AUCKLAND REGIONWIDE FLOOD MODELLING

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ABSTRACT (500 WORDS MAXIMUM)

With Auckland facing increased growth pressures, it is paramount for Council to have up-to-date flood data for land use planning and development controls. Auckland pressingly needs a high confidence model of flood risk, which can be built in a relatively short timeframe and is capable of running different growth and climate change scenarios consistently. With more recent LiDAR and other new base data available, the regionwide flood modelling was initiated with the aim to provide consistent flood information across the entire Auckland region.

Due to the substantial project scale and different technical challenges, separate models were required to be built for the rural and urban portions of the region. Both models are predominantly 2D and in comparison, the rural model represents close to a rapid flood approach, while the urban model represents framework modelling including trunk drainage systems. Each modelling exercise was split into two stages, with the first stage focusing on piloting and defining modelling methodology, and the second stage refining the model and producing flood risk data.

To meet the project objectives and achieve key outcomes required, innovation was critical at every aspect of the project. New modelling methodology has been developed and applied with a view into the future for potential further use of the model. QAQC and "ground truthing" is of great importance for the acceptance of the model outputs. The paper will dial into the details of key project challenges and how they were worked through for a successful delivery.

Data publication and sharing is also a key component for this modelling work. During the course of the project, a substantial volume of interim and final data was generated. To facilitate better data utilisation and to maximise project value, a new data sharing platform has been implemented which allowed practitioners to interrogate model output data timely and efficiently without having to sought for specialist input.

The regionwide flood modelling is one of its kind and is expected to be the best flood risk tool for strategic planning of Auckland on a regional scale. It updates the floodplain mapping for the entire region and provides valuable data for error checks and complements the detailed catchment models. At this stage the rural model is completed, and the project is near completion for piloting the urban model. The entire project is planned to be finalised in approximately two years.

KEYWORDS

Flood data, data management, flood modelling, hydraulic modelling, strategic planning, catchment planning, stormwater management

PRESENTER PROFILE

Cheryl is the Principal Hydraulic Modelling Delivery at Healthy Waters. She is responsible for managing the Auckland Council hydraulic modelling programme for stormwater management purposes. With nearly 20 years of experience as a modeller, Cheryl is passionate about improving data management and enhancing hydraulic modelling by knowledge sharing and process improvements.

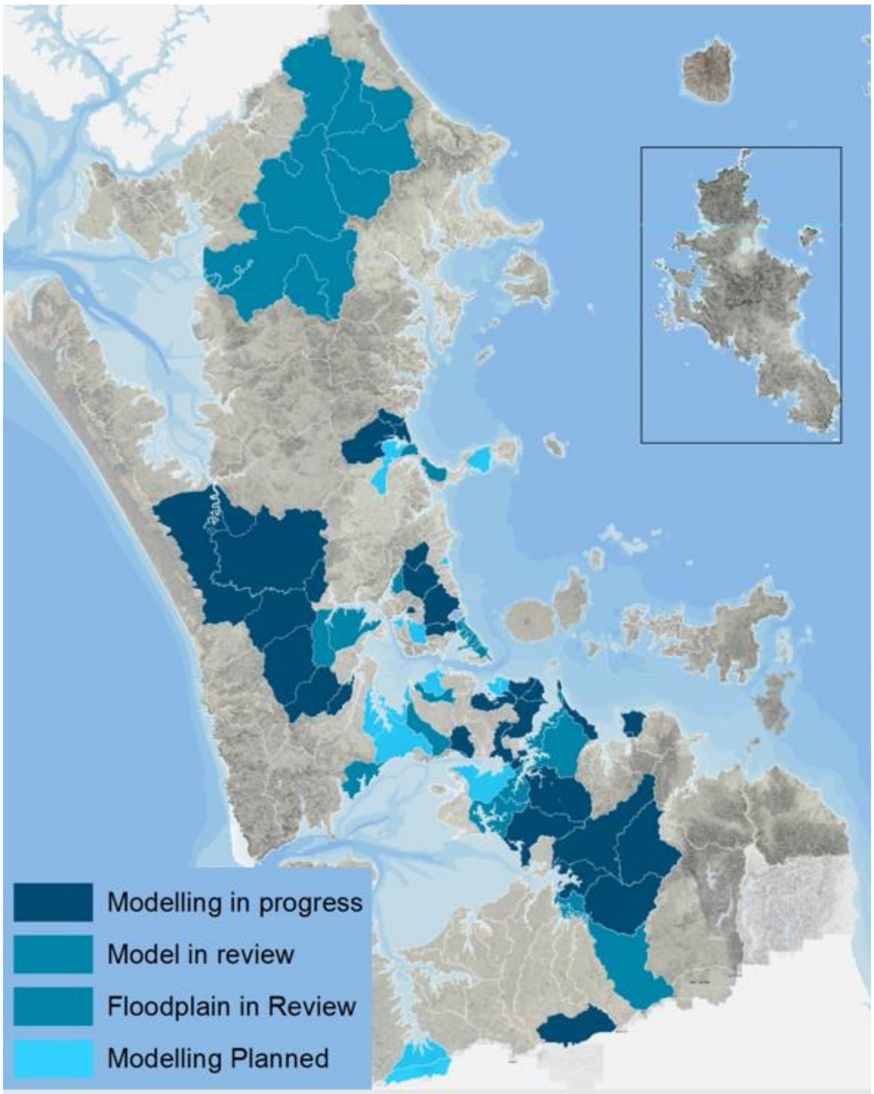
1 THE NEED OF A REGIONWIDE MODEL

1.1 THE CURRENT MODELLING PROGRAMME

Hydrologic and hydraulic modelling has been implemented in Auckland for decades, leading to a significant amount of flood data, which has provided eminent value in policy planning, stormwater management as well as development and design. To enable best value achieved in modelling, Auckland Council has an ongoing rotative modelling programme that aims to continuously improve data quality and keep flood data current.

Currently, Auckland Council's models are mostly built at catchment scale. Detailed models built at this scale can be applied to achieve multiple objectives from supporting policy planning, to development controls and catchment management, as well as localised infrastructure designs. However, modelling is a very complex and specialised activity, which requires highly skilled professionals and can take months to years to complete. Typically, from planning to completion, a full catchment model build project cycle can take any time between two and five years. The entire project cycle includes model schematisation, asset and topographical surveys, detailed model build, flood data generation and floodplain mapping, as well as system performance and flood risk assessments. Figure 1 shows an example snapshot of some previous on-going catchment modelling projects in Auckland.

Figure 1: Example snapshot of on-going catchment modelling



Keeping models up-to-date and meeting the latest modelling specifications can be challenging due to factors such as priority changes, resource constraints, and technical complexities. Auckland Council has identified significant gaps in its model data inventory, mostly related to currency, consistency, and accuracy. With rapid development changes and technological advancements, existing models and flood data can quickly become outdated, necessitating new model runs.

The Council's modelling programme is typically planned for three years and prioritised annually. However, due to resource constraints, modelling efforts are often focused on areas experiencing more changes, leaving some models becoming very out-dated. It is common for neighbouring catchments to have models that were built years apart, using different input data, inconsistent modelling methodology, and various modelling software versions.

1.2 THE CURRENT CHALLENGES

As the models are built on catchment scale, flood data such as floodplains are also generated at catchment scale. The 100-year Average Recurrence Interval (ARI) scenario is typically used for mapping floodplains, and the resulting data is published as a compiled regional layer on Auckland Council's GeoMaps. Despite being based on the best available model outputs for each catchment, the regional floodplain layer lacks consistency on a larger scale due to several factors, including:

- Climate change assumptions
- Land use planning horizon
- Boundary conditions
- LiDAR data availability
- Model software and versions
- Modelling methodology

The challenges presented by inconsistencies in the floodplains generated at the catchment scale also extend to other model outputs such as system performance data, flood flow, depth, and hazard data. These outputs are also typically generated on a catchment scale, creating difficulties when conducting regional-scale data analysis. As a result, the use of individual catchment models for data analysis, followed by upscaling or compilation, can be time-consuming and may result in errors. Some examples of regional-level data interrogation objectives that require integrated analysis include:

- Evaluating the impact of regional-scale land use changes on flooding
- Identifying high-risk flood zones that cross catchment boundaries
- Assessing the effectiveness of regional-scale flood mitigation strategies
- Understanding the impact of climate change on regional-scale flood risk.

To address these challenges, it is essential to improve consistency in model outputs at the regional scale, enabling more efficient and accurate regional-scale data analysis. To better support strategic planning, Auckland pressingly needs a high confidence model of flood risk, which can be built in a relatively short timeframe and is capable of running different growth and climate change scenarios consistently.

2 PROJECT PLANNING

With more recent LiDAR and other new base data available, the regionwide flood modelling project was initiated with the aim to better support strategic planning and to provide consistent flood information across the entire Auckland region.

2.1 THE MODEL SCHEMA

Due to the substantial project scale and different technical challenges, separate models were required to be built for the rural and urban portions of the region with different schematics. For rural Auckland, flood risks are predominantly associated with river systems with minimal pipe network. Modelling of the rural areas therefore needed to focus on representing the main river systems and topographical features. With newer high accuracy LiDAR data, a 2D schema was determined for modelling the rural area as well as it’s stream systems. This 2D approach is considered more advantageous compared to 1D as it is easier for data post processing and floodplain mapping, which is a key project objective as the rural floodplains are largely outdated.

