DATA DATA EVERYWHERE AND NOT A DIGIT DROPPED - THE WAIKATO DISTRICT COUNCIL EXPERIENCE

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ABSTRACT

This paper outlines the Waikato District Council experience in modernising the collection and management of data for operations and compliance reporting. Like it or not, data (and in particular good quality data) is driving the water industry. Data requirements are on the increase: to prove compliance, to prove performance, to plan for the future and to reduce risk. It has now got to the point where a small rural council like Waikato District Council will typically handle in excess of 30,000 points of manual data points and tens of millions of SCADA data points each year. This data comes from various different agencies and needs to be reported to numerous different stakeholders, so it is no longer acceptable to rely on human-based systems and simple spreadsheets to manage operations and compliance.

Every consent and every standard has evolving rules for analysis and a responsible operator needs to deploy a system that caters for this. Add greater sophistication in analytical methods and handling of time series data from SCADA systems, and the traditional methods for data management are becoming swamped, inefficient and ineffectual as a management tool.

When looking to the future of data management, Waikato District Council (WDC) posed the following basic questions: what data is needed, where is that data coming from, where does it need to go to, what is the quality of the data, what is the chain of custody for that data, how is that data managed, what happens to legacy data, what systems are needed for today's data and how to make provision for future data requirements? An outline of how the Waikato District Council addressed these questions and arrived at a cloud based system is mapped in this paper. A case study of a simple aerated pond-based wastewater treatment plant is presented, including operations and compliance reporting that involves SCADA data from two agencies (one internal and one external), one lab, and site personnel, complete with internal and external reporting structures.

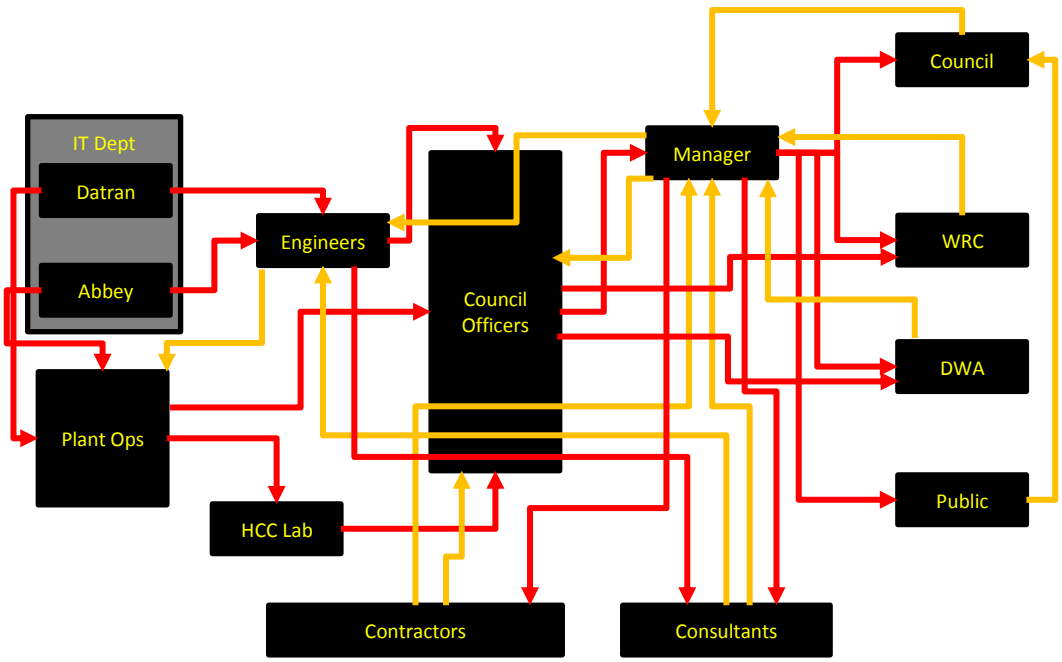
INTRODUCTION:

The operation of water and wastewater treatment facilities requires the collection of large amounts of data, and from a wide variety of sources. The typical situation in local government is for that data to be scattered across the organisation, stored according to the preferences and habits of individual staff within each team or department. The result is a high degree of uncertainty and inertia: uncertainty as to what council's data set is at any given time and where it is stored; human inertia that must be overcome any time the data needs to be collected, collated, and analysed, even for activities as routine as compliance reporting.

