ISSUE NO 1





VARIATION 3

TECHNICAL REVIEW: STORMWATER

DRAFT

TUAKAU, PŌKENO, HUNTLY & NGĀRUAWĀHIA

Version Control

Version	Date	Author	Reviewer	Change Description
1.0	5/05/2023	Andrew Boldero	Mike Chapman	Draft for comment
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This report has been prepared for the Waikato District Council for the technical assessment of the impact on stormwater from the proposed Variation 3 as described to us, limited to the scope of work agreed between the client and Te Miro Water Limited. No responsibility is accepted by Te Miro Water Limited, or its directors, servants, agents, staff, employees, or subcontractors related to the inherent flood model limitations, or the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any or for any other purpose by any other persons or party not listed above.





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1 INTRODUCTION

This technical report considers the potential effects of the proposed rule changes, in relation to stormwater management, for the medium density rules relating to Variation 3 on behalf of the Waikato District Council.

The scope of this report is to consider the effects of the proposed Variation 3 rules and recommend alternatives or revised rules if appropriate. Te Miro Water has undertaken a review of the existing and proposed rules across the district plan and other relevant documents and considered likely effects of these rule changes. This includes consideration of how the existing and proposed rules align with Te Mana O Te Wai, the fundamental concept underpinning the National Policy Statement for Freshwater Management.

Te Mana o te Wai: Protecting the mauri of the Water

The scope of work also includes undertaking rapid flood modelling to refine the flood risk/overland flow path areas where rule changes could negatively affect the natural and built environments. This was undertaken for the following towns:

- Tuakau
- Pōkeno
- Huntly
- Ngāruawahia

The summary section of this report collates the recommendations for changes to the existing and proposed district plan rules to ensure sustainable development is achievable in the future and aligns with Te Mana o te Wai values.

2 RELEVANT LEGISLATION, RULES AND POLICIES

SECTION SUMMARY: There are significant rules and regulation governing stormwater management across varying levels of legislation.

The following acts, plans, legislation and guidelines outline the stormwater requirements for land management and development in the Waikato District. The below list is provided for information only;

National Acts

- Resource Management Act
- The Building Act
- Waikato River Authority Act

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• Land Drainage Act

National Policies

- National Policy Statements (NPS) Fresh Water Management, and the fundamental concept of Te Mana o te Wai
- New Zealand Building Code

Regional Consents

• Stormwater Discharge Consents (Issued by WRC)

Regional Plans and policies

- Waikato Regional Policy Statement,
- Stormwater Management Guideline(s) and
- Regional Plan
- Te Ture Whaimana o Te Awa o Waikato the Vision and Strategy for the Waikato River Waikato River Authority
- Waikato-Tainui Environmental Plan

District Plans and Policies

- Waikato District Stormwater Bylaw
- Waikato District Council Operative & Proposed District Plan
- Waikato District Council Stormwater Code of Practice
- Regional Infrastructure Technical Specifications (RITS)
- Waikato District Council Catchment Management Plans (Huntly, Pōkeno, Tuakau and Ngāruawahia)

Refer to Appendix B for a summaries of the main legislation/documents/plans relating to stormwater management.

3 TE MANA O TE WAI

SECTION SUMMARY: The Proposed District Plan Rules related to stormwater do not align well to the values of Te Mana o te Wai where fresh water exists as the provisions do not appropriately enable protection, restoration, enhancement or show priority for surface water quality or flows within the natural water courses or their tributaries.

Te Mana o te Wai, or mana of the water, recognises the vital importance of clean, healthy water for maintaining the health of our waterbodies, freshwater ecosystems and the communities that rely upon them for their sustenance and wellbeing.

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Essential Freshwater is part of a new national direction to protect and improve our rivers, streams, lakes and wetlands. The Essential Freshwater package aims to:

- Stop further degradation of our freshwater.
- Start making immediate improvements so water quality improves within five years.
- Reverse past damage to bring our waterways and ecosystems to a healthy state within a generation.

The NPS-FM 2020 strengthens and clarifies Te Mana o te Wai by providing stronger direction on how Te Mana o te Wai should be applied when managing freshwater.

The six principles of Te Mana o te Wai include;

- 1. **Mana whakahaere:** the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater
- 2. Kaitiakitanga: the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations
- 3. **Manaakitanga:** the process by which tangata whenua show respect, generosity, and care for freshwater and for others
- 4. **Governance:** the responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future
- 5. **Stewardship:** the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations
- 6. **Care and respect:** the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation

Te Mana o te Wai has a hierarchy of obligations. This hierarchy is incorporated into the Objective of the NPS-FM. The first priority is the health and well-being of the water body, ahead of any human uses of that water. The second is people's health needs (such as drinking water), the third is the ability of people to communities to provide for their social, economic and cultural well-being now and in the future.

3.1 NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT 2020

The NPS-FM (2014 – revised in September 2020) and Te Mana o te Wai (2014 but strengthened in September 2020) were released after the drafting of stage 1 (July 2018) and stage 2 on Natural Hazards (July 2020) of the Proposed District Plan. Although submissions on Natural Hazards weren't finalised until July 2021 it is likely that the latest version of the NPSFM and Te Mana o te Wai were either not available or not fully understood during the drafting of

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the Proposed District Plan provisions. We understand that the provisions of Variation 3 need to give effect to the NPSFM.

Table Colour Key

Green = Unlikely to have stormwater effects

Yellow = Concerns around potential effects

Red = Likely adverse effects – revision recommended

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We have reviewed the proposed Variation 3 rules and outlined below consideration of how existing and proposed rules may or may not give effect to Te Mana o

te Wai.

Table 1: Te Mana o te Wai summary

Principal	Potential Stormwater relevance	Existing Rules	Proposed Rule V3	Recommendations
Preserve	Existing overland flow paths, flood areas, riparian zones and vegetation relating to waterway health.	The PDP rules allow some development that can intrude on these areas impacting flood levels and ability for treatment to occur. There are examples of this across the district where riparian areas, gullies etc have been developed on.	Proposed further intensification of urban properties will limit the ability to preserve existing freshwater eco- systems.	Ideally the PDP would enable preservation of flood planes/overland flow paths, tributaries and their riparian zones. Identification of freshwater health areas to be protected.
Restore	Existing overland flow paths, flood areas, riparian zones and vegetation relating to waterway health.	Restoration of waterways required riparian areas not to be developed. These areas are not protected under the current rules unless they come under specific setback standards of identified watercourses.	Proposed further intensification of urban properties will further reduce available land areas for restoration.	Ideally the PDP would enable restoration of flood planes/overland flow paths, tributaries and their riparian zones.

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Enhance Existing overland flow paths, The ability to enhance freshwater Proposed further intensification of Ideally the PDP would enable enhancement of flood areas, riparian zones requires space to rehabilitate and reurban properties will further reduce flood plains/overland flow paths, tributaries and vegetation relating to vegetated tributaries. The current rules ability to enhance waterways and and their riparian zones. waterway health. in the PDP do not protect all of these their tributaries. areas. Prioritises the Urban development, The Variation 3 (and current PDP), in Ideally the PDP and Variation 3 would remove Permitted activities and lack of health and wellidentification of waterway tributaries our view, prioritise urban flood plain and riparian zones from the transportation, commercial being of freshwater and industrial operations do not enable freshwater to be development over the health of permitted activity rules. and expansion. prioritised over other community and freshwater by intensification of the commercial needs. urban area.

Summary: Space is needed to enable restoration, enhancement and prioritisation of waterways which are key elements for Te Mana o te Wai (including and their sub-catchments and riparian areas). The PDP and Variation 3 provisions, in our view, do not prioritise freshwater over urban development as:

- They enable development in areas needed to restore and enhance freshwater.
- They enable infilling of the flood plain which increases flood levels (by offsetting flood volume and adding to cumulative effects). Increased flood levels can also add to erosion and sediment mobilisation into the waterways.
- They encourage maximum use of urban lots which reduces existing vegetation cover. This reduces the positive effect that vegetation has on stormwater (exfiltration, treatment, shading, increases bank stability).
- They encourage maximum use of urban lots which reducing the ability to manage overland flows.