In contrast to rural areas, many rounds of detailed modelling were carried out overtime for most urban Auckland. The published floodplains are also up to date for most urban areas. Mapping floodplains therefore is not the key objective for urban modelling. Instead, the urban model needs to be capable of predicting flood risks relatively accurately resembling catchment models, but superior from a model stability and data consistency perspective. The model also needs to be schematised for easy post processing and data publication. The urban model therefore is required to include the trunk pipe network as 1D component, with all overland flow paths and urban streams modelled in 2D.

Both models are predominantly 2D. In comparison, the rural model represents close to a rapid flood approach, while the urban model represents framework modelling that includes primary drainage systems.

2.2 STAGING

Both regional models are implemented in two stages, with the first stage focusing on piloting to understand project constraints and to refine methodology, and the second stage on bulk producing model and flood data.

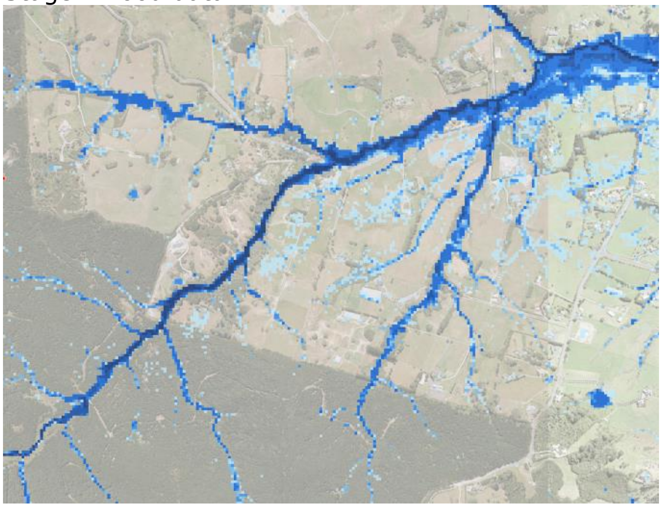
For the rural rapid model, stage 1 pilot testing was carried out for the entire rural extent, with large grids and minimal details included for both hydrological and hydraulic model components. This was because flood data in the rural areas are largely out-dated or even missing, and a sound preliminary understanding of the flood extent is critical for mapping floodplain and producing data rich GIS layers, especially at such a substantial scale. This approach has proven to be effective in two ways:

1) stage 1 model results filled significant rural data gaps and provided useful flood information in a very short timeframe, and
2) stage 1 learnings and data outputs prepared a solid foundation for stage 2 modelling and data production.

Figure 2 shows a comparison between stage 1 and stage 2 modelled outputs, and Figure 3 shows a comparison between previously published floodplain and the updated floodplain generated from the rural rapid model.

Figure 2: Flood data comparison between Stage 1 and Stage 2

Stage 1 flood data



Stage 2 flood data

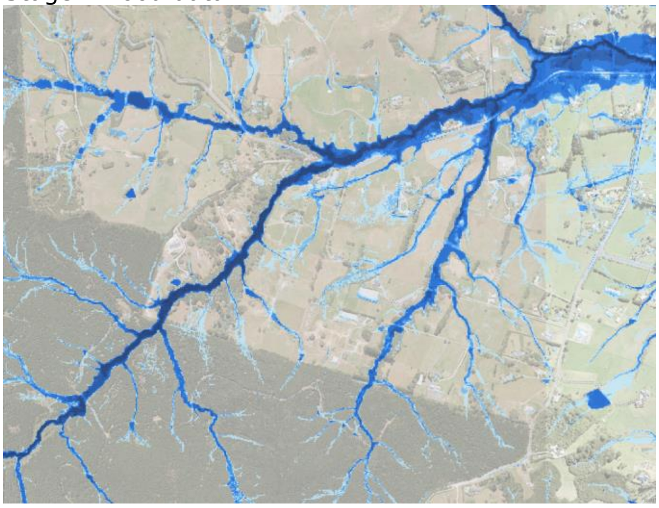


Figure 3: Floodplain comparison before and after the regional modelling

Previously published floodplain

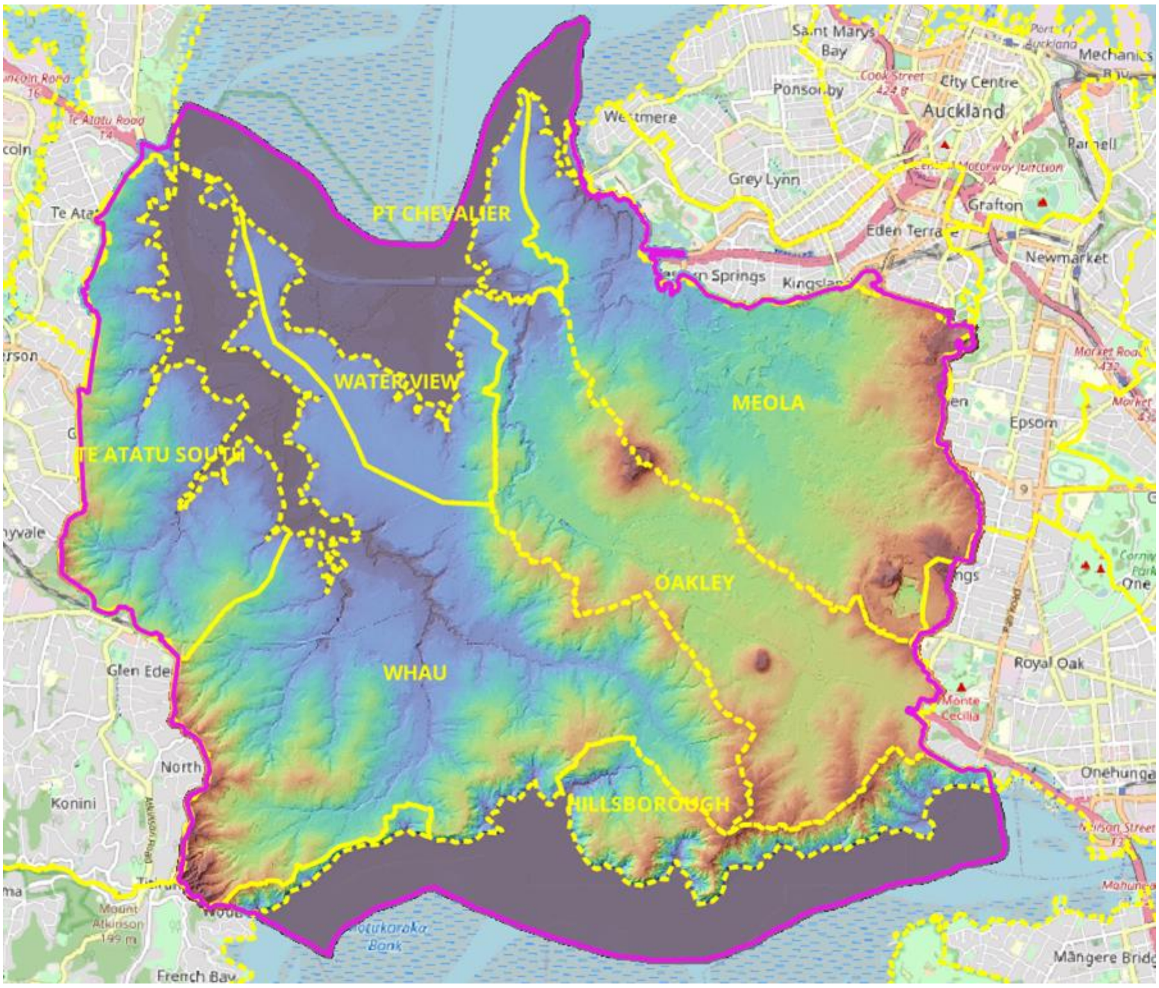
New floodplain to be published

For urban Auckland, there was no urgent need to fill flood data gaps locally, and due to network complexity it was difficult to estimate the required modelling effort without thoroughly defining a detailed modelling methodology. It was therefore decided that stage 1 pilot of the urban framework model should be carried out for a catchment area that represents typical Auckland urban environment at a size that is suitable for rigorous hardware testing.

The stage 1 pilot area includes several individual stormwater catchments, which covers approximately 70km^2 of land area (Figure 4). The pilot area displays a wide range of topographical and catchment characteristics, such as:

- Both steep terrain and flat low-lying areas with different soil types.
- Varied land use types, such as populated urban and suburban areas, industrial and commercial areas, as well as green spaces and estuaries.
- Different types of pipe network, including stormwater pipe network, combined sewer network, and soakage systems.

Figure 4: Urban framework model - pilot unit coverage



At the time when this paper was written, the urban pilot model was built and ready for validation. It is anticipated that stage 1 urban modelling will be completed in the next two months, before the rest of the units are rolled out for bulk data processing and modelling.