This status quo is a consequence of treating data management as an afterthought to the operation of physical plant and equipment, rather than a fundamental aspect of effective management. Without some degree of investment, only rudimentary tools can be used, namely paper and spreadsheets. Once upon a time, implementing more sophisticated systems would have required resources well beyond New Zealand Local Government. Technology is now sufficiently advanced that robust database management systems, web services, and mobile communications are available as commodities. This paper outlines the experience of Waikato District Council in migrating to a modern data management system in order to improve performance and reduce risk across the organisation.

BACKGROUND:

In order to establish a baseline for comparison, an assessment of the status quo was made. The focus of this assessment was 'sources' and 'sinks' of data: where did it come from, where did it go, and how did it get between the two. A greatly simplified picture can only begin to illuminate the bewildering complexity of data flows within and between WDC and its numerous stakeholders. The following diagram is what might be termed the 'data ecosystem' of Waikato District Council:



A few characteristics became immediately apparent:

- For the vast majority of stakeholders, they were reliant on another person to deliver data when it was required

- For many stakeholders, the ‘chain of custody’ of data was more than 2 links long before it reached them
- No one within the ecosystem had access to the entire data set, and therefore no one had knowledge of it nor could obtain a complete data set.

The consequences of this were severe:

- Human intervention in data handling resulted in delays in transmission of data that could be measured in minutes (best case) to days (not unusual) to never (worst case)
- Concatenating human data handling made the problem exponentially worse (‘A’ manually wrote down a number, handed it to ‘B’, who wrote a report and submitted it to ‘C’, and so on)
- Any changes to the data as it changed hands created multiple versions of ‘the truth’ that could be difficult to reconcile after the fact, if queried or challenged
- There was no overall organisational awareness of what the data actually was or what it said
- Decision-making was confounded by delays and errors in supporting data

In summary: too many valuable human resources were being dedicated to menial activities in a manner that was detrimental to the organisation. This established the need to address this problem through a change in technological and business systems. Initial estimates indicated that across the entire organisation that in the order of 2-3 FTEs were being deployed to support data management and reporting.

OBJECTIVES OF THE NEW SYSTEM:

In order to proceed with a new system, the objectives of doing so first needed to be defined. The identified objectives can be summarised as: efficiency, auditability/transparency, reliability/security and strategic fit.

Efficiency: this entailed the elimination or reduction of errors and delays resulting from human handling of the data. Data should be delivered from source to sink in the fastest and most convenient manner possible. This meant reducing the burden of data entry, eliminating links in the chain of custody of data, and reducing or eliminating the overhead of analysing and reporting on collected data.

Auditability/Transparency: these were identified as related concepts that reflect confidence in the data set. Auditability is being able to clearly state, for a given piece of data, what the data is, when it was recorded, who (or what) recorded it, and where it was recorded. Transparency refers to the same idea, but for changes in the data: what was changed, why it was changed, when it was changed, and who changed it. Storing data on spreadsheets is a very widespread practice that fails on most of these fronts.

Reliability/Security: Data flow is prone to service disruptions due to weather, earthquakes and the often overlooked routine operational issues such as maintenance and upgrades. Councils have a statutory duty to store and report on the data that they collect, and the old adage ‘failing to prepare is preparing to fail’ rings true. Data storage in a new system had to therefore incorporate geographically dispersed repositories to be isolated against individual events; multiple layers of backup, including to council itself; and respect for data sovereignty legislation that requires critical data be stored within New Zealand boundaries. At the same time, Council already employs experts to oversee internal network security, and so the solution needed to be compatible with existing requirements from the IT department, without introducing additional workload for them.