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Example of prioritised waterways over urban development

Examples of non-prioritised waterways/tributaries



4 STORMWATER DISCHARGE CONSENTS

Each town (Tuakau, Pōkeno, Huntly and Ngāruawāhia) has its own discharge consent issued by Waikato Regional Council. These consents contain conditions that outline the requirements for stormwater management. Including, but not limited to;

- Stormwater treatment
- Maintaining overland flow paths
- Reducing flood risks
- Reporting
- Maintenance
- Community consultation and education

The PDP rules should ideally include standards or require a resource consent to ensure that the Council can comply with the stormwater discharge consents as additional development is undertaken. Areas for consideration are shown in the table below.

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Table 2: Stormwater Discharge Consent Conditions Summary

Discharge Consent (WRC issue) requirements not covered by Variation 3 proposed rules

WRC issued stormwater discharge consents: 105051 (Tuakau), 108592 (Pōkeno), 105644 (Huntly) and 105645 (Ngāruawāhia).

Consent Condition	Proposed Variation 3	issues	Recommendation
Stormwater Treatment	Not covered - additional rule recommended to ensure SW discharge consent compliance	Include the treatment requirements from the consent conditions within the district plan rules so that they align. This will include the treatment criteria (% removal) for: • Total Suspended solids • Nutrients/minerals • Heavy Metals • Hydrocarbons • pH etc	All areas within the district wide discharge consents are required to comply with the consent rules. Variation 3 should align with this requirement to ensure no adverse effects.
Stormwater Detention	Not covered - additional rule recommended to ensure SW discharge consent compliance	Stormwater detention requirement are required to match existing flows to post development flows to ensure flooding is not increased. In some areas with existing flooding issues this is increased to 80%/70% of pre-development flows.	All areas within the district wide discharge consents are required to comply with the consent rules. Variation 3 should align with this requirement to ensure no adverse effects.

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Stormwater Extended Detention	Not covered - additional rule recommended to ensure SW discharge consent compliance	The stormwater extended detention requirements are to mitigate increased erosion and sediment mobilisation in waterways from additional discharge to sensitive waterways.	All areas within the district wide discharge consents are required to comply with the consent rules. Variation 3 should align with this requirement to ensure no adverse effects.
Overland flow path management	No changes proposed, covered under EW rules providing 1.5m offset.	Maintaining overland flow paths and capacity is critical in managing flood risk. Any reduction in overland flow path capacity will be adverse upstream and/or downstream effects.	All areas within the district wide discharge consents are required to comply with the consent rules. Concerns are that the 1.5m doesn't provide protection from sediment mobilisation and doesn't allow compliance with Te Mana o te Wai as this offset does not enable riparian margins to be maintained or restored.
Surface runoff – intersecting surface flows outside of (causing concentrated flows)	Not covered - additional rule recommended to ensure SW discharge consent compliance	Some developments can cause concentration of surface flows from contributing catchments. This is usually checked as part of the effects assessments in a consent application. Concentrating flows by reducing overland surface flow areas can cause downstream effects of erosion and sediment mobilisation.	All areas within the district wide discharge consents are required to comply with the consent rules. Variation 3 should align with this requirement to ensure no adverse effects.

5 DEVELOPMENT PROCESS - FLOW CHART SUMMARY

SECTION SUMMARY: Allowing additional permitted developments will mean critical checks provided by a resource consent process are not in place to avoid or minimise adverse effects from medium density developments on freshwater. The Building Code does not cover the full requirements for stormwater management so should not be relied upon to manage stormwater effects unless changes to processing are

The below flow chart (simplified) shows the process for developments requiring a resource consent against the process for a permitted activity. The consenting process is the only process that enables Council to ensure there are no (more than minor) adverse effects. The building code does not cover the stormwater management and mitigation requirements that outlined in the discharge consent conditions or the District Plan(s).



Figure 1: Council Process Flow Chart (Simplified)

6 VARIATION 3 RULES REVIEW – SUMMARY TABLES

SECTION SUMMARY: Some of the Variation 3 proposed stormwater rules for permitted activities will likely results in adverse effects. The main concern is the infilling of flood plains resulting in increase flood levels. Water quality may also be affected in terms of reduced vegetation. The proposed Variation 3 rules do not protect the space around waterways and their tributaries. Without space for stormwater, it is difficult to see how Te Mana o te Wai will be given effect to, especially the enhance and prioritisation objectives.

The Variation 3 provisions covering stormwater or that may affect stormwater, have been reviewed and potential impacts identified. These are summarised in the following tables. Items that could potentially cause adverse effects are discussed in subsequent sections.

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Table List for rule review(s):

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Green = Unlikely to have stormwater effects

Blue = Will have effects on stormwater but these are addressed by the rules or proposed qualifying matters.

Yellow = Concerns around potential effects

Red = Likely adverse effects - revision recommended

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Table 3: Medium Density Rule Review – Variation 3 updates

Existing PDP Rule	Variation 3	Potential issues	Potential effects/outcomes		
MRZ2-S4 Setbacks					
1m area and side boundaries	1m rear and side boundaries (no change)	No change	No increase in adverse effects in relation to stormwater.		
3m Frontage	Reduced to 1.5m Frontage.	Additional infilling from building platforms across the site reducing flood storage volumes and ability to manage overland flow paths.	No increase in adverse effects in relation to stormwater provided there are no overland flow paths or flood plain areas along the frontage. This applied to existing and proposed DP rules.		
MRZ2-S5 Building Coverage	MRZ2-S5 Building Coverage				
Maximum building coverage on an existing GRZ site is 40% and on an existing MRZ site is 45%	Increase to 50%.	Increased infilling potentially required within flood zones for building foundations reducing available flood storage. Reduced areas to manage overland flow paths.	Increased flooding from reduced flood storage. Increased flooding from restricted or removed overland flow paths. Reduced water quality from reduced vegetated areas		



			Recommendation: No increase to building coverage for properties within the flood plain unless assessed by a suitably qualified person(s).	
MRZ2-S6 Outdoor Living Sp	ace			
Minimum area of 20m ²	Minimum area of 20m ²	No change	No increase in adverse effects in relation to stormwater.	
Minimum dimension of 4m in any direction	Minimum dimension of 3m in any direction	Could impact by increasing flood plain filling and restricting overland flow path management. Average sized soakage pit is larger than 3m.	Reduced areas to manage overland flow paths resulting in additional flooding. Limits area available for soakage disposal.	
Outdoor area must be for sole use only.	Can be communal (one space shared).	Total outdoor space reduced. For 3 dwellings minimum outdoor space was 60m ² and is now 20m ² . Less space to manage flood storage and overland flow paths.	Reduced area to manage overland flow paths resulting in additional ponding. Limits area available for soakage disposal and rainwater tanks (reuse and detention). Potential issue if within flood plain.	
MRZ2 Minimum residential unit size				
Minimum internal floor areas: Studio = 35m ² ,	Removed	With no minimum internal floor areas, houses could include more bedrooms within smaller overall areas, and	This could result in decreased water quality due to additional vehicles.	





