45 11-0041856 - 45 11-0047245 - 45 11-0047245 - 45 11-0812455	- Last reading Index : 619.991 m3 24h Consumption : 8.574 m3	Date : 30/04/2012
- 65 11-0812613	Last data Consumption Monthly Overview Architecture info Radio investigation	
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Alarms Types

- Tamper
- Dismount
- Collector
 Unreachable
- Reverse Flow
- Constant Flow (leaks)

Alarms – Constant Flow (Leaks)

- The alarm is created when the meter records at least 2 L/hr for every hour in a 24 hour period
- This may indicate there is a leak
- A spreadsheet is used to prioritise the leaks and send a leak letter
- There may be continual use of water at the property
- The minimum constant flow rate can be set to a higher rate i.e. where a property operates 24 hours per day

Where Constant Flow is Not a Leak

- The use of 2 L/hr does not always mean that there is a leak – particularly during summer
- Evaporative Air Conditioners:
 - Mobile unit 3 L/hr
 - Ducted 3-4 outlets 20 L/hr
 - 5-7 outlets 25 L/hr
 - 8+ 45 L/hr
- Filling a pool over a day or several days may create an alarm
- We must find the right balance to ensure that we don't advise there is a leak when the usage is legitimate, or delay when it is a leak

What Happens to the Data?

- The data will be analysed on a daily basis by the administrator
- Leak letters will be sent for all leaks and recorded in Grange – depending on set parameters
- SAP work orders will be created for Tamper and Dismount alarms to ensure reading accuracy
- Meters with zero usage will be audited to ensure that the cyble/pulse is registering usage
- The administrator will update EverBlu to ensure that it is in synch with Grange i.e. meter changes etc

System Limitations

- Cybles
 - clip on the cyble can be broken and there is no alarm for this
 - Easily damaged, i.e. by dogs, and costly to replace \$100
 - Serial number must be entered into EverBlu correctly to be part of the network
 - Pulse calibration required new to field crews
- Collectors
 - They have a reduced signal behind them when mounted on poles
 - They must be angled in the direction towards the meters with which it is communicating.
 - The range can vary from 200m to 1.2km based on obstructions i.e. buildings, fences, meter box etc

System Limitations

- Access Points
 - The maximum of 1200 meters per Access Point is limited by data quantity. More likely 800.
 - They must be secured in a box which reduces signal strength
 - They must be at a powered site with maintenance access
 - Site surveys to measure signal strength of the collectors are critical for Access Point Placement

Required Field Activities

- Due to the number of alarms both usage and system related there will be more property inspections required
- Training is required to use the software and rectify alarms
- Staff roles and tasks will change with the new technology
- Manual readings still required to validate cycle readings

Success Story

- While the system is being set up and tested 172 leak letters have been issued by the end December 2011 for leaks >30 L/hr.
- In the same period the number of standard leak letters issued was:
 - AR 76
 - GR 79
 - GS-61
 - SW-236
 - MW 274
 - NW 447
- It is expected when the system is fully operational the number of contacts will increase
- There are currently 2029 constant flow alarms activated in EverBlu >2 L/hr.

Success Story

- Detected constant flow alarm of 1.5kL per hour
 - 25 litres per minute
 - 37kL per day
- Property was unoccupied
- Contacted agent and had site inspection
- 170kL was lost due to the leak
- Leak could have wasted 3700kL until the next meter reading
- Account would have been about \$21,000

Possible Use in the Future

- Trial using Western Powers smart grid is proposed to begin later in 2012
- Meters being installed in Karratha and Port Hedland as well as other remote communities and towns
- AMR meters are likely to be installed in other places where there are access or OSH issue
- Other different types of AMI meters with the technology built inside the meter
- Data gathering will be independent of a particular manufacturer. I.e. all data will be stored in PI
- Corporate Reporting systems will be developed for processing usage and alarm data
- My Water Portal under development for customers to see their own water usage

Additional benefits

- Water Zones being established for water loss within reticulation and transfer pipelines.
- Better determine customer water use patterns on a weekly/monthly basis
- Ability to optimise the scheme storage for a given week.
- Schedule maintenance windows during months of low use


Future Smart Meter Networks







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