2.3 THE SCALE

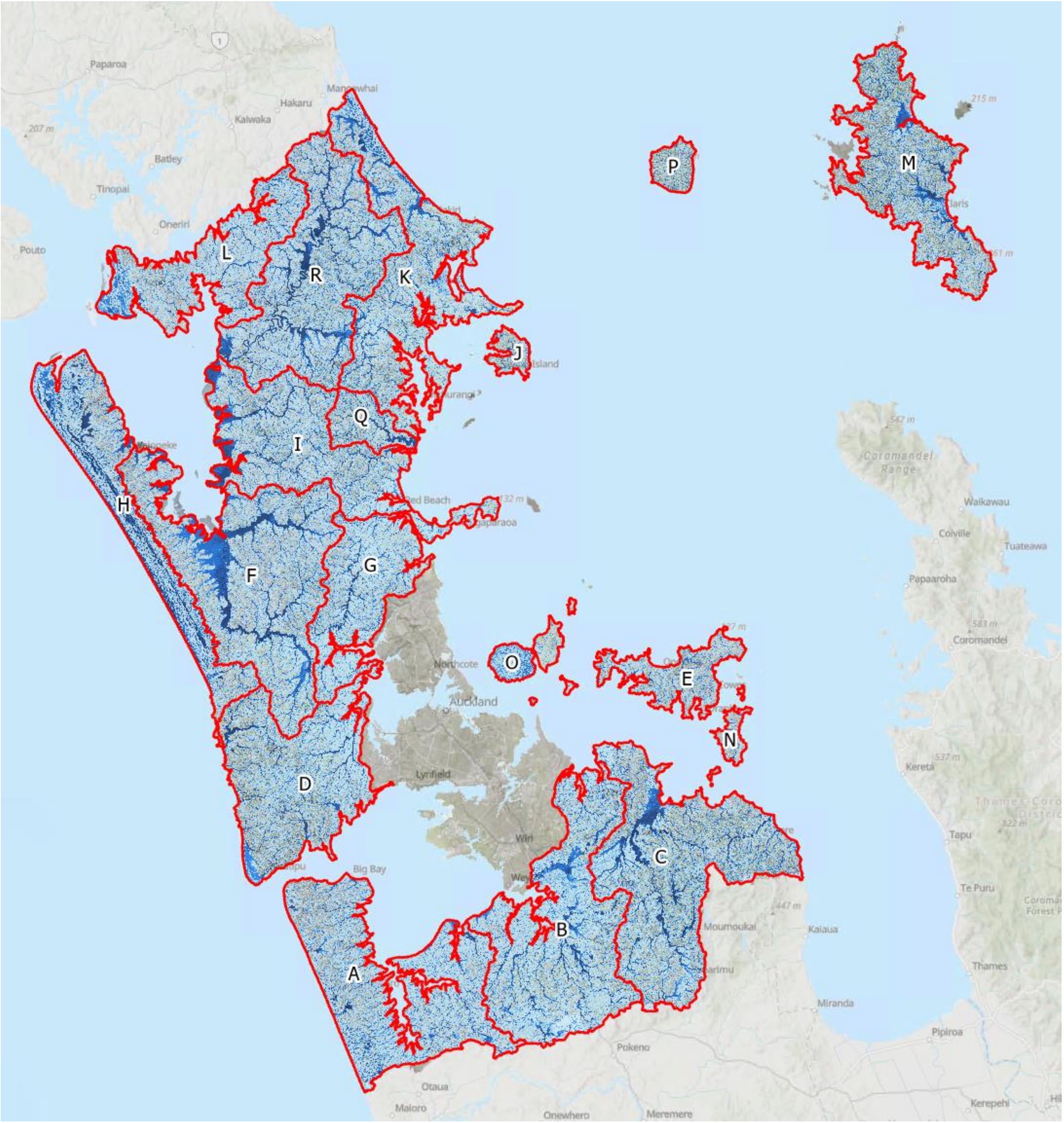
2.3.1 RURAL RAPID MODEL

The rural rapid model covers areas generally outside the rural urban boundary with some overlapping the main metropolitan areas and a number of small urban settlements, including Massey, Henderson, Kumeu, Warkworth, Papakura, and Pukekohe, etc. The model covered 90% of the Auckland region with a total area of 4500km^2 split into 18 simulation units, as shown in Figure 5.

As part of the modelling project, a fully connected geometric network was created including 32,000km of streams and overland flow paths, 34,000 depression areas and approximately 800,000 flow extraction cross sections. Over 2,000 rainfall runoff profiles were generated as per TP108 hydrology to account for localised catchment characteristic, considering rainfall, soil, land use and climate change factors. Hydraulically, the model used a direct rainfall approach and consists of over 400million 2D cells of 4x4m size.

Each model simulation took days to complete, and hundreds of terabytes of data was generated.

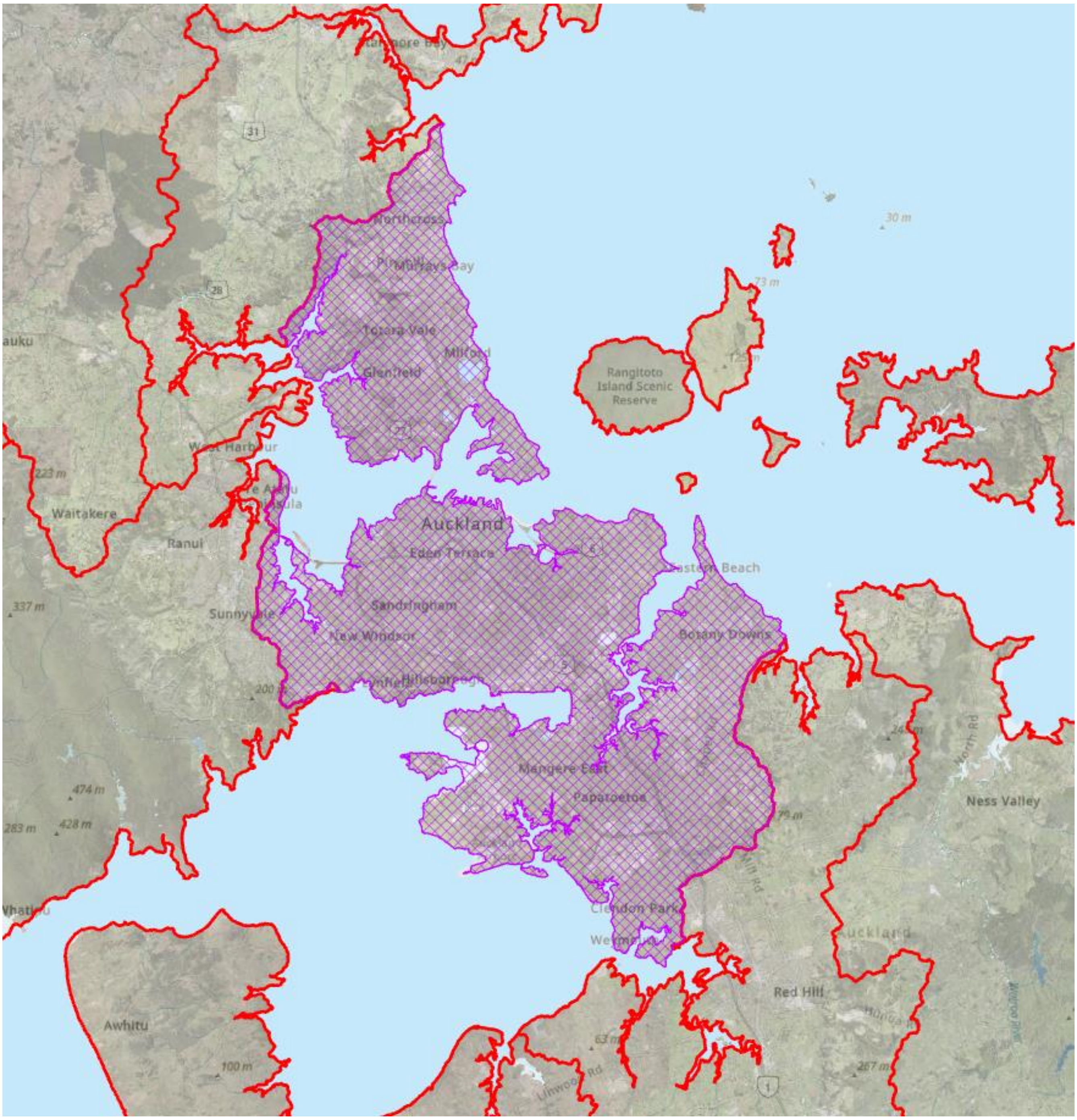
Figure 5: Regional rural rapid model coverage



2.3.2 URBAN FRAMEWORK MODEL

The urban framework model covers Auckland's central metropolitan areas as well as urban areas on the outer skirts that were also included in the rural model, such as Massey, Henderson, and Papakura, etc. Similar to the rural model, the urban model extent was also split into multiple units, which totals to an area of approximately 500km^2. Figure 6 shows the extent of the entire urban frameworks model extent.