One or more bedroom = 45m ²		therefore potentially increasing the number of vehicles and use of driveway(s).	Removing this rule could place more people within the flood plain. Recommendation: Minimum internal floor areas are maintained in areas within the flood plain.	
MRZ2 S10 Impervious surf	ace			
Impervious area of site must not exceed 70%.	No changes proposed.	Although no changes are proposed to this, it is more likely that the revision will require the maximum impervious area to be utilised.	While no change to this rule is proposed, intensification will have an effect when compared to the existing urban areas as it will increase the area of site utilised. This will reduce the average vegetation across the district which will have a direct effect on the water quality of the runoff. This also limits the ability to comply with Te Mana o te Wai principals.	
MRZ2 S11 Ground floor internal habitable space				
Garages shall occupy less than 50% of the ground	No changes proposed.	Example plans from the MfE design guide show a maximum floor area of 93m ² which means maximum garage area of 47m ² .	This provides a dimension of 5m x 9m. No foreseeable issues or adverse effects.	





floor space internal to buildings on the site.			
MRZ2 S13 Building Setbac	ks – Water Bodies		
20m from lakes	20m from lakes	No change	No adverse effects
20m from wetlands	20m from wetlands	No change	No adverse effects
23m from bank of River (excluding Waikato River and Waipa River)	21.5m	Reduced 1.5m	Offsets from rivers should be based on river modelling and flood extents. Reduction of setback could impact on flood storage and increase surrounding flood levels.
28m from Waikato River and Waipa River (transcription error – not 38m as per rules).	25.5m	Reduced 2.5m	Offsets from rivers should be based on river modelling and flood extents. Reduction of setback could impact on flood storage and increase surrounding flood levels.





GRZ-R15 Huntly North Wetland (this site will now	Any new building within the Huntly North Wetland specific	Building restrictions in the Huntly North Wetland area are still managed through Variation 3.	Maintain as a qualifying matter.
be within the MRZ2 zone.)	control identified on the planning maps.		di tutte de
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Table 4: WWS – R1 Rules review

WWS – RI (PER): Stormwater systems for new development or subdivision (00078)				
Rule ID	Existing Rule	Commentary and Recommendations		
(1)(a)(i)	Operates by gravity	Existing rule adequate and aligns with WRC standards and RITS.		
(1)(a)(ii)	Manages stormwater through a stormwater management plan.	Existing rule adequate and aligns with standard design practice, WRC standards and RITS. With a permitted activity there is no checks in place that confirm that a Stormwater Management Plan is fit for purpose.		
(1)(a)(ii)(1)	Primary system designed for 10% AEP	Existing rule adequate and aligns with WRC standards and RITS.		
(1)(a)(ii)(2)	Secondary system designed for 1% AEP	Existing rule adequate and aligns with WRC standards and RITS.		
(1)(a)(ii)(3)	Controlled discharge to a network with adequate capacity	This rule requires any new development to confirm the network has the capacity to accept the flows from the site. This rule restricts connection to existing under capacity networks. Engineering and asset knowledge is required to assess if the network is under capacity. Currently there is no hydraulic modelling of the existing network that outlines areas that are under capacity. As per section 8, based on installation date, most (>70%) of the piped network is likely undersized.		
(1)(a)(iii)	Stormwater management measure in place upon completion of development	Existing rule adequate and aligns with WRC standards and RITS.		

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(1)(a)(iv)	System designed using specific rainfall and climate change of 2.1 degrees.	Hirds version 4 allows for specific rainfall data but have updated the climate change prediction from version 3. Version 3 used degrees (Celsius) of temperature increase. Version 4 uses pathways (RCP) which includes a more inclusive prediction methodology. A 2.1 degree increase required by the rule is considered to align with RCP6.0 pathway. Although this is not included in the District Plan rules. A suitably qualified person would be aware of how to comply with this requirement utilising the latest rainfall data (HIRDS).	
(1)(a)(v)	Stormwater management measures and le	ow impact design	
(1)(a)(v)(1)	Retention for reuse	Aligns with WRC guidance and RITS Not included in detention calculations so independent of stormwater management outside the WRC scoring matrix requirements.	
(1)(a)(v)(2)	Soakage techniques	The building code method for determining the design soakage rate is known to over-estimate design soakage rates by up to 10 times and is considered not fit for purpose. Many Councils across NZ have updated engineering standards to remedy this. Soakage design is specialised and not considered suitable as a permitted activity.	
(1)(a)(v)(3)	Infiltration Rate of a minimum of 7mm/hour	If the infiltration tests indicate an infiltration rate of less than 7 mm/hour then infiltration is not normally considered appropriate due to the silty nature of the soils. This reference is from the WRC Stormwater Guidelines and is related to the soil type Silty Loam. 7mm/hour is less than the recommended soakage rates for a number of guidelines (Matamata Piako Soakage Guidelines = 30mm/hour, Auckland (TR2013/040) = 30mm/hour). A minimum soakage rate of 7mm/hr would be expected to require substantial area for the soakage asset and also be prone to blockages due to the low rate.	



		The design required to size soakage/infiltration devices is specialised and not considered suitable as a permitted activity, however this is covered in the building code and could be suitable if the infiltration design standard within the building code were updated.
(1)(a)(v)(4)&(5)	Treatment, Detention and gradual release to a watercourse or piped stormwater network	The rules state water treatment, detention and gradual release is required, but it doesn't provide specifics for the outlet flows (i.e. matching pre-development flows). There is an advice note that references the WRC guidelines and RITS which provide these specifics. In summary, the rule itself doesn't provide the required detail for compliance in isolation, but if you follow the advice note, then it does. The design required to size detention and release orifices is specialised and not considered suitable as a permitted activity. Additional guidance could be provided through the building code.
(1)(a)(v)(4)&(6)	 Stormwater Treatment shall address; Water quality Downstream erosion Scour effects Cumulative volume effects 	If the term 'Treatment' in the rule refers to treatment devices then the requirement list includes items that are not related to stormwater treatment (erosion, scour and cumulative volume). If the term 'Treatment' refers to general stormwater management (recommended), then this rule covers the listed requirements. As above these are not specific in the requirements unless the advice note is followed. Downstream erosion and scour effects are managed by detention and analysis of the receiving environment (watercourse and soil erodibility). Cumulative volume effects is generally a term used around impacts on the flood storage volume from infilling, however in this context it is not clear. No specifics provided. If the advice note is followed it requires an effects





		assessment to confirm flood levels/areas are not increased from the development. This process is specialised and not considered suitable as a permitted activity.
(1)(a)(vi)	Excludes soakage in unstable areas	Existing rule adequate and aligns with standard design practice. Doesn't cover downstream erosion and stability of watercourses as only related to soakage.
(1)(a)(vii)	Connection to existing drainage system must not result in the minimum level of service not being met. Alteration of existing drainage system or on lot detention required to ensure this.	Existing rule adequate and aligns with standard design practice. Doesn't cover downstream erosion and stability of watercourses as only related to soakage.
	Items not covered by WWS rules	 Overland flow path management (retention of existing overland flow path capacity) Erosion and scour in watercourses downstream of connections Reduction of flood storage or impacts on flooding Resilient soakage design





Table 5: WWS – Natural Hazard Rules review

NH-R-PER (1) Natural Hazard Rules - Flood Plain Management Area and Flood Ponding Area across all zones				
Flood plain man	Flood plain management area and Flood ponding area across all zones			
Rule ID	Existing Rule Commentary and Recommendations			
NH-R1	Construction of a new building, or reconstruction of or an addition to an existing building, is permitted unless specified in Rules NH-R2 – NH-R6			
(1)(a)	Construction of a new building, or reconstruction of or an addition to an existing building, unless specified in Rules NH-R2 – NH-R6 Minimum floor level 0.5m above 1% AEP	Existing rule adequate and aligns with standard design practice, district plans and building code.		
(1)(b)	Compliance with Standard NH-RI(1)(a) shall be demonstrated by a suitably qualified engineer with experience in hydrology.	No checks in place for a permitted activity rule, therefore no insurance that effects will be mitigated.		
NHR8	Earthworks to create a building platform for residential purposes are permitted			











(1)(a)-(h)	Councils discretion limited to the following: - Level of service	This rule covers the flood risk for areas defended by stop banks. These rules are considered to cover foreseeable risks and enable council to manage the flood risk in these areas. Huntly contains significant stop bank management area. This rule continues to apply as a qualifying matter.
	 Impact Effect of ground water Depth and duration of flooding Location of subdivision Adverse effects Transfer of effects Mitigation measures 	o Te Kauri Huntiv Luniv Luniv Luniv Luniv Luniv Mattier 9 GenstreetMap contributos



		Recommendation: Variation 3 rule areas are updated to exclude the identified defended areas (Huntly). This is required as there is no approval process within the permitted rules that enable compliance of these rules.
NH-R25	Construction of a new building, or reconstruction of, or new accessory building, located within 50m of the toe of a stop-bank where the stop-bank is under the responsibility of the Council, the Waikato Regional Council or the Crown	This offset is greater than the proposed variation 3 offsets. This rule continues to apply as a qualifying matter.
NH-R26	Earthworks located within 50m of the toe of a stop-bank where the stop-bank is under the responsibility of the Council, the Waikato Regional Council or the Crown.	This offset is greater than the proposed variation 3 offsets. This rule continues to apply as a qualifying matter.
NH-R68-R74	Mine subsidence risk areas	
NH-R71-R74	Covers construction of buildings and subdivision.	These rules continue to apply as a qualifying matter.