Strategic Fit: to discharge its duties as a local authority, council must exchange data and information with a number of external stakeholders including regulators, consultants, and contractors. In order to manage these relationships effectively, council needed to maintain a position of data

ownership, meaning control over where and when data flows, as well as having the most complete and accurate picture of its data. Ceding data ownership to anyone else would have put council at a disadvantage for commercial and/or legal negotiations with those external stakeholders. Therefore, council needed to adopt a system that reinforced its ownership position.

METHODOLOGY:

Achieving the outlined objectives was accomplished in phases, the first of which was the data review. Having mapped out the web of sources and sinks, and with the objective of reducing the burden of data collection, a rubric was created for categorising council's data set into three priorities:

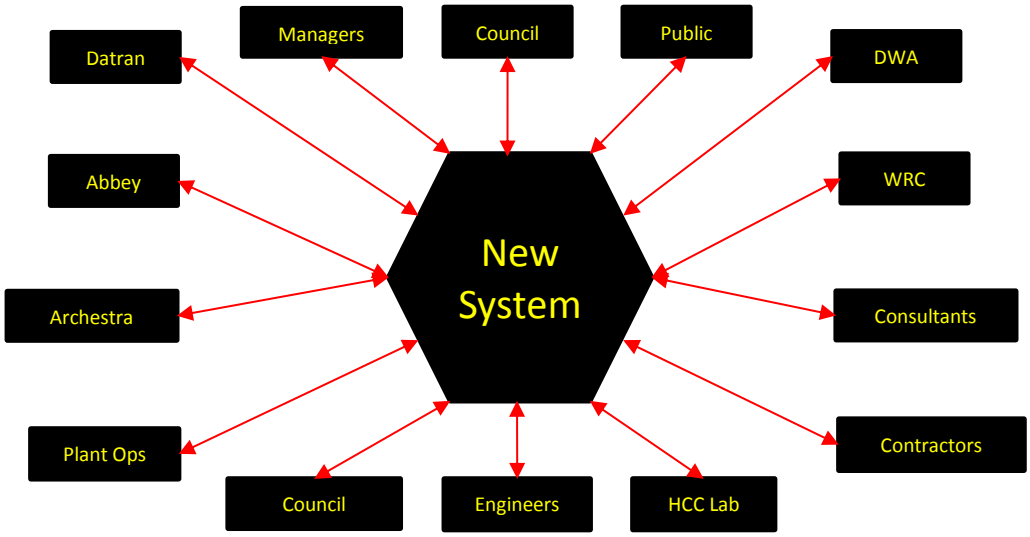
Priority 1: Compliance Data. Council has an unambiguous and statutory responsibility to record.

Priority 2: Operational Data. Used to verify that plant and processes are operating as designed, to inform planning and other decision-making, and to optimise over time.

Priority 3: IBU. 'Interesting But Useless'. This term applies to data where it isn't clear why the data is recorded, who is making use of it, or really what purpose it serves. Usually it is collected 'because it always has been' or out of some vague notion that it might be useful for something, at some point in the future.

The data review was conducted on a facility-by-facility basis, with the intent of ensuring that there were no gaps in priority 1 and priority 2 data, and substantially reducing priority 3 data collection.

Next, a re-mapping of data sources and sinks was undertaken in order to minimise the number of links in the chain of custody. The perfect arrangement is one where each stakeholder is only a single step away from the data repository:



With the modern ubiquity of internet connectivity, this arrangement was most easily satisfied by a cloud-based data system. Not only would a web-based service provide universal access, but also made it possible to achieve data quality and management objectives (transparency, accountability, security, and reliability etc).

Local government is fraught with cases of IT projects that have failed to live up to their marketed expectations, and so selection of the right supplier was a crucial element of selecting a new system. At a minimum the supplier needed to have a substantial New Zealand presence, and in particular a

demonstrated presence in the Waikato Region, due to the local emphasis on shared services and be robust enough to allow future organisational transitions.