Figure 6: Regional urban framework model coverage



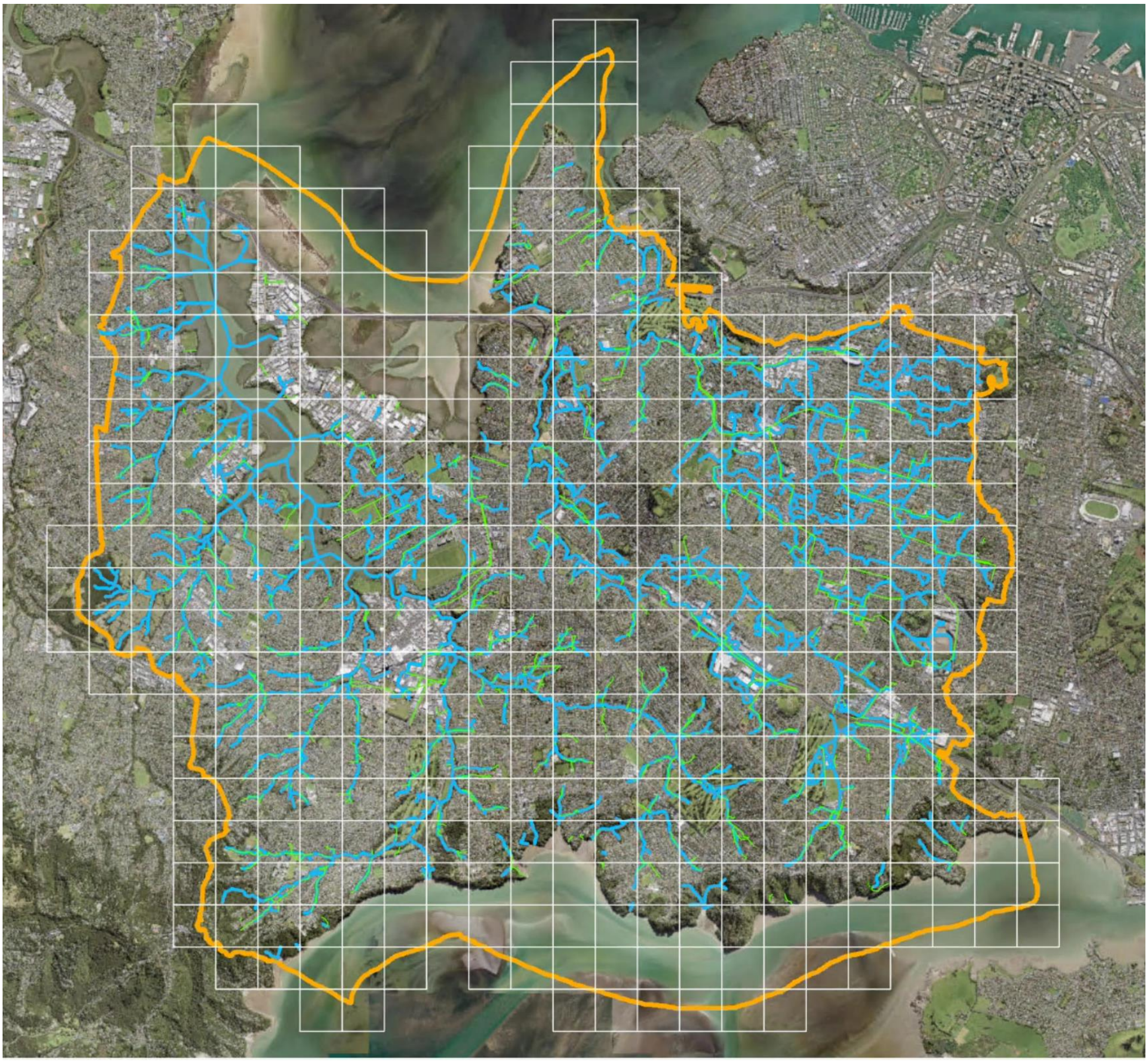
The urban framework model is essentially a 2D rain-on-grid model with main drainage pipe networks included as 1D features. The urban streams are an integrated part of the primary drainage network and are modelled within the 2D terrain. For the piloting unit alone, significant efforts were spent on analysing input data as well as developing rules and algorithms to facilitate automated data processing.

Listed below are some key statistics for the urban pilot model.

- 70km^2 of land area with 18km^2 of estuary and shallow coast areas using 2x2m grids.
- 140km of integrated stream network with culverts and bridges.
- 20% of the pipe network modelled, mostly for pipes larger than 450mm.
- 400 rain zones based on rain radar grids, 500x500m each.
- 90% of the total GIS nodes modelled, including catchpits, manholes and soakholes.
- Each simulation takes 3-4 days to run and generates 150Gb of data.

Figure 7 below shows an overview map of the model schema with rain grids and modelled stream-pipe network.

Figure 7: Overview of the urban pilot model unit with rain grids



2.4 PROJECT EXECUTION

2.4.1 DATA PROCESSING

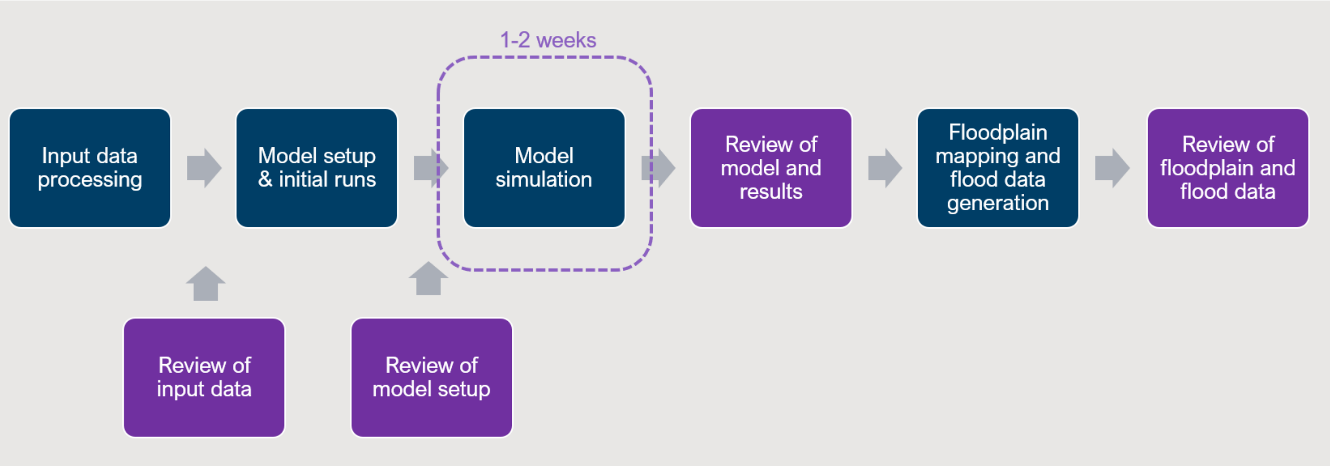
Due to the scale of the project, data processing requirements was uniquely significant. Automation of certain data processing steps was critical for project delivery as it greatly increased productivity with enhanced consistency and quality controls. It was key to plan out GIS processing needs and steps with the objectives and deliverables requirement in mind at the start of the project so that any rework was minimised. Efficient GIS processing was an essential and integrated component throughout the entire modelling project, for pre-processing of input data, simulation batch file creation and result extraction, as well as post-processing of model outputs and generating deliverables.

2.4.2 QAQC

Typically for Auckland Council, model reviews are carried out after the draft model and simulations are completed. This is when the model results are also available for sensibility checks to ensure quality assurance outcomes.

Due to the unit sizes, each model simulation takes days to complete, and any rework would severely impact on project programme and delivery. Quality control and assurance therefore is of vital importance to avoid major errors and reduce project delivery risks. Further to the reviews typically carried out after model simulation, additional two sets of reviews were included prior to final simulations, as illustrated below in Figure 8.

Figure 8: Additional reviews



Whilst these additional reviews introduced more hold points and seemingly prolonged the project programme, they were vital to project success for early issue identification and timely rectification, ultimately ensuring the project outcomes are achieved and that the model outputs can be used with confidence.

3 METHODOLOGY DEVELOPMENT

3.1 INITIAL MODEL TESTS

Both regional modelling projects involved substantial effort carrying out initial model tests, including both software and hardware related tests as well as modelling methodology tests. The tests are carried out for determining the following aspects.

- Optimum 2D grid size and whether to utilise the sub grid sampling (SGS) function, benchmarked using 1x1m grid size model results.
- The impact of low flow channel modelling using specific roughness values and DEM burning method.
- Suitable effective rain zone sizes to accommodate spatial distribution of design rainfall, land use zoning, and soil types.
- The inclusion of 1D components to represent culverts and bridges, and how it affects run time and result quality.
- The impact of initial conditions and whether it should be applied by GIS processing or hot start runs.
- Suitable model schema balancing output data quality and hardware requirements.

For the urban framework model, further rigorous tests have been carried out to develop a rain-on-grid 2D modelling methodology that is capable of producing comparable model results to detailed catchment models. Typical challenges include:

- What is the optimum pipe network extent to include in the model, without compromising flood risk predictions?
- How to prepare DEM within urban streams to ensure hydraulic connectivity and energy loss calculations at inlets and outlets of the pipe network?
- How to improve 1D/2D flow interactions and load 2D surface flows to the pipe network, especially where small drainage pipes are trimmed?
- How to model private and public soakage systems, where there are significant data gaps?
- How to drain large depression areas, where network is trimmed, or no asset data is available?
- Is it necessary to load roof runoff directly to a nearby modelled pipe? How?