Table 6: EW-R – Earthworks – Land Use review

EW-R Earthworks – Land use effects [000078]{000047}				
Rule ID	Existing Rule	Commentary and Recommendations		
EW-R13 Permitted	Earthworks – General - Medium Density Residential Zone			
(1)(a)(i)	Located 1.5m away from waterway, open drain or overland flow path	The offset is minimal and increases risk for sediment mobilisation reaching a watercourse. Consideration of how this offset aligns with Te Mana o te Wai in terms of prioritising fresh water and enabling restoration of waterways and their riparian margins should be considered further.		
(1)(a)(ii)	Not exceed 1,000m ²	Unlikely to affect stormwater compliance.		
(1)(a)(iii)	Not exceed an area of 1ha over any consecutive 12 month period	Unlikely to affect stormwater compliance. Aligns with sediment and erosion control requirements.		
(1)(a)(iv)	The total depth of any excavation or filling does not exceed 1.5m above or below ground level	Unlikely to affect stormwater compliance.		

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(1)(a)(v)	The slope of the resulting cut, filled areas or fill batter face in stable ground, does not exceed a maximum of 1:2 (1 vertical to 2 horizontal)	Unlikely to affect stormwater compliance.
(1)(a)(vi)	Earthworks must not result in any instability of land or structures	Unlikely to affect stormwater compliance.
(1)(a)(vii)	Areas exposed by earthworks are revegetated to achieve 80% ground cover within 2 months of the completion of the earthworks;	Unlikely to affect stormwater compliance. As per sediment and erosion control requirements.
(1)(a)(viii)	Sediment resulting from the earthworks is retained on the site through implementation and maintenance of erosion and sediment controls and does not enter waterways, open drains or overland flow paths	Unlikely to affect stormwater compliance. As per sediment and erosion control requirements.





(1)(a)(ix)	Do not divert or change the nature of natural water flows, water bodies or stablished drainage paths	Rule considered adequate to manage water bodies.
(2)(e) Restricted Discretionary	Location of the earthworks in relation to waterways, significant indigenous vegetation and habitats;	Considered adequate to protect waterways and comply with Stormwater Discharge Consent conditions.
(2)(i) Restricted Discretionary	Flood risk, including natural water flows and established drainage paths;	Considered adequate to protect waterways and comply with Stormwater Discharge Consent conditions.
(2)(j) Restricted Discretionary	Land instability, erosion and sedimentation	Considered adequate to protect waterways and comply with Stormwater Discharge Consent conditions.

7 EXISTING LEVEL OF COMPLIANCE SUMMARY

SECTION SUMMARY: Known flood issues, water quality and erosion issues are prevalent across the district.

The existing compliance level based upon existing consent conditions from the 2021-2022 annual SW compliance report are outlined below:

Table 7: Stormwater Discharge Consent Compliance Summary

Town	WRC rating	WSL % rating	Flooding Complaints (2020-2022)/Total complaints	Known flood related issues
Pōkeno	Partial Compliance	71%	2/74	Flooding issues around sports field and Hynds areas. Stream erosion issues. Restricted development required (refer CMP)
Tuakau	Partial Compliance	73%	11/59	Flood issues around Dominion Road. Southern flood areas
Huntly	Partial Compliance	66%	11/139	Hakanoa Stream and lake flooding issues (complaints received in 2021, investigation showed outlet channel is undersized and flood pumps unable to operate as designed). Maintenance of catchpit inserts (minor flooding potential)
Ngāruawāhia	Partial Compliance	68%	15/86	Low level ponding in areas beside the SH. Waikato River levels.

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8 EXISTING NETWORK CAPACITY

SECTION SUMMARY: The existing piped stormwater network was primarily construction when the design criteria was less than the current level of service and therefore many pipes will be undersized across the district (estimated at 78% base on installation date (pre 2008)).

The existing stormwater piped networks in Ngāruawāhia, Huntly, Pōkeno and Tuakau are well known for being undersized. This is largely due utilising the 5 year ARI rainfall event (or less) excluding climate change for pipe designs prior to 2008.

The below table analysis the percentage of assets likely to be undersized, based on the most recent asset register data (extracted form the 2021-2022 Stormwater Annual Report).

Town	Total number of assets installed prior to 2008 (Undersized)	Total number of assets installed post to 2008 (Sized for the 10 year ARI + CC)	Total number of SW network assets	Percentage of undersized assets
Pōkeno	1656	273	1929	85%
Tuakau	1802	604	2406	75%
Huntly	1785	464	2249	79%
Ngāruawahia	1247	450	1697	73%

Table 8: Stormwater Pipe Network Capacity Summary (based on asset installation date)

Average Percentage of under-designed assets across all 4 towns above = 78%

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This method of estimating the capacity of the existing network provides an indication only and should not be utilised for renewal or long-term planning. This method was selected due to the time constraints. A more precise method would be to undertake a network model to identify under capacity pipes.

Refer to Appendix B for plans showing the piped network pre and post 2008.

9 EXAMPLE DEVELOPMENT SITE

SECTION SUMMARY: The impact of the proposed rules changes will encourage developments to utilised the maximum allowable impervious area (70%). Whereas without the Variation 3 rule changes not all developments would utilise this maximum. The increase from 40/45% building coverage to 50% will increase the requirement for earthworks. If these earthworks occur within the flood plain there will be adverse effects without offsetting the flood storage.

To evaluate the potential impact of the proposed Variation 3 Medium Density rule changes, we have undertaken an example site that complies with the 3 x 3 rules. This was undertaken using a 600m2 site being developed with 3 town houses. The following sections outline the design criteria used. The example site includes treatment and detention that is currently required and enforced by the consenting system at Waikato District Council.

9.1 DETENTION REQUIREMENTS (EXAMPLE)

An example detention sizing has been undertaken and is outlined below; Table 9: Detention Tank Sizing

Summary

	Total Impervious (m ²)	Total Pervious (m ²)	% total impervious	% total pervious
Pre-development condition [4]	0	200	0%	100%
Post-development condition	140	60	70%	30%
Post-development runoff volume [5]	3.74 m ³			
Pre-development runoff volume	0.54 m ³			
Hydrology mitigation volume	3.2 m ³			
Retention volume [6]	0.7 m ³			
Detention volume [7]	2.5 m ³			

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Minimum reuse tank size required by the 3 waters practice note is 5,000 litres.

Total size of tank required = 700 + 2500 + 5000 = 8200 litres.

typical tank sizes available:

- 9,000 litre with a diameter of 2.2m 2.6m
- 10,000 litre with a diameter of 2.3m 2.8m

9.2 TREATMENT REQUIREMENTS (EXAMPLE)

On site treatment devices have many issues in terms of maintenance and access. These are not preferred by the Waikato District or Regional Councils. The proposed legislation shows that it is not possible to meet the required water quality requirements by use of swales or filter strips, this leaves raingarden or filter chambers. In the example provided there is no space for swales and therefore the only practical options are a raingarden or a media filter. As media filters are expensive to maintain we have shown raingardens sized for each lot.