Alignment with council's strategic objective of data ownership imposed an additional constraint on the vendor, that they must have no vested interest in the data. From a strategic standpoint, if council's capacity to freely negotiate with contractors and consultants were to be impacted by a particular supplier's pecuniary advantage in holding council data, the real cost of procuring services from that supplier becomes many times greater, as it has an impact on future work or commercial arrangements. The desired supplier needed to be a neutral custodian of the data preferably with a sole focus on provision of those services. Failure to recognise these constraints could put Council in a position of conflict of interest on future works.

RESULTS:

As a result of analysis Council has implemented a cloud based data recording and reporting system from WaterOutlook. This system streamlines the flow of information through the organisation, eliminating the overhead of data handling at every level and opens the possibility of moving to a more efficient shared services arrangements with neighbouring Councils.

Data from numerous different sources, including plant operators, SCADA systems, Lab service providers, Regional Council telemetry, and NIWA feeds into a single, central repository. Advanced reporting and data transport tools communicate information to relevant stakeholders as soon as it reaches the system, with no human intervention required.

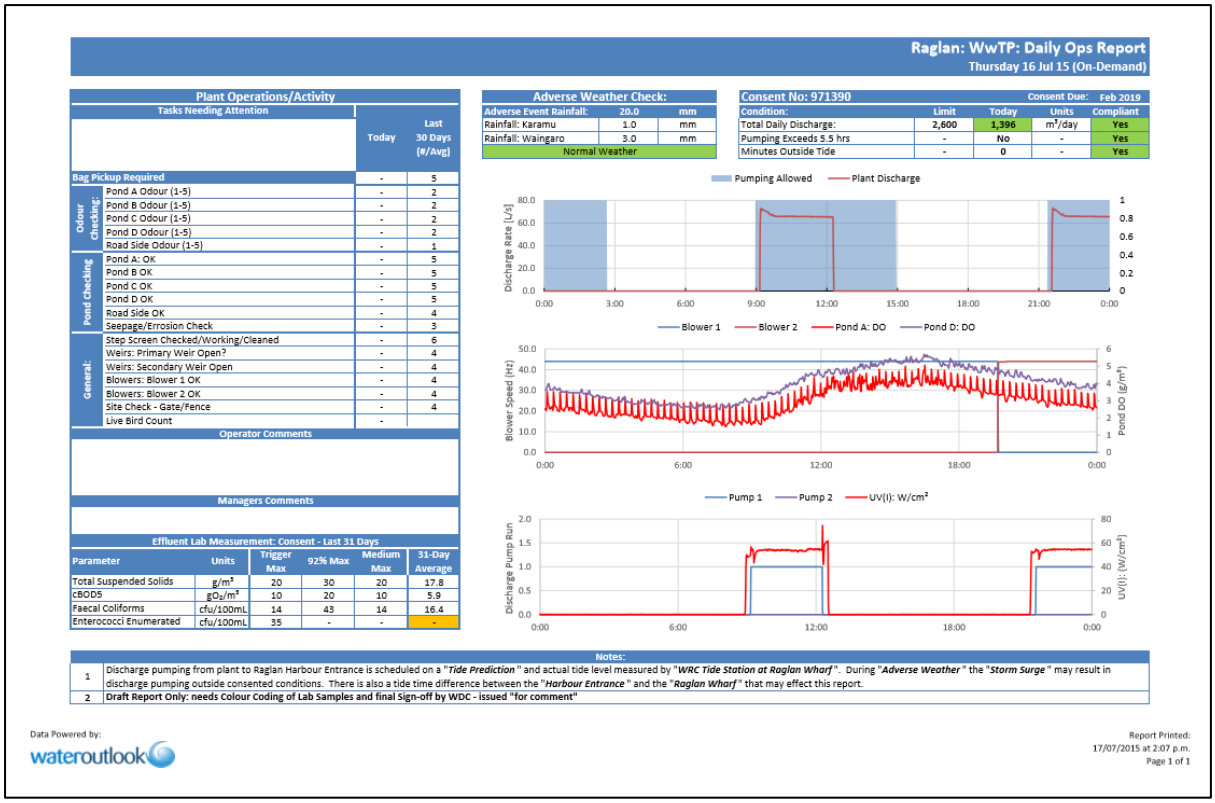
ALL stated Council objectives were met with the implementation of WaterOutlook.