3.2 MODEL CONSIDERATIONS

The famous quote "all models are wrong, but some are useful" by statistician George Box highlights the fact that models are simplified representations of the real world and are inherently imperfect.

Developing the regional modelling methodology requires balancing of conflicting priorities, by considering the overall project objectives and determining the level of accuracy required to meet those objectives. Achieving a balance between model accuracy and practicality is crucial at the regional scale, as overly complex large models will not only be costly and laborious to develop and implement, but also introduce a greater margin for error. It is important to consider the potential consequences of model errors and uncertainties, as they can have significant impacts on decision-making.

3.2.1 SPEED VS ACCURACY

As both regional models utilised 2D rain-on-grid method, one of the key considerations was what the optimum grid size was to model. As the modelling software provides sub-grid-sampling function for improved volume and flow calculations, this was also tested to see how this function can be used for the regional modelling.

A localised area of 35km^2 in the Hoteo catchment has been used for initial model tests to benchmark hardware requirements against output accuracy and overall performance using different grid sizes. Table 1 below shows the comparison results.

Table 1: Benchmarking simulation time vs data accuracy

Grid Size	Simulation Time (hours)	Output Size (GB)	Peak Flow Error*	Comments on accuracy and overall performance
1m	84.6	194	0%	Smallest grid size possible based on LiDAR DEM. However, impractical to use as there is not enough GPU capacity to support individual scenario runs for the regional model unit sizes.
2m	26.1	71.7	0.9%	Considerably faster with minimal increase in peak flow errors. However, single scenario running time for the each regional model unit is expected to take up to 2 months, which is still too long.

Grid Size	Simulation Time (hours)	Output Size (GB)	Peak Flow Error*	Comments on accuracy and overall performance
4m	3.3	18.1	3.9%	Continuous flood extent generated and good reliability for flow readings with acceptable error margin.
4m with SGS	8.6	24	11.1%	Slower to run than without SGS and more errors. Not an improvement.
10m	0.5	2.9	35.2%	Substantially faster with smaller output data size compared to 4m grids, but resulted in significant increase in error margins on flood flow predictions.
10m with SGS	0.5	2.7	13.2%	Similar run time compared to without SGS but with much improved accuracy on flow data.
20m	0.2	0.7	81.1%	Marginally faster than the 10m grid scenario. Unacceptable error margin on peak flow.
20m with SGS	0.2	0.7	12.8%	Similar run time compared to without SGS but with much improved accuracy on flow data.

* Peak flow errors were assessed based on three selected cross sections for all tested scenarios.

As floodplain mapping is one of the key project objectives, the rural model needs to be capable to reliably predict flows at $2m^3/s$, this leads to data reliability questions for models with grids equal or larger than 10m. Furthermore, any grid size smaller than 4m would significantly increase run time to a point that it becomes impractical.

The use of SGS functions has been found to enhance flow predictions for scenarios with larger grids. While the flood extent predictions are relatively precise across all SGS scenarios, the benefits of using SGS decrease as the grid size reduces. As such, the SGS functions were not used for producing the final flood data at 4m grids, as it was deemed to generate greater flow error margins and produce lower flood level results in areas such as depressions and overtopped roads.

3.2.2 CONSISTENCY VS SPECIFICS

Other model considerations, such as how much specific details should the model incorporate, were also debated for each model parameter. For example, the proposed soil CN values were questioned during the initial review on model inputs, mainly on the two specific points below:

- Based on TP108, different land use types may have an impact on CN values, even for the same hydrological soil group. Is it reasonable to use fixed CNs for each group, or should the land use types be considered?
- For certain areas, where there is minimal human activity and impact such as the Waitakere Ranges and Rangitoto Island, is it still appropriate to use a standard CN value for the underlying soil type?

After lengthy discussion, it was determined that the regional model should employ fixed CN values for each hydrological soil group, without any specific local considerations. This was due to a range of reasons outlined below:

- The current land use information is not comprehensive enough to differentiate land use and clearly identify boundaries where specific CN numbers should be applied. These areas included bush, not-grazed areas, minimal vegetative covered crop areas, and others.

- Other regional tools, such as the Auckland Council Peak Flow Tool, also use fixed CN values to apply TP108 graphical method flow calculations. Maintaining consistency would be beneficial for conducting analysis between these tools for further research and improvements.
- As a regional tool, it is crucial to maintain consistency and a streamlined approach for easier flood data interpretation in the future.
- The use of fixed CN values is expected to produce mostly conservative flood risk results, ensuring a cautious approach to flood risk management in the Auckland region.

Similar considerations are also given on parameters such as aerial reduction factors, rain zone sizes, and initial conditions, etc.

3.2.3 AUTOMATION VS MANUAL CHECKS

Due to the large scale of the modelling project, automating data processing was a necessary and critical component. GIS tools and project-specific scripts have been utilized for automation. For example, floodplain mapping involved using the inbuilt mapping tool from the TUFLOW modelling software as well as developing scripts for generating geometric stream networks and flow extraction cross-sections to determine floodplain start and stop locations. However, manual checks were still crucial to verify automated outputs and ensure quality control at the property level across the entire mapping extent. Floodplain reviews were carried out for every single location, and not just as spot checks.

Similarly, GIS automation has been used extensively for asset data processing in the urban model, creating a hydraulically connected geometric stream-pipe network, which included DEM burning and coupling treatments at inlets and outlets. The automated process outputs were reviewed beyond spot checks to ensure that pipe asset information is entered correctly, and that head losses are modelled appropriately for both the general pipe network and critical structures.

4 SENSITIVITY AND VALIDATION

In order to meet the project's key objectives, it is essential that both regional models are able to assess flood risks using TP108 design rainfall and simulate real flood events with results that align with observations. To achieve this, the regional models were subjected to validation against existing tools and observed storm events, which helped to improve the confidence level in the model's predictions.

4.1 VALIDATION AGAINST EXISTING TOOLS

4.1.1 TP108 GRAPHICAL METHOD

As part of the standard review procedure for Auckland Council models, the results were required to be validated against flows calculated using the TP108 graphical method at key locations. In the Kumeu catchment, several locations were selected for this purpose, and the results indicated a good agreement in volume calculations between the two methods. However, significant differences were observed in the flow hydrographs for peak flows and time of concentration (Tc). In Figure 9, a comparison of the flow for the 100-year ARI scenario is presented, which highlights the model-generated hydrograph has significantly higher peak flow and faster response compared to the hydrograph generated using the TP108 graphical method.

