BUILDING TECHNOLOGY ENABLED PLANNING CAPABILITY

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ABSTRACT

As water and wastewater provider to more than 1.4 million rural and metropolitan residents within Auckland (New Zealand's largest city), Watercare's mission is to provide reliable, safe and efficient water and wastewater services, and our vision is to be trusted by our communities for exception performance every day

In 2018, Watercare commenced the agile development of digital capability across the business as part of its Strategic Transformation Programme (STP). A principle feature of the STP includes the development of the right tools, and the best processes to meet our business needs. Watercare has historically been considered data rich but lacked widely available insights. A key business goal has been to create a consolidated approach to capturing, transforming, storing, reviewing, and utilising data to deliver insights according to an agreed value framework, particularly as it relates to planning the creation of new assets to meet Auckland's growth.

The agile squad responsible for the delivery of planning functionality was humorously named 'B-wing', but much like the powerful, yet focussed abilities of the Starwars fighter, this high performing squad has applied powerful approaches to delivering some unique and scalable outcomes, in keeping with the original product vision and will provide true and dynamic insights in a rapidly changing environment.

This presentation will showcase progress as it relates to planning and modelling capability, and how we anticipate that improved data, processes and tools will improve the effectiveness of network planning in three key areas.

- "Smart Storage" allows our key internal and external datasets to be transformed and imported or replicated in a new data lake. Automated transforms have been developed, and include quality and confidence attributes to ensure the most up-to-date data is maintained in the lake. This has required complex system integration, processes and source mapping, but has resulted in improved access, visibility and analytic capability across many datasets.
- "Improved Insights" solutions developed to date include an interactive cloud geospatial tool to access and export population data by all planning staff; publishing of hydraulic model results in an online GIS viewer with custom search and visualisation functionality; access key time series data from a variety of sources linked to assets in a GIS viewer. This has necessitated a range of new automated continuous deployment and security considerations and processes, which has provided opportunities for rich cross-team collaboration and true agile development.
- "Next Generation GIS" established a connected geometric model of our water and wastewater networks using corporate GIS data. The geometric model has been built to align with the geometry and schemas of the water and wastewater hydraulic models and outcomes have been prioritised by networks where capacity constraints are most significant. To date this has significantly reduced hydraulic model build time, but the key value is being delivered by unlocking modelling

functions such as integrated hydraulic modelling and performance validation, impact assessment and tracing, and an increased range of predictive network analytics.

The future roadmap involves a consolidated "user hub" to enhance experience and collaboration functionality, improved field data capture mechanisms, validation of hydraulic models using a wider range of IOT flow and pressure sensors. System performance scenario data from more frequent model runs will be maintained for consumption by Watercare and key partners. Dashboards and federated models will enhance predictive network analytics and facilitate regional collaboration in key planning decisions.

KEYWORDS

water, wastewater, network, modelling, level of service, resilience, operations, planning, customer, collaboration, digital, analytics

PRESENTER PROFILE

Brendon is Principal Planner - Water Networks, and also assists as a Strategic Business Adviser to the B-wing digital development team. Brendon has more than 20 years' experience in water networks and engineering in the Auckland region.

1 INTRODUCTION

As water and wastewater provider to more than 1.4 million rural and metropolitan residents within Auckland (New Zealand's largest city), Watercare's mission is to provide reliable, safe and efficient water and wastewater services, and our vision is to be trusted by our communities for exceptional performance every day.

The population of Auckland is estimated to have grown at a rate of around 35,000 people per year over the past 5 years and this is placing increasing pressure on Watercare's built and digital infrastructure capacity.

Fortunately, the rapid global development of digital capability and cloud data storage solutions over past decade means that utilities can own and manage vast data resources. Watercare, like many utilities, has become increasingly rich in data, but poor in widely available insights.

In 2018, Watercare commenced an agile development programme to enhance digital capability across the business as part of its Strategic Transformation Programme (STP). A principle feature of the STP includes the development of the right tools, and the best processes to meet our business needs.

The planning and construction value stream humorously named their two squads after Starwars Rebel Alliance fighters, A-wing and B-wing, the latter focussed on planners needs and is the subject of this paper. It is worth mentioning that B-wing is innocent in name only, as Starwars fandom suggests the fighter was renowned for its powerful engine, heavy weaponry, and a gyroscopic command pod that remained level with the horizon - features that resonate with the squad's culture and performance.