CASE STUDY: RAGLAN WASTEWATER TREATMENT PLANT:

The community of Raglan sits on the west coast and faces challenges familiar in many parts of New Zealand: a small permanent ratepayer base with a large influx of beach-seeking tourists during the summer months. This places substantial pressure on Council to deliver a high level of service from its treatment facilities, given only relatively modest infrastructure to do so: the plant consists of a series of oxidation ponds, some aeration, final UV treatment, and an outfall into the harbour mouth. The discharge consent mandates that discharges only take place on an outgoing tide.

Oversight of the treatment process has been tailored to the level of the organisation reviewing the data through a series of reports. These reports are automatically generated and emailed out to the relevant staff on a fixed schedule, with no additional effort beyond data entry.

Daily: a report gives the plant operators detailed insight into plant performance from the previous day. Weather and tide data from external sources is presented along with lab results, council telemetry feeds, and a summary of operational tasks that have been recently performed.



Raglan: WwTP: Daily Ops Report
Thursday 16 Jul 15 (On-Demand)

Plant Operations/Activity

Tasks Needing Attention		Today	Last 30 Days (#/Avg)
Bag Pickup Required		-	5
Odour Checking:	Pond A Odour (1-5)	-	2
	Pond B Odour (1-5)	-	2
	Pond C Odour (1-5)	-	2
	Pond D Odour (1-5)	-	2
	Road Side Odour (1-5)	-	1
Pond Checking	Pond A: OK	-	5
	Pond B OK	-	5
	Pond C OK	-	5
	Pond D OK	-	5
	Road Side OK	-	4
	Seepage/Errosion Check	-	3
General:	Step Screen Checked/Working/Cleaned	-	6
	Weirs: Primary Weir Open?	-	4
	Weirs: Secondary Weir Open	-	4
	Blowers: Blower 1 OK	-	4
	Blowers: Blower 2 OK	-	4
	Site Check - Gate/Fence	-	4
	Live Bird Count	-	

Operator Comments

Managers Comments

Effluent Lab Measurement: Consent - Last 31 Days

Parameter	Units	Trigger Max	92% Max	Medium Max	31-Day Average
Total Suspended Solids	g/m³	20	30	20	17.8
cBOD5	gO_2/m^3	10	20	10	5.9
Faecal Coliforms	cfu/100mL	14	43	14	16.4
Enterococci Enumerated	cfu/100mL	35	-	-	-

Adverse Weather Check:

Adverse Event Rainfall:	20.0	mm
Rainfall: Karamu	1.0	mm
Rainfall: Waingaro	3.0	mm
Normal Weather		

Consent No: 971390 — Consent Due: Feb 2019

Condition:	Limit	Today	Units	Compliant
Total Daily Discharge:	2,600	1,396	m³/day	Yes
Pumping Exceeds 5.5 hrs	-	No	-	Yes
Minutes Outside Tide	-	0	-	Yes