Figure 9: Modelled flow and TP108 graphical flow comparison

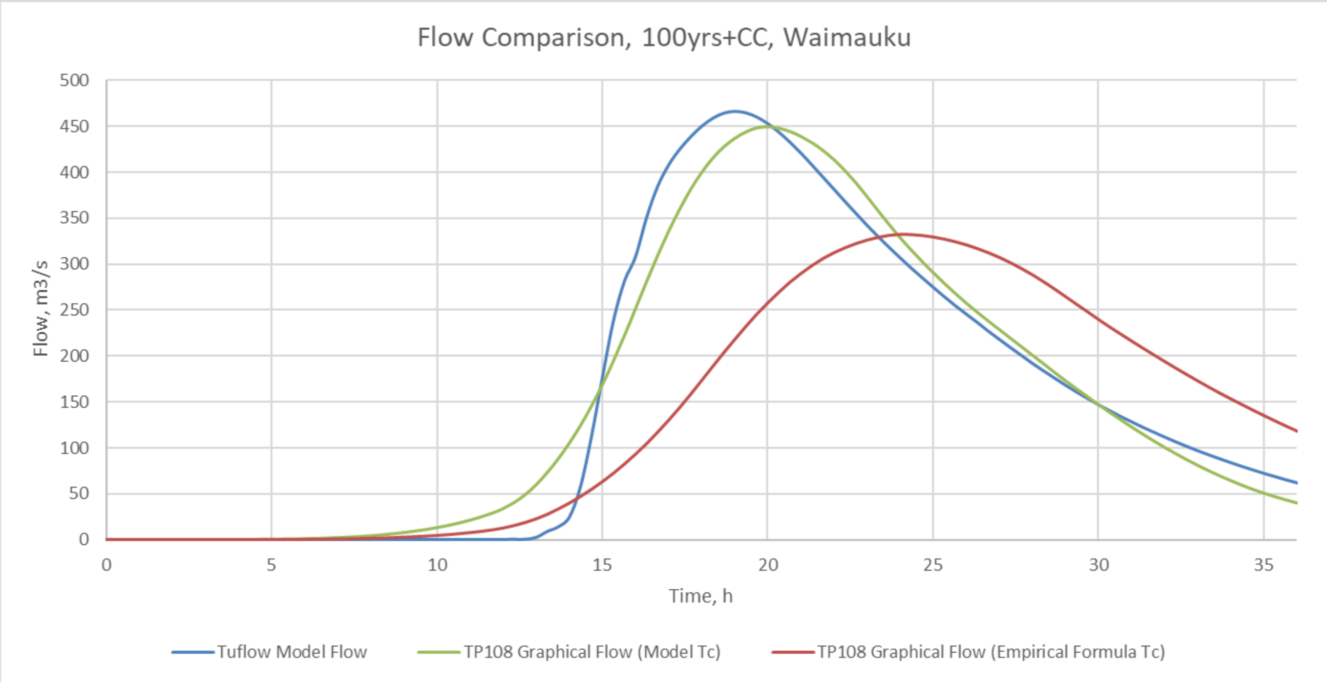


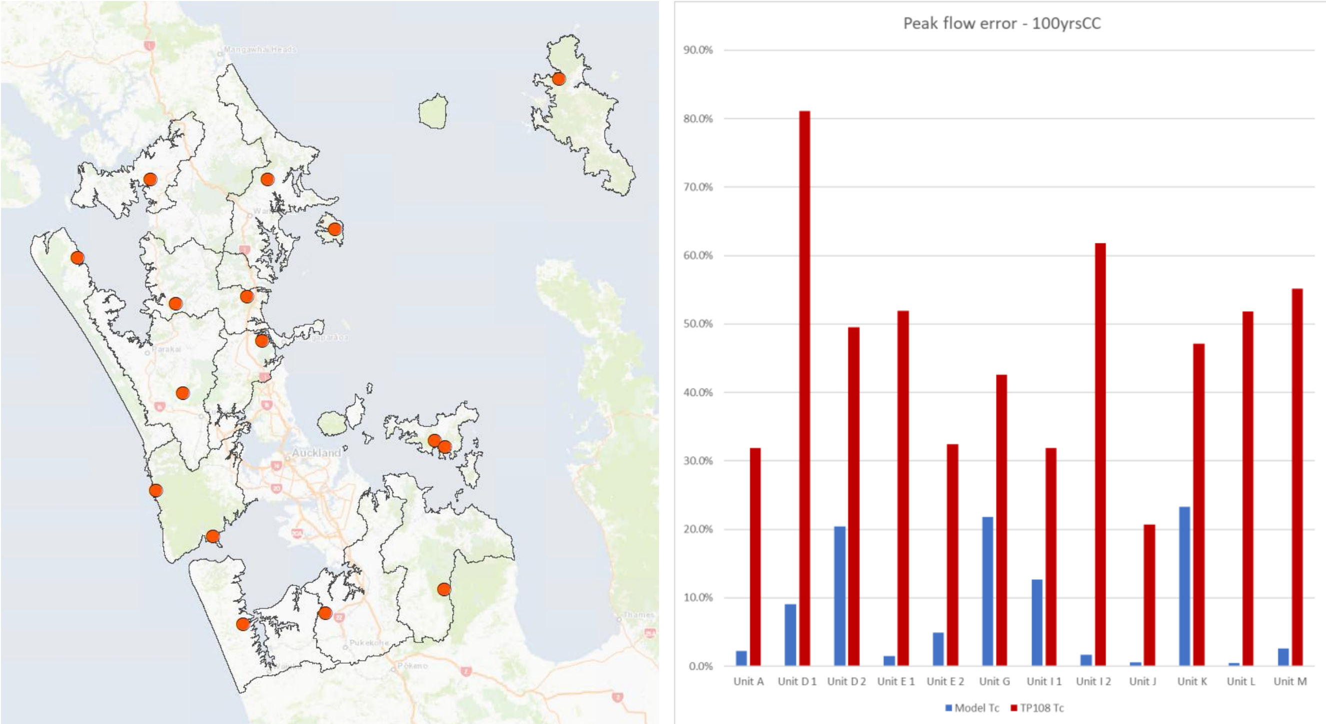
Figure 9 also shows an additional curve, which used the same TP108 graphical method but with the modelled Tc substituted in. As can be seen, the resulting hydrograph shows a greatly improved match to the modelled hydrograph.

The general validation finding suggests that the regional model predicts faster Tc with higher peaks for more extreme events, but slower Tc and flatter peaks for more frequent storm events. On the other hand, the TP108 graphical method utilises fixed Tc to estimate peak flows, regardless of the frequency of the events. Since the model accounts for hydraulic components and better describes topographical features compared to the TP108 graphical method, it is believed that the model estimated Tc may be more representative.

When model-predicted Tc was used to substitute in the TP108 calculations, the resulting peak flow differences were remarkably reduced for all chosen check locations. Figure 10 shows peak flow errors between the model and TP108 calculations, as well as reduced error margins when modelled Tc was applied.

Whilst this finding may have pointed out limitations of the TP108 graphical method, it was important to verify the model estimated Tc and peak flows further before the model could be considered suitable for flood predictions. The August 2021 event was subsequently used for model Tc verification (Section 4.2.1).

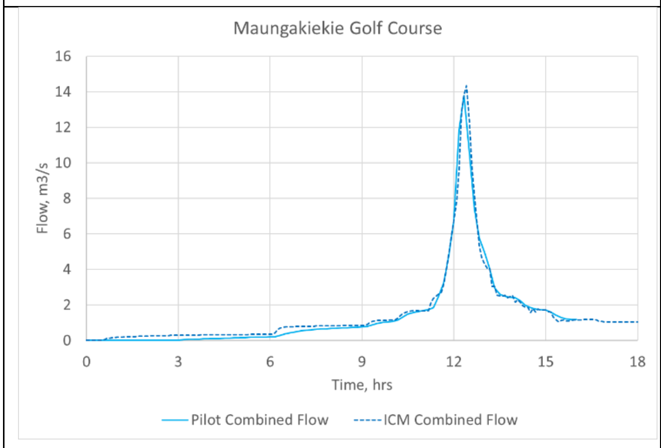
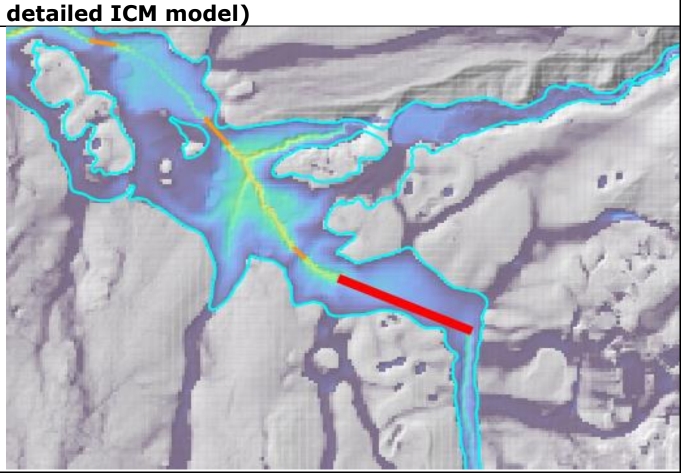
Figure 10: Peak flow errors comparison at random locations across the region