Raingardens require 3%-10% of catchment area. Based on driveway only area and using 5% of the catchment the size of a raingarden for each lot is approx. 2.2 m² (1.5×1.5 m).

9.3 SOAKAGE DISPOSAL (EXAMPLE)

Porous paving maybe utilised if soakage is available in the area. Soakage is variable across the district and often not available. Soakage design requires specific testing and design by a qualified engineer.

9.4 OVERLAND FLOW PATHS MANAGEMENT

Overland flow paths are a significant contributor in minimising flood hazards. The proposed rule changes do not enable sufficient area to manage overland flow paths. Only major overland flow paths are identified on Councils flood maps and models, however minor over land flow paths can also have an effect on flood levels and ponding if blocked or modified.

Currently the presence of overland flow paths through a site are checked during the consent review process. It is also required that these overland flow path ability to convey upstream flow is maintained. The central waterway in Pōkeno CBD is an example where development across the overland flow path has caused increased flooding in neighbouring properties. This limits future development potential.

9.5 COMPARISON: 3 X 3 DEVELOPMENT VS STANDARD SINGLE DWELLING

This shows an example of a scenario where a $600m^2$ lot could be divided into $3 \times 200m^2$ lots with the coverage areas required to comply with the proposed rules. Each $200m^2$ lot would contain 3 dwellings. This example includes the reduced offsets to the boundaries, $3 \times private$ raingardens for treatment, $3 \times soakage$ areas and reuse/detention tanks. This example has highlighted the following issues:

- No room to manage significant overland flow paths (>2m wide).
- Specific design required to fit water tanks and raingardens.
- No space for disposal via soakage unless driveways are used (this makes maintenance difficult).
- Requires on lot mitigation which has common issues including;
 - o Limited maintenance undertaken by land owner.
 - o Difficult for Council to check is management systems are still working as required.
 - Encourage the use of systems that are difficult to access, maintain and replace (i.e. under house or driveway tanks or soakage).
- Utilises most of the site for building requiring more earthworks.
- Increases driveway areas requiring treatment and vehicles per day on driveways.
- Decreases the vegetation and impervious areas.
- Increases runoff for larger events than designed for (i.e. >100 year ARI).
- Places more people in flood risk areas and increases additional people and vehicular movements during extreme rainfall events.

The following figures show the difference between the proposed 3x3 developments and the standard (average) single dwelling development, for a lot with an overland flow path through the central area.

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Figure 4: Variation 3 Development Type A: Development example where lot coverage is maximised across the full site area.



Figure 5: Variation 3 Development Type B: Development example where lot coverage provides open space in the centre of the lot.

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Figure 6: Variation 3 Development Type C: Development example where lot coverage is to one end of the lot.

Development Type	Ability to manage Over Land Flow Paths (OLFP)*	Ability to manage flood plain*	Ability to utilise on lot soakage for SW disposal*	Ability to utilise rain tanks for detention/re-use*
A	Blocks OLFP from all sides.	No room to offset flood plain	No obvious area for soakage	No obvious area for rain tanks
В	Unlikely but possible if OLFP is located across the centre of the lot.	Unlikely as open space is isolated (between buildings).	Unlikely but possible	Could utilise open space area
С	OLFP would need to be minimal and located front or back of lot.	Flood plain would need to be minimal and located front or back of lot.	Could utilise open space area	Could utilise open space area

Table 10: Ability to Manage Stormwater by Lot Layout

*Site/location specific

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10 FLOOD IMPACTS

SECTION SUMMARY: General discussion around flooding effects including offsetting flood storage. Whilst the individual increase of flood levels from a single development maybe small, the cumulative effects can be significant and have already resulted in flooding issues and impacts across the district.

Flooding is an issue in all the towns under consideration (refer to Appendix A). As outlined in the Tuakau, Pōkeno, Huntly and Ngāruawāhia Catchment Management Plans (CMP), there are currently multiple areas with predicted flooding in residential areas. The main waterways in Pōkeno, Huntly and Tuakau also contain significant erosion. It is likely that this is due to existing development (increased impervious areas) without mitigation (detention and extended detention).

Risks of infilling allowance increasing from 40% to 50% will vary depending on individual sites. The increase of individual developments may appear small in some cases; however, the accumulative effects will be significant. Infilling in the flood plain has already started to restrict development in some areas across the district. For example, in Pōkeno where new developments are required to mitigate to 70% of predevelopment flows (as per the Pōkeno CMP) which is an increase from the RITS standard 80% if there are downstream flooding issues.

Please note that detention tanks generally do not provide flood mitigation when developments are within the flood plain as the volume of the tanks are minimal compared to the flood volume. Detention tanks mitigate the down stream flows.

10.1 FREEBOARD

Freeboard represents the current level of service for flooding in the district which requires 500mm from the 1% AEP flood level (including RCP6 climate change prediction) to the finished floor level (FFL). Any increase in flood levels across the district will reduce this freeboard as shown below. Any increase in flood level will reduce this level of service.



Figure 7: Increased flooding and reduced freeboard (level of service) from infilling in the flood zone

10.2 OFFSETTING OF FLOOD VOLUME

Additional filling of the flood plain due to the need for increased building areas can have a significant impact on the flood storage volume as shown below.



Figure 8: Flood storage being offset by a new development.

10.3 COMPENSATORY CUTS TO MITIGATION FLOODING

Some development sites maybe able to provide compensatory cuts to ensure that flood volumes are maintained. This is show below in an example of what is commonly proposed. The area required to do this is not provided for in the limited offsets outlined in the Variation 3 rules (note the location of the boundary required to keep all site works within the boundary).



Figure 9: Offsetting of flood volume to mitigate infilling in the flood zone

10.4 AFFECTED PROPERTIES

The modelling undertaken in Appendix A shows the raw flooding and ponding areas across the urban zones. This shows a number of isolated ponding area which are due to the way the provided LIDAR flattens the houses (roofs) to provide the ground topography. In reality, these areas are unlikely to existing due to site drainage and the small diameter stormwater piped network. As these would not be considered a flood risk area potentially impacting on the main flood storage these have been removed for the following summary table. This table outlines the number of properties affected by flooding. This is based on the removal of isolated flood areas being removed if they cover less than 25% of the lot area (based on an average lot size).

Table 11 Affected Properties Table:

Town	Total Lots	otal Lots Total Lots		Percentage of V3	
	Urban Areas	within V3 zones	flood plain	flood plain	
Tuakau	2319	1011	253	25%	
Pōkeno	2360	1805	536	30%	
Huntly	3297	2319	1206	52%	
Ngāruawahia	2583	1621	723	45%	

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11 RECOMMENDATIONS

It is understood the following recommendations can be made through the Variation 3 process:

- Developments within the flood plain (including overland flow paths) should be restricted under Variation 3 or require the developer to gain a consent to ensure effects are less than minor (change from Permitted to Restricted Discretionary or similar).
- 2. All district plans are required to give effect to Te Mana o te Wai and the NPSFM

The following recommendations should also be considered by the Council:

- 3. Some existing District Plan Rules should be updated to enable flood plain and overland flow path management is achieved and adverse effects are minimised.
- 4. Some existing District Plan Rules would benefit from re-wording to ensure their requirements are clear and concise.
- 5. Additional rules should be considered to enable WDC to comply with its current stormwater discharge consents.
- 6. Identification of areas required for enhancement of fresh water waterways and tributaries to inform planning decisions and zoning (and any new district plans).
- 7. Additional routing is recommended on the flood hazard maps to ensure isolated ponding areas due to the LIDAR ground surface processing are not included as flood risk areas.
- 8. Update the High Risk Flood areas utilising depth x velocity components to more accurately represent high risk areas.