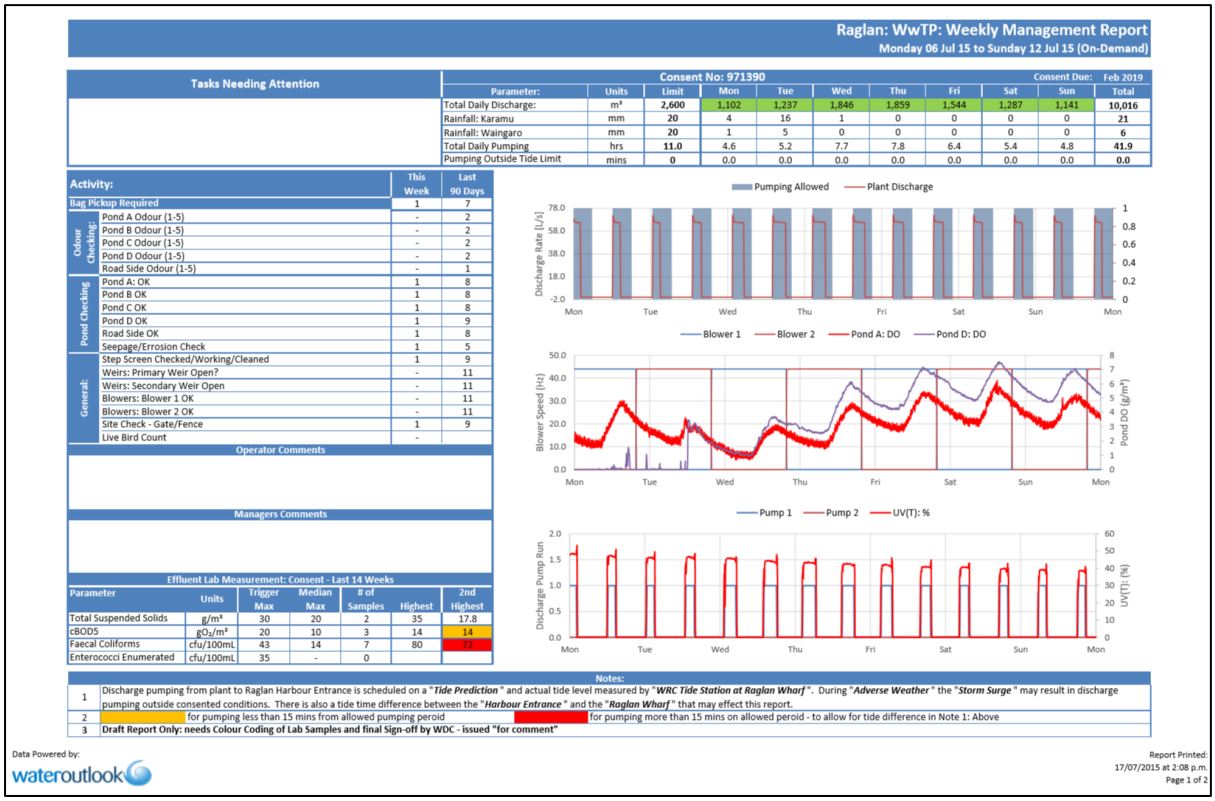
Notes:

1. Discharge pumping from plant to Raglan Harbour Entrance is scheduled on a "***Tide Prediction***" and actual tide level measured by "***WRC Tide Station at Raglan Wharf***". During "***Adverse Weather***" the "***Storm Surge***" may result in discharge pumping outside consented conditions. There is also a tide time difference between the "***Harbour Entrance***" and the "***Raglan Wharf***" that may effect this report.
2. **Draft Report Only: needs Colour Coding of Lab Samples and final Sign-off by WDC - issued "for comment"**

Data Powered by: wateroutlook

Report Printed: 17/07/2015 at 2:07 p.m. Page 1 of 1

Weekly: this view of the data is geared towards the treatment team supervisor. Much of the same data is presented as in the daily report, but with an emphasis on highlighting performance against consent conditions and any gaps in operational data. The longer time frame facilitates reviewing these reports from multiple plants without being swamped by reports.



Raglan: WwTP: Weekly Management Report
Monday 06 Jul 15 to Sunday 12 Jul 15 (On-Demand)