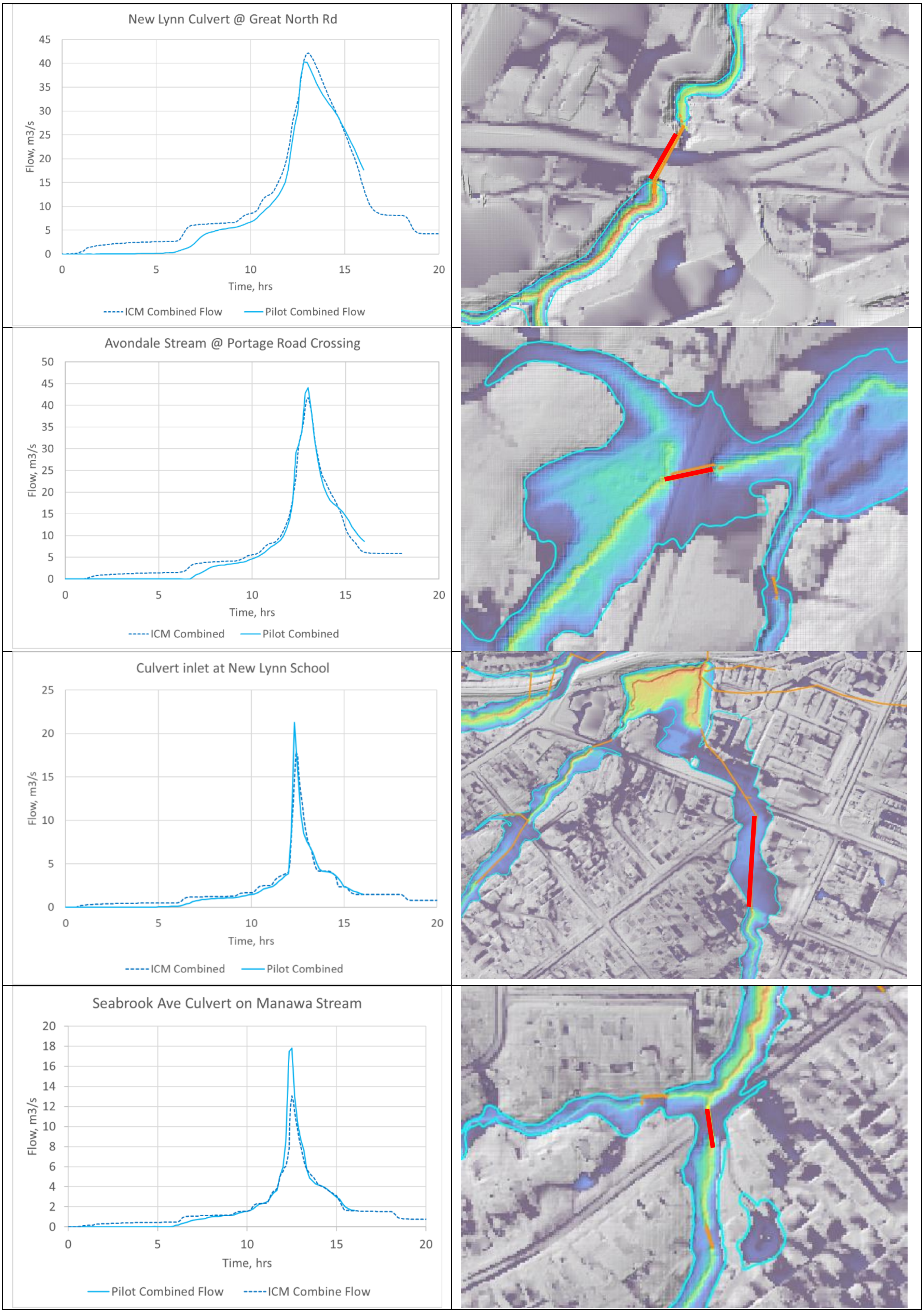


4.1.2 DETAILED MODEL RESULT COMPARISON

As mentioned previously, the urban framework models are required to resemble detailed catchment models for flood predictions. The pilot model has therefore been simulated using the same tide and rainfall boundary conditions as the detailed Whau catchment ICM model and the results from both the pilot urban framework model and the detailed model were compared for both flow and flood extents. Comparisons at selected locations are shown in Table 2.

Table 2: Model comparisons at selected locations

Flood Comparison **(Pilot model flow vs detailed ICM model flow)**	**Flood Extent Comparison** **(Depth raster of pilot model overlaid with existing floodplain outline, which was generated from the detailed ICM model)**
	


New Lynn Culvert @ Great North Rd
Flow, m3/s
Time, hrs
ICM Combined Flow
Pilot Combined Flow
Avondale Stream @ Portage Road Crossing
Flow, m3/s
Time, hrs
ICM Combined
Pilot Combined
Culvert inlet at New Lynn School
Flow, m3/s
Time, hrs
ICM Combined
Pilot Combined
Seabrook Ave Culvert on Manawa Stream
Flow, m3/s
Time, hrs
Pilot Combined Flow
ICM Combine Flow

4.2 VALIDATION USING STORM EVENTS

4.2.1 AUGUST 2021 KUMEU EVENT

In August 2021, the local Kumeu community experienced an extreme storm event resulting in flooding of the township as well as surrounding farm and residential areas. The regional rural rapid model was used to simulate this event with RADAR rainfall data, and the model results were compared to river gauge data as well as observed flooding depth and extents.

The validation modelling area included the entire Kaipara River catchment, covering major townships such as Kumeu and Helensville, and major tributaries like the Kaukapakapa River. Figure 11 shows the locations of the two river gauges used for model validation, as well as the RADAR grids, which indicate that there was heavier rainfall at the top of the catchment, affecting Kumeu township, and less rainfall for the Kaukapakapa River catchment.

Figure 11: August 2021 Kumeu event validation extent

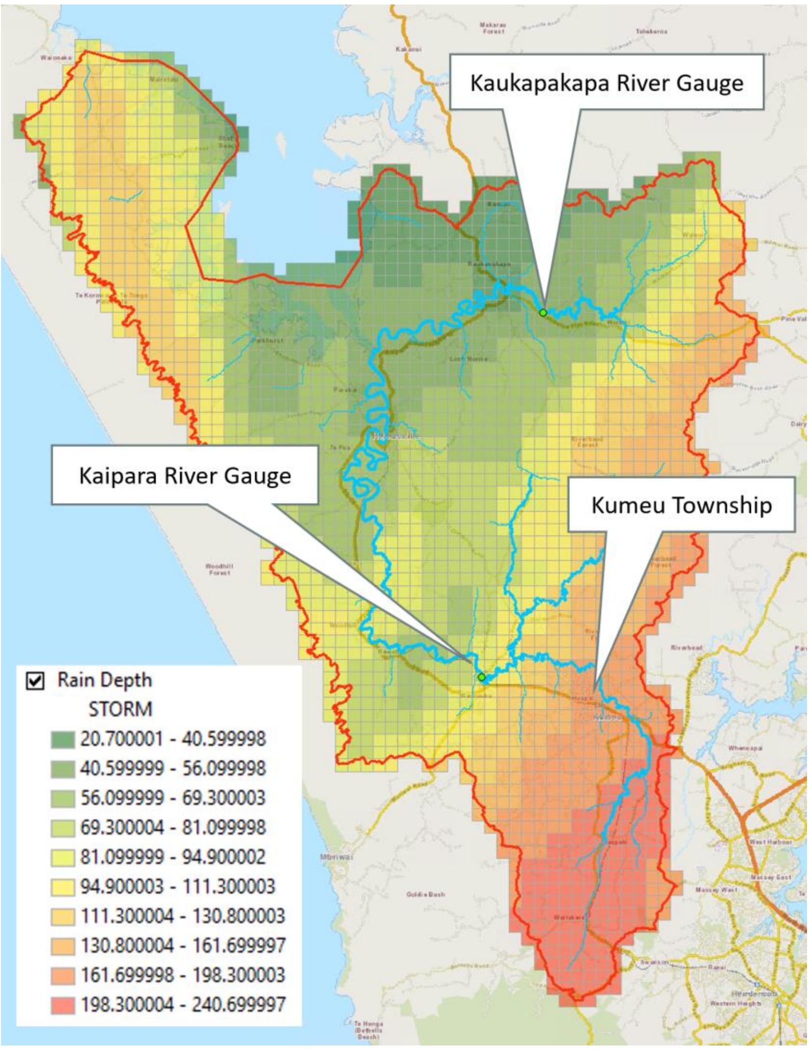
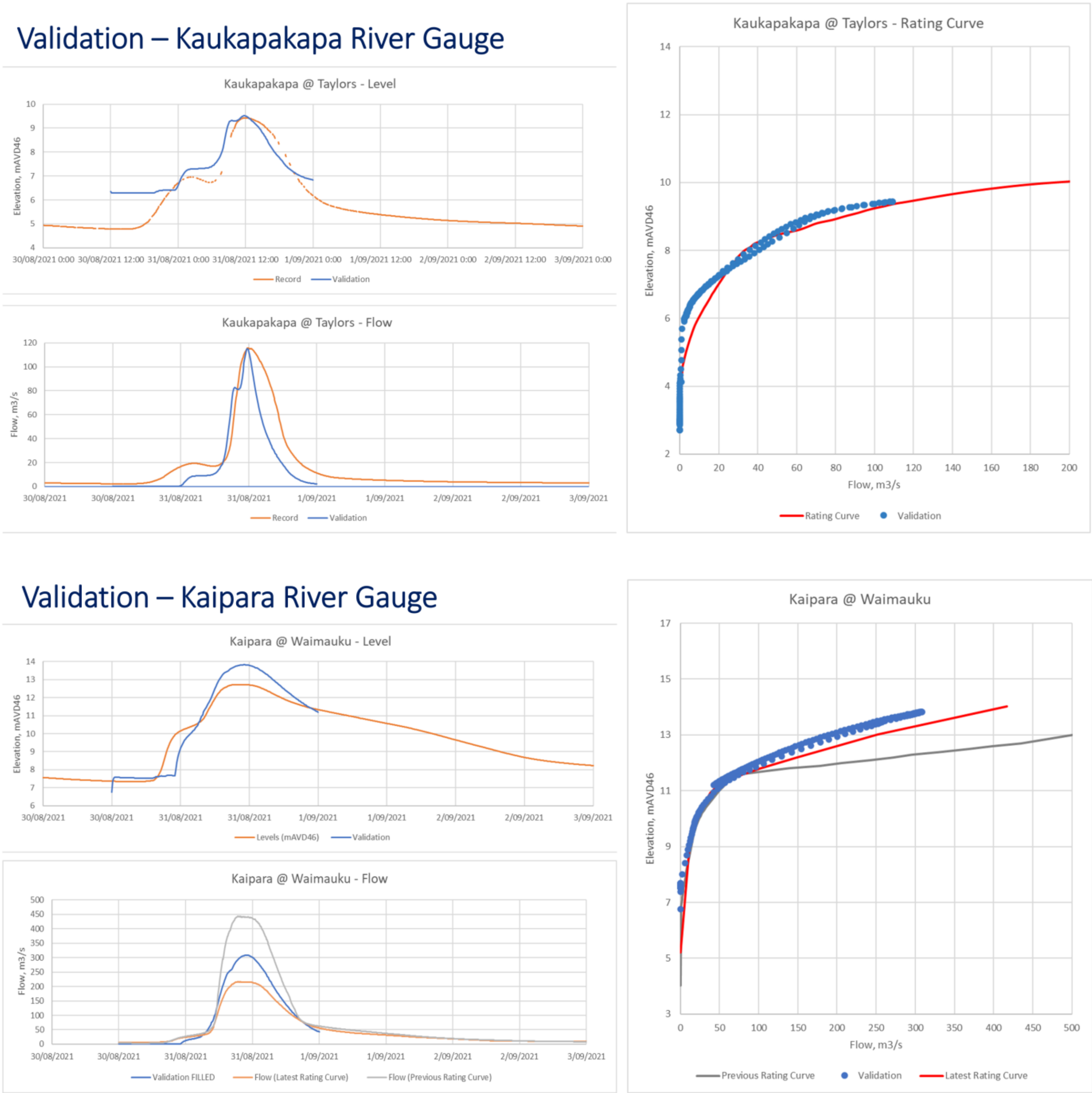


Figure 12 shows the comparison between the modelled results and gauge measurements at the Kaukapakapa River and Kaipara River sites. The time to peak in the modelled results matched well with the measured data at both gauges. At the Kaukapakapa River site, the modelled flows and water levels closely followed the gauge's rating curve. However, at the Kaipara River site, initial differences were observed between the modelled data and the rating curve for higher flow conditions. Further investigation revealed that the rating curve was based on flows lower than 100m^3/s and was therefore unreliable for high flow conditions. With the availability of a newer rating curve, the modelled results were found to correspond better with the measured data, confirming the hydraulic performance of the model.