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Figure 10: Recommend Council Process (simplified)

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31 May 2023



Table 12: Detailed Recommendation Summary

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Detailed Recomm	Detailed Recommendations				
Rule ID/Ref.	Rule/Requirement Description	Recommendation(s)			
Variation 3					
MRZ2-S5 Building Coverage	Maximum building coverage on site is 40%. Increase to 50%.	Recommendation: No increase to building coverage for properties within the flood plain unless assessed by a suitably qualified person(s).			
MRZ2 S13 Building Setbacks – Water Bodies	Existing rule required 25.5m offset, proposed rules reduces this to 21.5m (-1.5m). Existing rule required 28m from Waikato River and Waipa Rivers, proposed rules reduces this to 25.5m (-2.5m).	Offsets from rivers should be based on river modelling and flood extents. Reduction of setback could impact on flood storage and increase surrounding flood levels. More information is needed to understand how this reduction was calculated. Needs to include assessment of effects. Without detailed information we recommend this remains as is.			
WWS-1 R1 Rules: W	/WS – RI (PER): Stormwater systems for new development or subdi	vision (00078)			
(1)(a)(v)	Stormwater management measures and low impact design				
(1)(a)(v)(2)	Soakage techniques	The building code method for determining the design soakage rate is known to over-estimate design soakage rates by up to 10 times and is considered not fit for purpose. Soakage design			

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		is specialised and not considered suitable as a permitted activity. Recommend that soakage is a RDIS activity and not a Permitted Activity and re-wording of this section to clearly define the rule is required.
(1)(a)(v)(3)	Infiltration Rate of a minimum of 7mm/hour	The design required to size soakage/infiltration devices is specialised and not considered suitable as a permitted activity, however this is covered in the building code and could be suitable if the infiltration design standard within the building code were updated. Recommend that the minimum allowable soakage rate is increased to 30mm/hour to align with accepted soakage guidelines and is a RDIS activity and not a Permitted Activity. Also, re- wording of this section to clearly define the rules is required.
(1)(a)(v)(4)&(5)	Treatment, Detention and gradual release to a watercourse or piped stormwater network	The rules state water treatment, detention and gradual release is required, but it doesn't provide specifics for the outlet flows (i.e. matching pre-development flows). There is an advice note that references the WRC guidelines and RITS which provide these specifics. In summary, the rule itself doesn't provide the required detail for compliance in isolation, but if you follow the advice note, then it does. The design required to size detention and release orifices is specialised and not considered suitable as a permitted activity. Additional guidance could be provided through the building code.





(1)(a)(v)(4)&(6)	Stormwater Treatment shall address;	Reword the rule to provide a clear understanding of what is required.		
	 Water quality Downstream erosion Scour effects Cumulative volume effects 	Remove from permitted activity status (to RDIS).		
Items not covered by WWS rules	 Overland flow path management (retention of existing overland flow path capacity) Erosion and scour in watercourses downstream of connections Reduction of flood storage or impacts on flooding Resilient soakage design 			
WWS – Natural Haz	ards: Flood Plain Management Area and Flood Ponding Area	across all zones		
NH-R Permitted	Flood plain management area and Flood ponding area across all z	ones		
NHR8	Earthworks to create a building platform for residential purposes			
(1)(a)	Filling height is only to the extent necessary to achieve compliance with Rule NHR1(1)(a).	Recommend that permitted activity is revised to Restricted Discretionary (RDIS) for filling within the flood plain.		

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NH-R9	Permitted activity status enables infilling for building with no controls except limiting to building platform. RDIS rules require adverse effects to be managed. Earthworks not provided for under Rules NH-R7 or NH-R8 [000043	3, {000073, 000051}
(1)(a)	In the GRZ – General residential zone, MRZ – Medium density residential zone, LLRZ – Large lot residential zone, SETZ – Settlement zone and RLZ – Rural lifestyle zone, a maximum volume of filling above natural ground level of 10m ³ per site, and a maximum cumulative volume of filling and excavation of 20m ³	Recommendation: Remove infilling within the flood plain or overland flow paths from permitted rule. Allow if an effects assessment show the effects are less than existing effects.
NH-R11 to R22	High risk flood area across all zones	High risk flood zones are specified at 1m depth and 1-2m/s. This is significantly higher risk that what is considered a hazard (as per standard D x V analysis rick matrix). Consideration: Rules restricting development in High Flood Risk areas should be expanded across flood plans in line with the Australian Disaster Resilience – Technical flood risk management guidelines: Flood hazard, as adopted by Tauranga City Council to align with Worksafe NZ requirements



APPENDIX A – FLOOD RISK AND NETWORK CAPACITY MAPS

- Tuakau
 - Flood Hazard Map Aerial and Zones
 - Flood Hazard Map Flood depths, High Risk Flood Areas and Zones
 - o Network Analysis undersized pipes (base on installation date)
- Pōkeno
 - o Flood Hazard Map Aerial and Zones
 - Flood Hazard Map Flood depths, High Risk Flood Areas and Zones
 - o Network Analysis undersized pipes (base on installation date)
- Huntly
 - o Flood Hazard Map Aerial and Zones
 - Flood Hazard Map Flood depths, High Risk Flood Areas and Zones
 - Network Analysis undersized pipes (base on installation date)
- Ngāruawahia
 - o Flood Hazard Map Aerial and Zones
 - Flood Hazard Map Flood depths, High Risk Flood Areas and Zones
 - Network Analysis undersized pipes (base on installation date)









Project:

Variation 3 Tuakau Flood Extent

Document: TMW-CSW Sht 1 N Date:31/05/2023 Rev 0 165 330 660 m



LEGEND



unity maps contributors



	TE MIRO. WATER	
5	Client: Waikato	
	Project: Variation 3 Tuakau Flood Model	
	Document: TMW-CSW Sht 1 N Date:6/06/2023 Rev Image: Non-state state sta	
(LEGEND	
<u> </u>	MPD Flood Model 1% AEP + CC Maximum Depth (m) <0.1	
	0.10-0.20 0.20-0.40 0.40-0.60 0.60-0.80 0.80-1.0	7 _{rig} Rd
	1.0-2.0 (High Risk) * >2.0 (High Risk) * Zone variation 3 Plan Zones	
	Residential Village	

* High risk flood areas determined by depth greater than 1m only. Actual high risk flood areas require a velocity x depth analysis (To be undertaken)

Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.







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	MPD 1% AEP + CC Flood Extent
	Zone variation 3
Plan	Zone
	Country Living
	Business
	Business Town Centre
	Industrial
	Heavy Industrial







LEGE	ND
	Old SW Network (Pre 2008) 79%
—	New SW Network (Post 2008) 21%
Zone	variation 3
	GRZ - General residential zone
	MRZ - Medium density residential zone
Plan Z	Zone
	Country Living
	Business
	Business Town Centre
	Industrial
	Heavy Industrial

88 m

164 m

Wajy LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS









APPENDIX B - STORMWATER REGULATION AND RULES SUMMARY

LAND DRAINAGE ACT

The Land Drainage Act is a New Zealand legislation that provides for the establishment, maintenance, and improvement of land drainage systems. The Act defines a land drainage system as any works or facilities for the drainage of land or the protection of land from flooding or inundation.

The Act empowers local authorities to establish and operate drainage systems within their respective areas, as well as to acquire land, and to exercise powers of entry to carry out necessary work. The Act also requires landowners to contribute to the cost of drainage works, proportionate to the benefits they receive from the works.

Under the Act, local authorities are required to consult with affected landowners and other interested parties before undertaking any drainage works or levying any rates. The Act also establishes a process for resolving disputes between landowners and local authorities over drainage matters.

Overall, the Land Drainage Act provides a legal framework for the establishment and operation of land drainage systems in New Zealand, with the aim of reducing the risk of flooding and inundation, protecting property, and promoting the sustainable management of water resources.

The Land Drainage Act was first passed in 1908. In 1948, the Act was amended to clarify the powers of local authorities in relation to land drainage and flood protection. In 1964, the Act was further amended to allow for the construction of artificial waterways for the purposes of drainage and flood protection. In 1988, the Act was again amended to reflect changes in local government structure and functions. This amendment transferred the responsibilities for land drainage and flood protection from catchment boards to regional councils. The most recent amendment to the Land Drainage Act was made in 2017. This amendment updated and clarified the Act to ensure that it was fit for purpose in the modern context of land drainage and flood protection.