A key goal for B-wing is a consolidated approach to capturing, transforming, storing, reviewing, and utilising data to deliver insights, particularly as it relates to planning the creation of new assets to meet Auckland's growth.

2 CAN PLANNING ENGINEERS BECOME AGILE?

2.1 USER-CENTRIC FOCUS

From the inception of the STP programme, Watercare took a strategic approach, placing the customer (in this case planning engineers) at the centre of the transformation rather than using a traditional ‘bottom-up’ business requirements process.

Journey maps, derived from real customer and workforce data and sentiment, were created through iterative design workshops and served as a useful guide as the delivery programme unfolded.

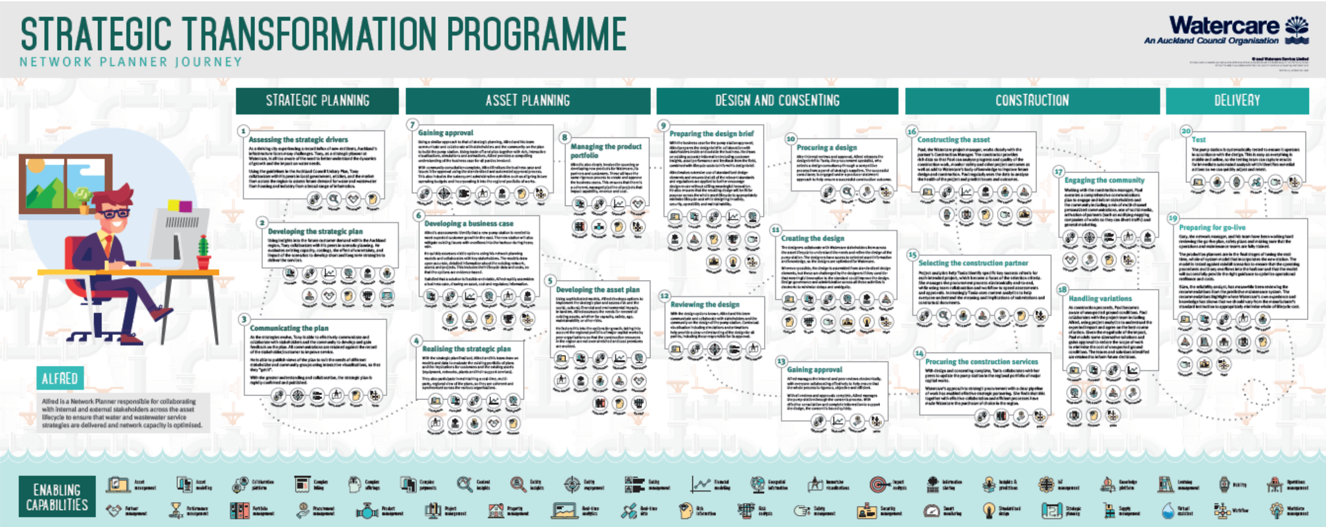

Figure 1 – Watercare STP Network Planner Journey Map.

2.2 AGILE DELIVERY

The development and release of ‘minimal viable product’ has been delivered by a squad of planners as ‘subject matter experts’, combined with highly skilled digital developers using an agile methodology. Contrary to the idea suggesting ‘agile’ involves a more relaxed approach, it is our experience that agile methodology results in high velocity toward outcomes through more intensive planning and preparation, more regular planning meetings, and greater clarity around user story grooming (definitions of feature), and acceptance criteria for completed work. Agility has also been enabled through well-coordinated squad scrum meetings, sponsor reviews, and regular re-assessment of product value.

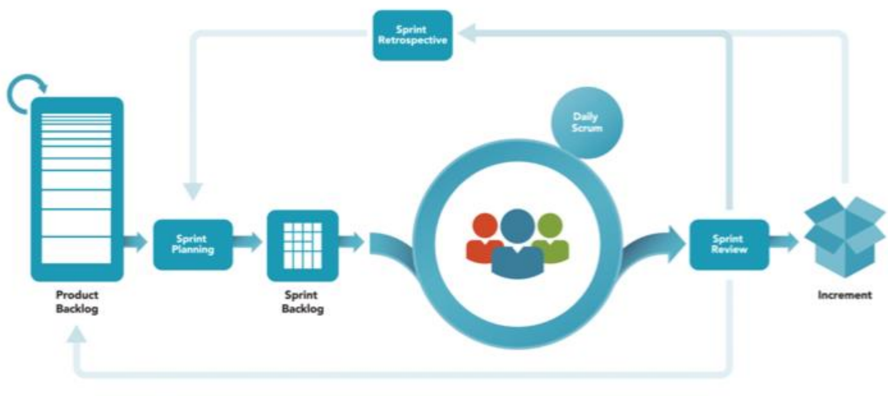

Figure 2 – Scrum (Agile) ceremonies in an effective squad environment (Source: Scrum.org)

2.3 VALUE FRAMEWORK

A key principle of the programme has been to ensure value is clearly targeted through a suitable benefit lens – involving analysis, tracking and re-evaluation. In a ‘minimum viable product’ environment, this translates into what Almquist et. al. describe as ‘functional’ elements.