Tasks Needing Attention

Consent No: 971390 — Consent Due: Feb 2019

Parameter:	Units	Limit	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total
Total Daily Discharge:	m³	2,600	1,102	1,237	1,846	1,859	1,544	1,287	1,141	10,016
Rainfall: Karamu	mm	20	4	16	1	0	0	0	0	21
Rainfall: Waingaro	mm	20	1	5	0	0	0	0	0	6
Total Daily Pumping	hrs	11.0	4.6	5.2	7.7	7.8	6.4	5.4	4.8	41.9
Pumping Outside Tide Limit	mins	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Activity:		This Week	Last 90 Days
Bag Pickup Required		1	7
Odour Checking:	Pond A Odour (1-5)	-	2
	Pond B Odour (1-5)	-	2
	Pond C Odour (1-5)	-	2
	Pond D Odour (1-5)	-	2
	Road Side Odour (1-5)	-	1
Pond Checking	Pond A: OK	1	8
	Pond B OK	1	8
	Pond C OK	1	8
	Pond D OK	1	9
	Road Side OK	1	8
	Seepage/Errosion Check	1	5
General:	Step Screen Checked/Working/Cleaned	1	9
	Weirs: Primary Weir Open?	-	11
	Weirs: Secondary Weir Open	-	11
	Blowers: Blower 1 OK	-	11
	Blowers: Blower 2 OK	-	11
	Site Check - Gate/Fence	1	9
	Live Bird Count	-	

Operator Comments

Managers Comments

Effluent Lab Measurement: Consent - Last 14 Weeks

Parameter	Units	Trigger Max	Median Max	# of Samples	Highest	2nd Highest
Total Suspended Solids	g/m³	30	20	2	35	17.8
cBOD5	gO_2/m^3	20	10	3	14	14
Faecal Coliforms	cfu/100mL	43	14	7	80	72
Enterococci Enumerated	cfu/100mL	35	-	0		

Notes:

1. Discharge pumping from plant to Raglan Harbour Entrance is scheduled on a "***Tide Prediction***" and actual tide level measured by "***WRC Tide Station at Raglan Wharf***". During "***Adverse Weather***" the "***Storm Surge***" may result in discharge pumping outside consented conditions. There is also a tide time difference between the "***Harbour Entrance***" and the "***Raglan Wharf***" that may effect this report.
2. for pumping less than 15 mins from allowed pumping peroid — for pumping more than 15 mins on allowed peroid - to allow for tide difference in Note 1: Above
3. **Draft Report Only: needs Colour Coding of Lab Samples and final Sign-off by WDC - issued "for comment"**

Data Powered by: wateroutlook

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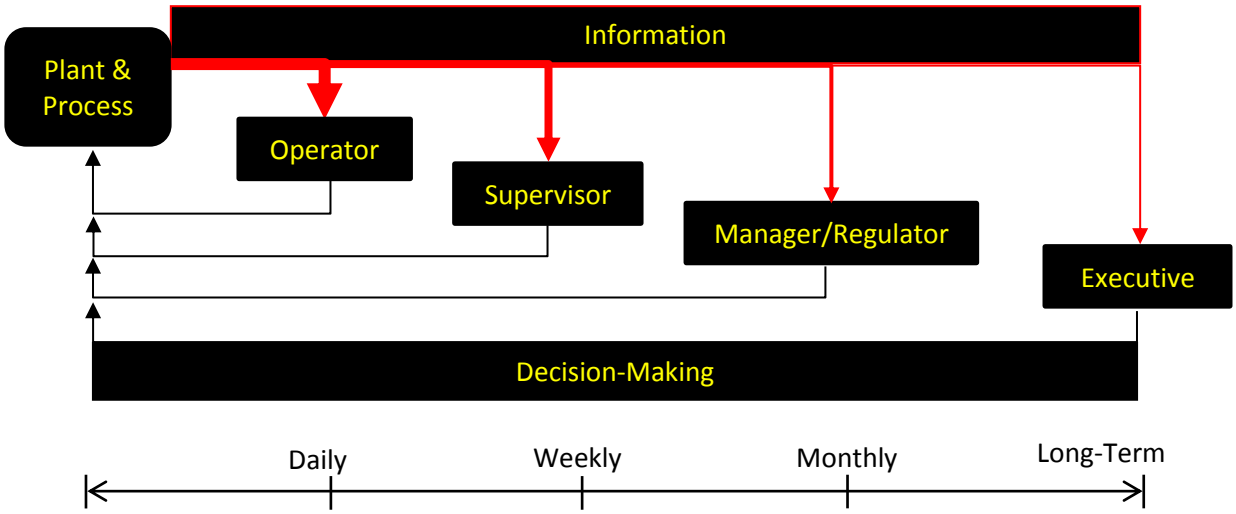
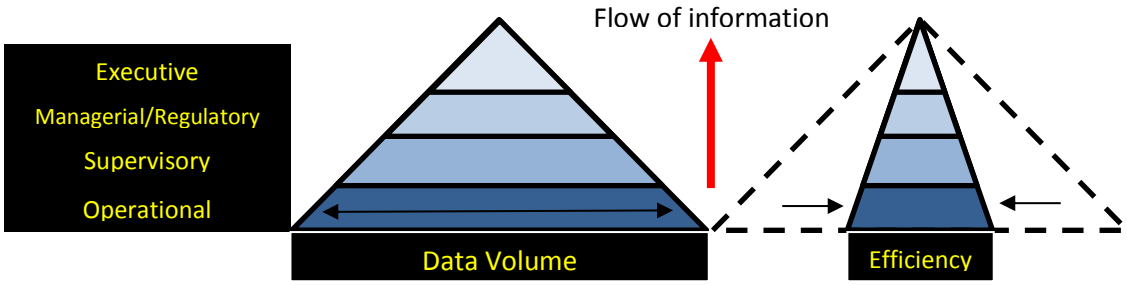
Monthly: rather than showing extensive raw data, this report presents a summary of the plant's performance against compliance conditions. The target audience is therefore managers and compliance officers from the regional council.