RESOURCE MANAGEMENT ACT 1991

The Resource Management Act 1991 of New Zealand, which has been subsequently amended in 2010 is summarised below in terms of stormwater effects. The Act is a comprehensive piece of legislation that covers a wide range of environmental management issues in New Zealand, including stormwater management.

Regarding stormwater, the Resource Management Act sets out various provisions to manage its impacts on the environment and ensure that the stormwater outcomes are of appropriate quality. Some of the key provisions related to stormwater quality outcomes include:

Objectives and Policies: The Act requires regional councils to prepare a Regional Policy Statement (RPS) that sets out objectives and policies for the management of natural and physical resources, including water. The RPS must provide for the sustainable management of water, including the management of stormwater quality and quantity.

National Environmental Standards: The Act allows for the development of National Environmental Standards (NES) that set out specific requirements for the management of particular environmental issues. In 2011, the government developed the National Environmental Standard for Sources of Human Drinking Water (NES-DW) that sets out requirements for the management of land use activities that may impact on sources of human drinking water. The NES-DW includes provisions to manage stormwater quality by requiring that discharge of contaminants from land to water is controlled to maintain or improve water quality.

Resource Consent: The Act requires that any activity that may have an adverse effect on the environment, including stormwater discharges, must have a resource consent. Resource consents for stormwater discharges may include conditions to manage the quality of the discharge, such as requirements to prevent or control the discharge of contaminants from land to water.

Monitoring and Reporting: The Act requires monitoring and reporting of the quality of stormwater discharges to assess compliance with the relevant water quality standards and consent conditions. Regional councils are required to establish monitoring programs for stormwater discharges and report on the results of monitoring to ensure compliance with water quality standards.

Enforcement: The Act provides for enforcement measures, including fines and prosecution, for non-compliance with resource consents and water quality standards.

Overall, the Resource Management Act sets out a framework for the management of stormwater impacts on the environment, including requirements for the management of stormwater quality to prevent or control the discharge of contaminants from land to water. The Act requires regional councils to develop policies and standards to achieve water quality outcomes, establish monitoring programs to assess compliance with standards, and provide enforcement measures to ensure compliance with resource consents and water quality standards.

NEW ZEALAND BUILDING ACT AND CODE

In New Zealand, the Building Act 2004 provides the legislative framework for regulating the construction, alteration, demolition, and maintenance of buildings. It sets out the requirements for obtaining building consents, code compliance certificates, and outlines the roles and responsibilities of building professionals, such as architects, engineers, builders, and building consent authorities.

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The Building Code is a set of minimum standards and requirements for the design, construction, and performance of buildings, established under the Building Act. The code outlines technical specifications for things like structure, fire safety, moisture control, accessibility, and durability, among other aspects. It serves as a reference for building professionals to ensure that buildings are safe, healthy, and durable for the occupants and the environment.

In summary, the Building Act sets out the legal requirements for building work, while the Building Code provides the technical specifications for meeting those requirements.

The New Zealand Building Code has several requirements related to stormwater management, including:

- Roof drainage: All buildings must have a suitable roof drainage system that prevents water from entering the building and discharges it to a safe location.
- Surface water drainage: The site must be graded to prevent surface water from ponding or flowing towards buildings. Surface water must be discharged to a safe location.
- Subsoil drainage: Subsoil drainage must be provided where necessary to prevent water from accumulating and affecting the stability of the building or causing dampness.
- Overland flow paths: Overland flow paths must be provided to direct stormwater away from buildings and towards a safe discharge location.
- Retention and detention systems: Buildings must be designed with suitable retention and detention systems to manage stormwater runoff.
- Erosion and sediment control: Adequate measures must be taken to prevent erosion and sedimentation during construction and to prevent sediment runoff from the site after construction.

These requirements are designed to ensure that stormwater is managed effectively to protect buildings and the environment.

The New Zealand Building Code includes provisions related to earthworks in a floodplain area. Specifically, clause E1 Surface Water aims to minimize the risks to people, property, and the environment from surface water runoff. It includes requirements for managing the effects of earthworks on surface water runoff and avoiding increases in surface water runoff that could cause harm. The clause also requires the collection and discharge of surface water to comply with local authority requirements, which may include provisions related to floodplain management.

In addition, the Building Code also includes a set of design standards for drainage systems, including stormwater management. These standards are found in Acceptable Solutions E1/AS1 and E1/AS2, which provide guidance on the design and construction of drainage systems to minimize the risks associated with surface water runoff. These documents include requirements for the sizing, layout, and installation of drainage systems, as well as

guidelines for the selection and use of drainage materials. They also provide guidance on the management of surface water runoff from buildings and surrounding areas, including earthworks in floodplain areas.

REGIONAL COUNCIL STORMWATER DISCHARGE CONSENTS

The stormwater discharge consent conditions may include requirements for monitoring and reporting of discharges, limits on discharge volumes and flow rates, provisions for treatment of stormwater prior to discharge, and measures to minimize environmental impacts. It is likely that the specific conditions would be tailored to the site and surrounding environment and would be based on various environmental and technical assessments. Specific conditions include;

- The consent holder must ensure that the discharge does not exceed the specified limits for various contaminants, including total suspended solids, biochemical oxygen demand, and various heavy metals.
- The consent holder must regularly monitor the discharge to ensure compliance with the specified limits, and provide regular reports to the Waikato Regional Council detailing the monitoring results.
- The consent holder must implement measures to mitigate adverse effects of the discharge on the receiving environment. This includes measures such as installation of sediment traps, erosion and sediment control, and revegetation of disturbed areas.
- The consent holder must provide adequate public notification of the discharge, including information about the nature of the discharge, its potential effects on the environment, and contact details for the consent holder.
- The consent holder must comply with any other relevant legislation, policies, and guidelines, including the Resource Management Act 1991, Waikato Regional Policy Statement, and Waikato Regional Plan.
- The consent holder must comply with any other relevant conditions that may be imposed by the Waikato Regional Council, and provide regular updates to the Council on any changes to the discharge or the operations of the facility.

CATCHMENT MANAGEMENT PLANS

The Catchment Management Plans provide a comprehensive framework for the management of Waikato Towns and Villages, with a focus on protecting and restoring the catchment's natural ecosystems, while also managing land use and development to minimize impacts on water quality and quantity (flooding and overland flow paths). The CMPs provide for the implementation of a range of management measures to achieve the objectives and targets for the catchment, and includes provisions for monitoring and reporting on progress towards achieving these targets.

The CMPs also include objectives and targets for the management of the catchment, including:

- The reduction of contaminants;
 - Nutrients Sediment Heavy Metals

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Floatables

Hydrocarbons/oil

- Protection and restoration of the catchment's natural ecosystems
- Outline flooding areas within the catchments with the aim of minimising flood risk
- Assist achieving more sustainable development by;
 - Outlining Land use controls
 - Planning constraints and opportunities
 - Supporting the use of low-impact design

DISTRICT PLAN SUMMARY

The Waikato District Plan sets out specific provisions for managing the effects of flooding, including restrictions on the location and design of new development in areas at risk of flooding. The Plan requires that any proposed development in a flood-prone area must take into account the potential flood hazard and be designed to minimize the risk of flooding.

The Waikato District Plan contains rules that aim to manage the risks associated with flooding. The district is vulnerable to flooding due to its location along major river systems, such as the Waikato River and its tributaries, as well as its low-lying coastal areas.