For B-wing, direct benefits are primarily focussed on reducing and deferring the need for new fixed capital (asset) costs, reducing third party spend, optimizing the use of existing assets, and reducing operating cost. Indirect benefits were strategic (the ability to shape regional activity and improve responsiveness to change), and informed decision making such as improving forecasting accuracy / foresight.

2.4 IMPACT MAPPING

The value approach enforced a discipline of regular re-evaluation to ensure we knew we would deliver value, and considering any changes since the original value proposition. This discipline caused us to re-engage in an impact mapping exercise after 6 months of development, engaging a wide representation from the planning community. This strategic approach involved mapping actors, behaviours, and deliverables required to achieve the value goals.

It was agreed that planners should be capable of:

- Accessing insights without technical assistance
- Maximising peer collaboration opportunities
- Analysing and interpreting drivers of change
- Integrating structured and unstructured data
- Developing and assessing past, current, future models and scenarios
- Streamlining workflows
- Visualising strategic plans

Figure 3 – Impact mapping with network planning staff.

3 PRODUCT DELIVERY

The specific domains and corresponding skillsets within the squad have varied over the past 18 months as we have focused on portions of the overall product, but as a planning community we have maintained a product vision that integrates various forms of data and system insights, and collaboration within a geospatial framework.

Figure 4 – Integrated planning product vision: synchronization of data and systems; dashboards providing geospatial, network, and temporal representations; collaboration functionality.

3.1 SMART STORAGE

Much of the squad focus during early 2018 involved integrating and automating data (primarily temporal) from a mix of onsite structured storage servers, cloud services, and external sources.

Figure 5 – Rainfall dashboard developed to facilitate drill-down access to (automated) external data

The squad leveraged heavily from Watercare's newly formed Datahub, whose role is to connect to, automate, transform, cleanse and prepare data for consumption through various dashboards and interfaces that digital teams develop – a wider remit than B-wing. While the maturity of B-wing and Datahub has continued to develop, this early work was crucial as it became a pilot for a new corporate standard for data integration, frameworks for managing quality and confidence, and formed the basis for decisions on architecture, which have enabled significantly more capability to date.

A corporate data-lake was then established, and data from all sources and various storage systems is now replicated in this data-lake. Although this has required complex system integration, processes and mapping, this infrastructure has resulted in improved access, visibility and analytic capability across many datasets – both internal and external.

3.2 IMPROVED INSIGHTS

3.2.1 INSIGHTS LIBRARY

The STP team introduced a cloud 'wiki' tool as a platform for the collaborative development and editing of requirements, documentation and other material, and it quickly became evident that this platform had capability as a knowledge base for the planning community.

This discussion turned into a set of requirements for what became the Insights Library, a space for the development and posting of data sets, analysis and dashboard widgets. The objectives / functions / features included:

- Sharing / collaboration and permissioning
- Smart search capability
- Links to data confidence framework
- Source / contact (links to process maps)
- Links to data quality dashboard
- Lineage of modeling / transforms (link to process map)
- Versioning / date / status (draft vs corporate publish)
- Ability to follow / like content