There is an overhead associated not only with collecting data, but also with processing it. By tailoring the reporting cycle to each level of council, each staff member receives exactly the information set that they need, as often as they need it, but no more. This aligns the frequency of information flow and depth of detail required with the level of decision-making. From the structuring of reports the following data flow efficiency metric was developed:



THE HUMAN PROJECT:

Enhanced organisational awareness can be a two-edged sword: with greater transparency into the dataset in its entirety comes greater visibility of any problems that exist. This can be politically challenging within any organisation, but it doesn't have to be. By definition it is impossible to solve a problem that you don't know exists, and so wider discovery of existing problems should be regarded as a necessary and positive first step towards resolving those issues. As a result, Council has transitioned from a state of 'unknown unknowns' to having well-defined areas of uncertainty.

The more people interact with data the easier it is to get data overload, therefore WDC are striving for a culture of "Timely Meaningful Data Delivery". This requires extensive training and awareness of the meaning of data. As a genuine commitment is required to achieve this process of continual improvement this is an entire subject in itself and for the sake of brevity is not discussed in detail here.

MACHINE-TO-MACHINE DATA EXCHANGE

One of the benefits of a cloud-based data repository is the ease with which data can be exchanged with other systems through modern data protocols. WDC has established connections with Waikato Regional Council that allow telemetered data to flow directly between each other's databases. This means WDC can build reports that incorporate rainfall and tide level data, and WRC can have water abstraction data in near-real time for hydrological modelling. This interface is compatible with the WaterML2.0 standard, and therefore ready to support enhanced data standards currently under discussion within the National Environmental Monitoring framework.

THE FUTURE

With a new baseline established for the core activities of water and wastewater operations, there is potential to extend this same discipline to other areas of council business: solid waste, stormwater, trade waste, asset management and so on.

The same machine-to-machine approach that enables data exchange between district and regional council can be used to exchange data between systems within council. The ultimate goal is to have all operational and compliance reporting within council automated and paperless. This will release WDC officers to work at higher levels of service delivery and efficiency in management of its resources.

CONCLUSION

WDC identified that the older status quo of data management practices foster risk, uncertainty, and generally impede the ability to effectively deliver water and wastewater services. Implementing a modern technological system will support Council to deliver a reduced level of uncertainty in its service delivery while at the same time increasing the effectiveness of it resources. By adopting a structured approach of defining outcomes along with a cloud based Operations and Compliance data system, Council will deliver on greater value to Waikato District ratepayers.