Figure 12: Gauge and model data comparison



The model however did overestimate flood level at the Kaipara River gauge for the validation event. To gain a better understanding of the flow difference, a comparison was made between the volume from each hydrograph and the total rainfall runoff volume, as presented in Table 3. The volume for the modelled hydrograph closely matched the rainfall runoff, thereby verifying the model's mass balance. However, flows computed from both rating curves exhibited higher error margins. This discrepancy is likely caused by the hydrological modelling methodology, especially for the discrepancies between the modelled TP108 rainfall loss parameters and the specific August 2021 storm event conditions.

Table 3: Volume check (@36hrs)

Item	Total volume, million m^3	Percentage, %
Rainfall runoff	13.9	100%
Validation model	13.5	97%
Flow based on previous rating curve (prior to the Aug 2021 event)	19.3	140%
Flow based on latest rating curve	11.1	80%

4.2.2 JANUARY 2023 EVENT

The severe flooding that occurred across Auckland in January 2023 provided valuable flood information for validating the regional model, particularly for the urban pilot modelling. The model validation process is currently ongoing, and the results are anticipated to be available for presentation at the upcoming conference.

5 DATA SHARING

5.1 DATA GENERATION

The regional modelling project is still on-going and has produced a significant amount of model output data to date, with the data size currently at 200TB and continuing to grow as we develop new urban models and improve existing rural models. In addition to the model files and flood data outputs, the project also delivers a range of technical reports and associated regional GIS layers, such as geometric stream and pipe networks, depression areas, flow cross sections, and floodplains. Input data layers generated and processed for modelling, such as road breaklines and low flow channels, are also included in the model deliverables for future updates as needed.

Currently the regional rural rapid model is completed with the 100yr ARI floodplain mapped. The model is now used for additional scenario runs to understand how different factors may impact on flood risks. This involves simulating different design rainfall, tide boundary conditions, climate change factors, and development scenarios. The model is also used to estimate the maximum probable flood extents. A rich amount of flood data is expected to be produced as the models are continuously simulated for more scenarios.

5.2 FLOOD DATA PLATFORM

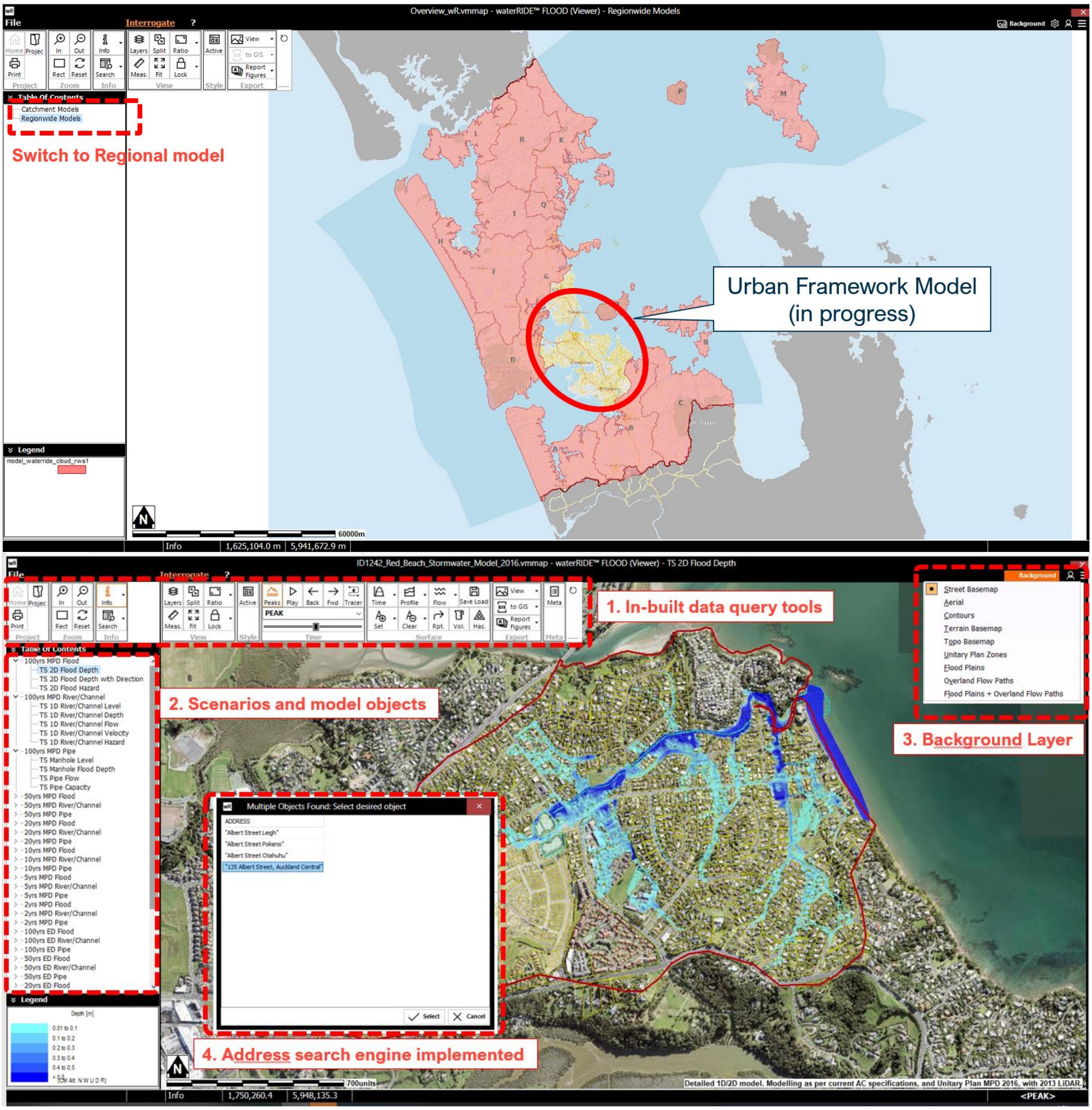
To effectively manage the vast amount of data generated from the regional model and hundreds of catchment models, Auckland Council needed a way to easily access and share the flood information. However, the flood data from catchment models were often difficult to access and interpret, as they were displayed in limited PDF maps or stored in modelling software that are only accessible by modellers. This led to a bottleneck in providing flood information to customers, making it a specialised activity.

As the regional modelling project generates an increasing amount of data, it was becoming pressingly important to make flood data easily accessible for interrogation and analysis to support Auckland's fast-paced development. A consolidated data platform was necessary for publishing dynamic model results, providing simple data interrogation and querying tools that can be used by stormwater professionals.

WaterRIDE was chosen as the flood data platform for its benefits such as consolidated data, modelling software independence, cloud-based accessibility, intuitive interface, pre-defined thematic maps, powerful data analysis tools, efficient data querying, and customisable flood reports. With the support from the software developer, Auckland Council had the platform setup and customised the interface with functionalities such as address search, background layers, automated flood report generation, etc.

Most of the Council's recent models including both regional and catchment models are now uploaded onto this platform with key scenario results, as shown in Figure 13. Time series model results, such as flow, depth, velocity, hazard, can all be mapped and queried from the platform. Data interrogation can also be made on volume and duration. This platform provides a single consolidated location for all flood data requests.

Figure 13: WaterRIDE flood data platform



6 CONCLUSIONS

The regional flood modelling project is a unique endeavour and is anticipated to become the preeminent flood risk tool for strategic stormwater planning at a regional scale. It provides updated floodplain mapping for the entire region and produces a consistent set of flood data which complements the detailed catchment models and serves as a valuable tool for error checks.

As of now, the rural rapid model is complete, and the urban framework model is nearing completion of piloting. The entire modelling project is anticipated to conclude in approximately two years. The model is expected to be continuously utilised to generate a wide range of flood data for publication on several data platforms. The simulations planned include typical design storm scenarios, as well as exceedance events like maximum probable flood.

The regional model is set up to enable convenient on-going updates, as major input data becomes available. The objective is to actively maintain the model, so that Auckland Council's flood data is kept up to date.

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REFERENCES

Auckland Regional Council (1999), Guidelines for stormwater runoff modelling in the Auckland Region, TP108.