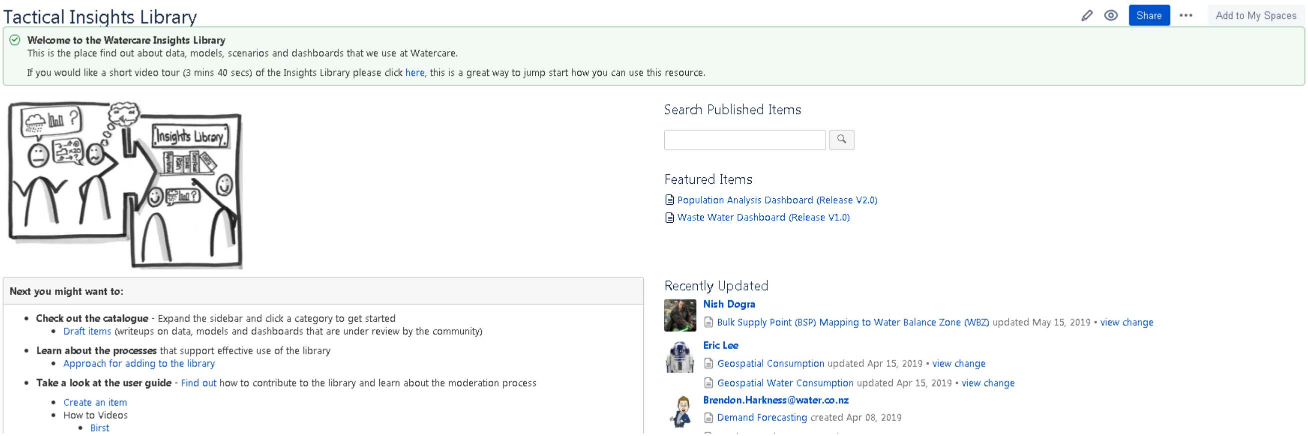

Figure 6 – Watercare Insights Library.

3.2.2 REGIONAL DEMAND MODELLING

Future network and production planning requires an understanding of levels of certainty in population data to inform decision making and improve forecasting accuracy / foresight. Watercare has historically utilised the Statistics New Zealand projections, provided as a regional LTP forecast by Auckland Council (in large ART zones). However, as the current projections are based on the 2013 national census, the granularity of the current population baseline and future projections required validation.

B-wing had committed to providing tools for querying and exporting population data to the business, but also to develop a more comprehensive model for distributing the current population. The resulting model involved complex data manipulation, based on an array of internal and external data sources as outlined below.

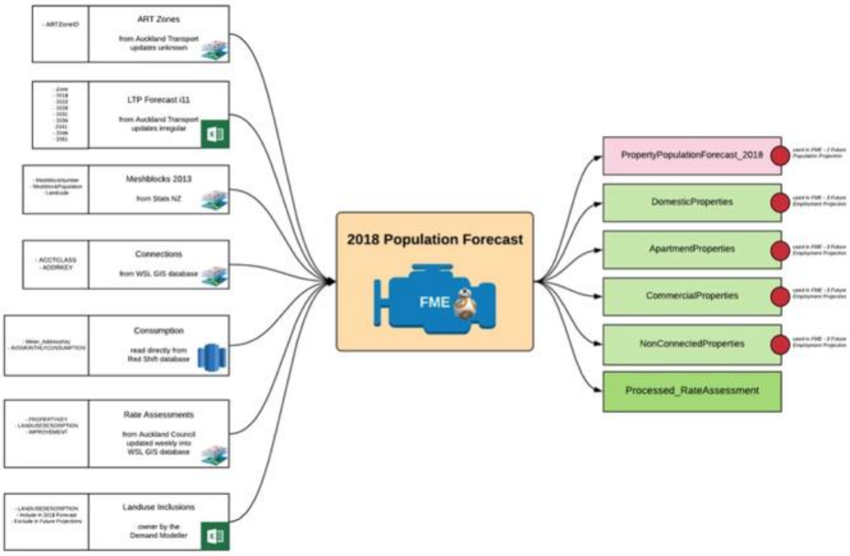

Figure 7 – Future population model inputs and outputs.

The outcomes provided immediate improvements. An example is outlined in Figure 8 below, where the use of additional external data generated significantly higher population density in the central business district.

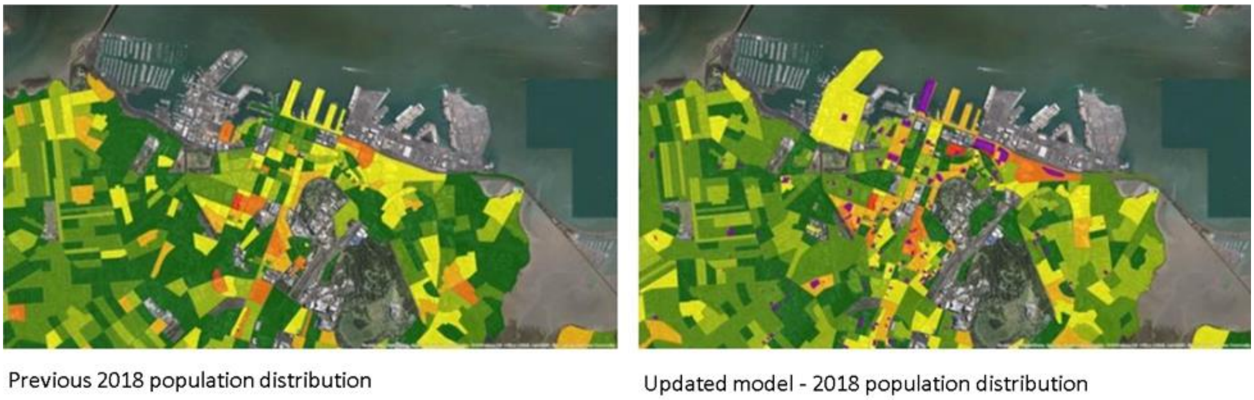

Figure 8 – Previous and updated current population modeling.

3.2.3 PUBLISHING GEOSPATIAL / NETWORK INSIGHTS

Through the iterative development process, B-Wing focussed first on organising and validating Watercare's key data sets, which then helped to inform the insights that were created. As development continued, it was clear that the user experience had to be at the heart of delivering insights back into the business. Making insights available, without a user experience that supports adequate adoption and trust within the user communities, would mean that the value of the project would not be achieved.

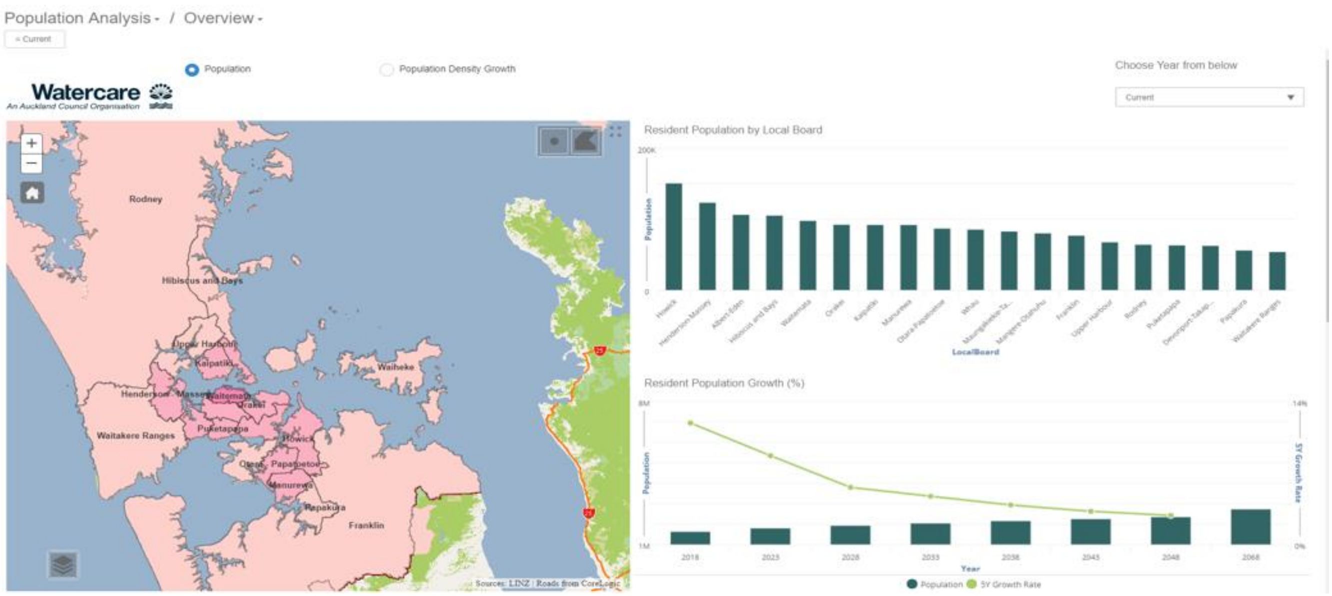

Figure 9 – Early user experience for interfacing with GIS insights presented some challenges

The shift in focus to user experience led to a single insights platform, based solidly in an ESRI based GIS solution. B-Wing focussed on ways in which they could enhance the GIS platform to streamline the user experience while consuming the additional insights. Ultimately, a full-stack architecture was selected, which would allow for fully customisable front-end visualisations and an enhanced experience for our users.

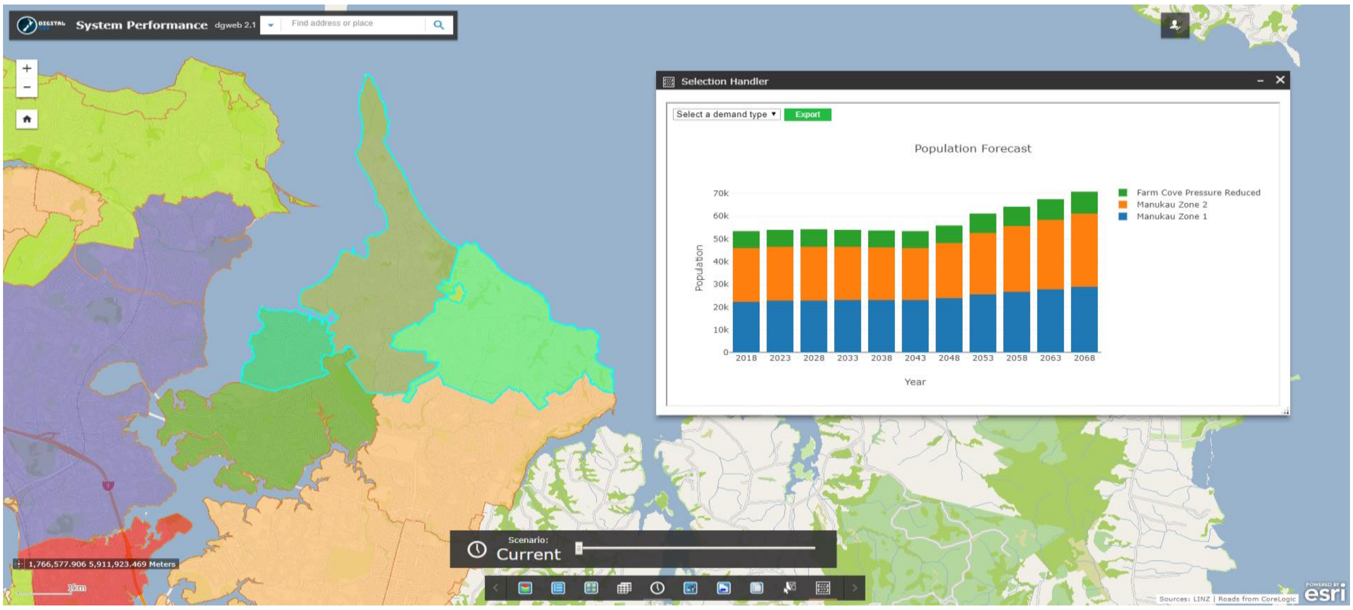

Figure 10 – Updated UI allows for a more streamlined user experience with key corporate datasets in a single interface.

To create this user experience, we developed a microservices architecture which would allow us to retrieve relevant data sets directly from our data-lake and bring them back securely to a presentation layer within GIS. This includes the storing of our key data-sets such as population, consumption and supply mapped geospatially within the lake. This mapping occurs using automated back-end geospatial queries, which means that the insights are kept up-to-date and relevant to the changing landscape. The microservices have also been designed so they are reusable by other tools within the business which may need to retrieve the same insights into other interfaces.

The platform currently hosts geospatial representation of our hydraulic water and waste water models, population projections, historical consumption and supply. We have also enabled access to our key system performance time-series data, with a geospatial interface to query the performance of our assets.

With relevant datasets, insights and an interface selected, we needed to consider how we could provide access to our tools beyond Watercare. Many of our planning partners and consultants require the same or similar data and insights to inform their work. We realised that our current on-premises GIS architecture would not support the growing need to be able to share and collaborate across our partners and peers. This has led to us exploring hosting our GIS platform in the cloud, which could enable multiple security approaches to providing access to our key partners and peers.

We are looking to carry on developing our interface and utilising our Watercare's new UX / UI team to help analyse how user adoption can further be enhanced and how we can ensure we are maximising value from our platform.

Figure 11 – Clickable wire-frames help test user interface concepts with users without having to invest in costly development changes

3.2.4 DEPLOYMENT

To ensure enhancements and future use-cases can be developed and released efficiently, we invested in developing a fully automated deployment pipeline. This means we can deploy securely across deployment environments with a 'single click' approach. The process is secure and repeatable, reducing deployment overheads and ensuring our resources can focus on adding additional value into the business.

We have integrated our front-end and back-end code bases, as well as our testing automation. This ensures the full stack can be deployed, with all user authentication and security keys merged dynamically through terraform into our builds, without any sensitive information hard-coded.

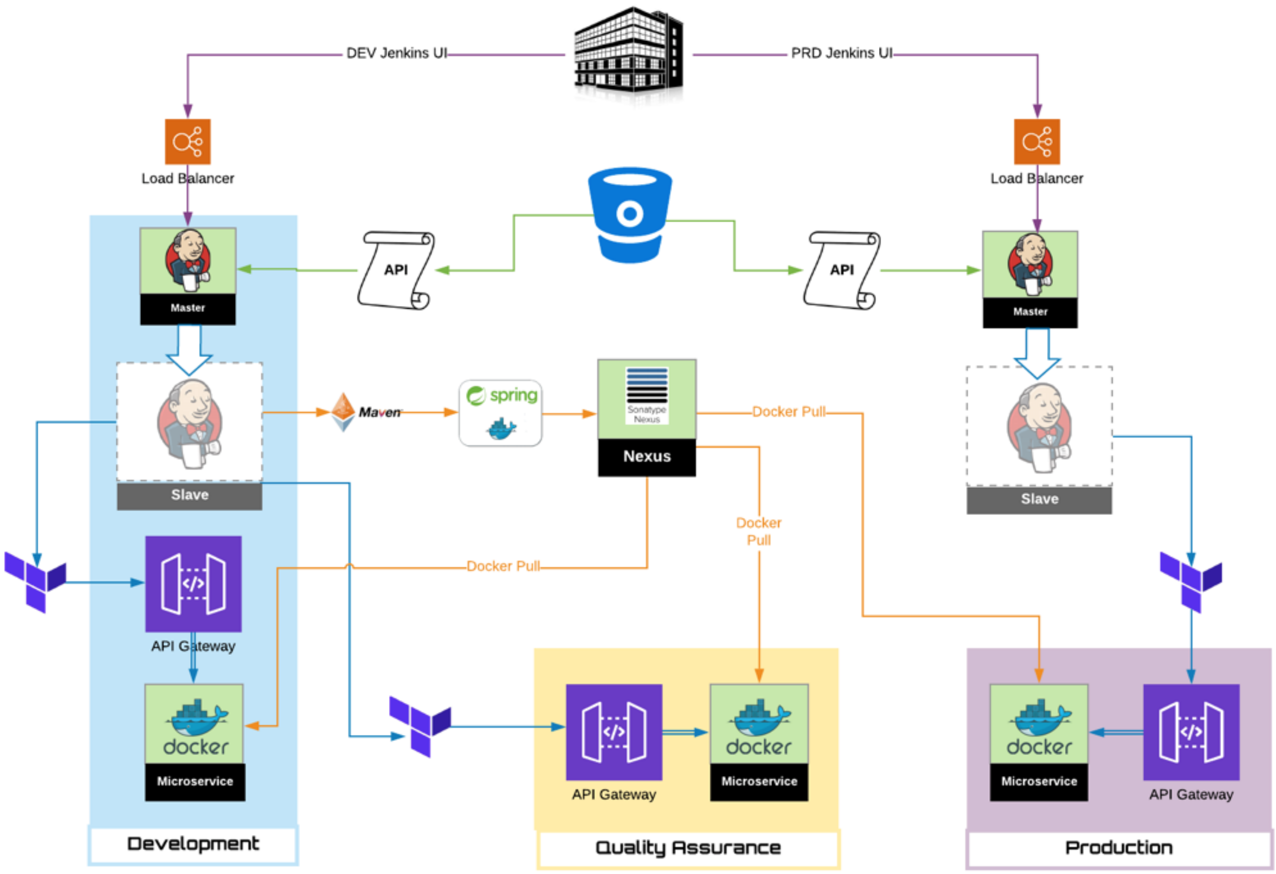

Figure 12 – Our CI/CD pipeline architecture for Dev, QA and Production environments

3.3 NEXT GENERATION GIS

To extract maximum value from our network analytics capability, Watercare embarked on a quest to cleanse GIS asset data and create a geometric network to align with the geometry and schemas of water and wastewater hydraulic models. Initially a proof of concept was developed to validate the proposed cleansing process, and the desired network and isolation tracing functionality. Following the success of this POC, an additional agile squad was established and resourced to manage a region-wide approach.

Figure 13 – Geometric network proof of concept indicating successful upstream network tracing.

This step change in data integrity enables short term benefits, including a consolidated view of asset performance and reduced hydraulic model build cost, but the key value is being delivered by unlocking modelling functions such as stakeholder impact assessments, hydraulic long sections, boundary isolation, upstream and downstream network tracing, and ultimately, continuous validation of our models.

4 THE FUTURE OF PLANNING

4.1 WAYS OF WORKING

Watercare's planning engineers have embraced elements of the Agile methodology in workload planning, solution design, prioritising work packages with other business units. Although the level of associated planning and meetings can be higher, the team has experienced an uplift in collaborative culture and programme visibility.

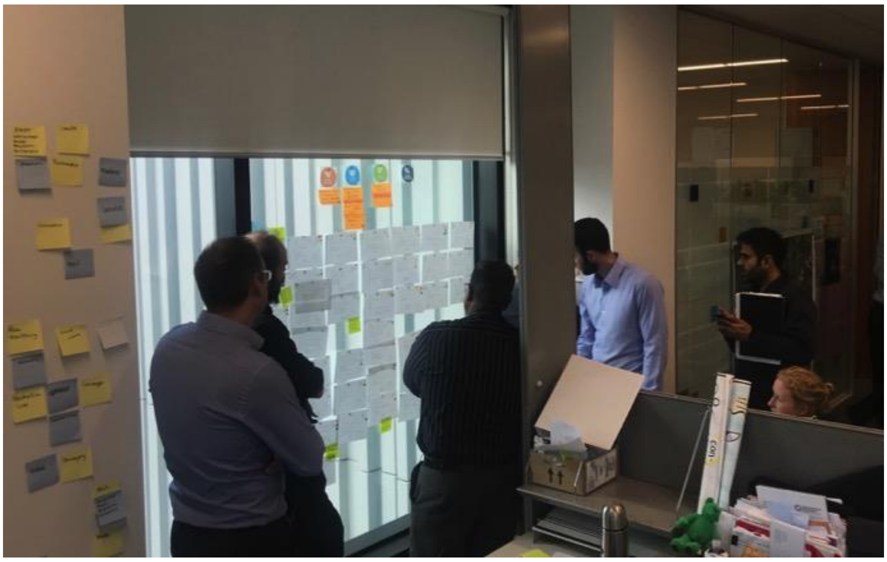

Figure 14 – Planning and operations staff discussing and prioritizing projects.

The cloud-based Insights Library capability has also been extended as a useful platform for the collaborative development of strategy documents, procurement, and team meetings.

4.2 FUTURE PRODUCT ROADMAP

B-wing continues to deliver incremental releases at high velocity, and although the current squad will be down-scaled toward the end of 2019, Watercare’s digital delivery model will develop a number of features on the backlog.

These include:

- A consolidated ‘user hub’ including synchronization of documents and workflow. This will enhance experience and regional collaboration functionality.
- Innovative field data capture mechanisms.
- Validation of hydraulic models using a wider range of IOT network sensors.
- A broader range of system performance scenario data, extended to both Watercare and key partners.
- Dashboards and federated models to enhance predictive network analytics
- Development of demand models in order to assist with shaping regional activity and improving responsiveness to change.

5 CONCLUSION

Watercare has historically been rich in data, but poor in widely available insights, however through the delivery of innovative planning capability by B-wing – alongside people and process change – significant direct and indirect value is being unlocked.

Much like the fictitious B-wing fighter, a squad comprised of specialist developers, subject matter experts and support crew has applied powerful approaches to delivering unique and saleable outcomes and developed a product which is in keeping with the original product vision that will provide true and robust insights in a rapidly changing environment.

The adoption of agile methodology for digital delivery, although requiring more intensive planning, has improved transparency, collaboration, and has been adopted by many in the wider business, including the planning community.

The integration and automation of data into the data-lake has necessitated data quality and confidence frameworks and has improved access, visibility and analytic capability across Watercare’s rich data resources.

The development of advanced geospatial models and toolsets has provided better insight into system performance and capacity and is likely to assist Watercare and our key partners in reducing capital and operating costs, assisting to optimize the use of existing assets.

The automation of our continuous integration / continuous deployment pipelines has ensured that further enhancements can continue to be made to the platforms and tools created. Allowing our planning tools to be more agile in pivoting to the changing needs of the planning community.

We believe the development of a geometric network of our water and wastewater networks will unlock future opportunities, including integrated hydraulic modelling and performance validation, impact assessment and tracing, and an increased range of predictive network analytics.

ACKNOWLEDGEMENTS

Ross Millen, Paul De Quaasteniet, Mike Dunstone, Watercare B-wing squad

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