Some of the district plan rules relating to flooding in the Waikato District include:

- Flood hazard overlay zones: The district plan designates flood hazard overlay zones that identify areas that are at risk of flooding. These zones are used to regulate land use and development in these areas, and to require specific design standards for buildings and infrastructure to reduce the risk of flood damage.
- Building level restrictions: The district plan specifies maximum building floor levels in flood hazard overlay zones to ensure that buildings are not constructed at a level that would increase the risk of flooding damage and harm.
- Setback requirements: The district plan requires a minimum setback from waterways and other areas at risk of flooding to ensure that buildings and infrastructure are not located in areas that are likely to be impacted by flooding.
- Stormwater management: The district plan includes rules that require developers to manage stormwater runoff from their properties to reduce the risk of flooding. This may include the installation of detention ponds, swales, and other measures to manage the quantity and quality of stormwater runoff.
- Earthworks and filling: The district plan includes rules that regulate earthworks and filling in areas at risk of flooding. These rules aim to ensure that earthworks do not increase the risk of flooding or impact on the natural environment.

Overall, the district plan rules relating to flooding aim to manage the risks associated with flooding, protect people and property, and promote sustainable development in the Waikato District.

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APPENDIX C - HYDRAULIC MODELLING REPORT

Modelling Standards

- Waikato Regional Council Modelling Guidelines
- Waikato District Council Modelling Guidelines (hydraulic modelling setup)
- Regional Infrastructure Technical Specification

Modelling Software

TUFLOW model will be used for 2D rain on grid to determine the existing inflows, Outflows, overland flow paths

and flood areas.

Hydraulic and Hydrological Parameters

The hydrologic and hydraulic model selection and parameters are outlined in Table 1.

Table 1 Hydrologic and Hydraulic Model Parameters

PARAMETERS	DETAILS AND ASSUMPTIONS
SUMMARY	The flood assessment uses a 1D/2D TUFLOW (Version 2020-01-AA) hydraulic model. Design flood hydrographs have been developed using HEC-HMS software for the 1% AEP events with Climate Change to 2120.
	In summary, the parameters used in the TUFLOW model include:
	 Councils GIS data was used for dimensions, length, inverts, and roughness. Where insufficient information was not available to define asset data (i.e., pipes data missing or incorrect), assumptions around size, grade and material were made. A Manning's 'n' roughness distribution has been applied to reflect changes in vegetation and land use type within the study area. Roughness values have been determined from the land use coverage from LINZ data in a shapefile format The 2D TUFLOW model uses a 2m x 2m grid with the ground level applied within each grid cell taken as the average of the LiDAR points within that cell. No soil infiltration was considered in the hydraulic model, as this is accounted for in the hydrological modeling. The boundary condition downstream consists of a Normal Slop, assumed as a 1% slope in all the scenarios. Although the stream is discharging into the Waikato River for the assessment, the tailwater level has not been considered. All isolated ponding less than 20% of an average lot size of 600m² has been removed from the flood maps to more accurately represent flood hazard areas. Ponding less than 100mm has been excluded from the results model.
MODELLING APP	ROACH
The model incorp Probably Developr	orates rain on grid approach where global and excess precipitations are used for the Maximum nent (MPD) scenario. This includes 70% impervious for urban areas and 90% for commercial.
VERIFICATION	Field verification has not been undertaken as it is not included in the project scope. It is recommended verification be undertaken as part of future works if required. No calibration with real world data has been undertaken.

	Hydrologic	al Losses for MPD s	cenari	o were Calculated using	g the <i>li</i>	nitial and Const	<i>ant loss</i> r	nethod.
HYDROLOGICAL LOSSES	The following infiltration values are used for different soil drainage groups							
	Soil			Initial Co		nstant		
		Gro	up	Loss(mm/hr)	loss((mm/hr)		
		А		19		11.4		
		В		8.1		7.6		
		С		4.5		3.8		
		D		3.2		1.3		
	Source:Hee	c.usace.army:		I I				
	https://ww	/w.hec.usace.army.r	nil/cor	nfluence/rasdocs/r2dum	n/lates	t/developing-a-	terrain-n	nodel-
	and-geospatial-layers/infiltration-methods							
	Because of the variety of soils in the area, a weighted CN was determined for each sub-catchment.							
	Adopted c	urve numbers have	been s	ourced from the HCC G	IS curv	/e number datas	set devel	oped as
	part of HC	C's stormwater mas	terplar	n project (HCC, 2017).				
	The weight	ted curve numbers	for dev	veloped areas also inco	rporat	ed different % i	mpervio	us areas
	has been ir	ncorporated in the r	nodel.	The assumptions are ba	ased o	n the table belo	W	
		Zone Name	%	mpervious in ED		% Imperv	vious	
						in MPD		
		Rural						
			AR	EA TAKEN FROM BUILDING L	AYER	AREA TAKEN F	ROM	
			A	ND 100% IMPERVIOUS APPLI	ED	BUILDING LAYE	RAND	
						100% IMPERV	lous	
						Arreito		
		Posidontial	_			80		
	-	Commorcial	_			00		
	+	industrial				90		
		Roads				30		
		AREA TAKEN FROM ROAD LAYER AND 80% IMPERVIOUS APPLIED						
	Hydrologic	sub catchmont do	linosti	an was initially dovelo	nod u	sing the water	bod dof	inition
CATCHMENT	algorithm	within the GIS onvi	ropmo	on was initially develop ant. This tool defines s	peu u ub cat	sing the waters	arios bas	inition ad on
	anguittiini	the digital terrain d	ata (Lif	AR) and identification	of flow	unaths based or	a topogra	eu on
DELINEATION			מנמ (בונ		01 110 0		rtopogra	ipny.
	Individual	road catchments w	oro do	lineated for manholes	and ca	atchnits falling i	nside the	e road
ROAD	nolvgons -	The catchments we	e delir	heated in a way to make	e sure	to have at leas	t one rec	reiving
CATCHMETNS	catchpit in	each of them.	c uciii		c surc		t one ree	,crving
	ou compre m							
	Runoff hvo	lrographs for the ro	ad cat	chments were distribut	ted ov	er all the catch	pits fallir	ng in a
	road catch	iment. Manholes ai	e not	linked to the 2D doma	ains so	o that they can	not rece	ive or
	discharge v	discharge water.						
	Rainfall dat	ta was taken from th	ne exis	ting model – the rainfall	was s	ourced from the	e NIWA F	IRDS v4
DESIGN RAINFALL	website on	website on the 10th of March 2020 and is outlined below.						
	HIRDS (V4) Design rainfall depths (mm) – Historical Data							
		Town	Dur	ation / AEP event	1	LO% AEP	1%	AEP
	-	Tuakau		24h - Duration		112	17	79
	P	Pōkeno		1h - Duration	119	190		
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	Huntly		24	1h - Duration	111	175		
	Ngā	Ngāruawahia		1h - Duration	127	198		
	WRC recommends adopting RCP 6 as a minimum which was used for the model as outlined below;							
LAND USE / ROUGHNESS	The area was separated into land cover classifications in QGIS using five categories (houses, roads, dense vegetation, cultivated areas, and Water bodies). The remaining areas of the catchment were assumed to be grass cover. Manning's values are consistent with the Waikato Stormwater Management Guideline							
	Houses	Grass	Roads	Water bodies (Low Vegetation)	Water bodies (Dense	Water bodies (Medium		
					Vegetation)	Vegetation		
	0.5	0.0	0.0	0.03	0.07	0.04		
	 Pipes with missing inverts, were assigned the invert levels from the neighbori manholes or pipes. In case, none of the connected manholes and pipes have any inverts, then the invert were interpolated from the ground network as <i>invert = ground level - 0.6 - diameter of the largest connected pipe</i> A 600mm cover was assumed for all the interpolated points Additional sensibility checks were undertaken when pipe data showed a reduction pipe sizes as flow moves downstream. This was only updated if the pipe size deviat more than one standard pipe size or if we had reason to believe there was an error the GIS data (i.e. a potential typo resulting in a non-standard pipe size). 					s, then the inverts ected pipe ved a reduction in pipe size deviated re was an error in ze).		
MANHOLES	 Diameters for Manholes with missing diameter were taken from the largest connected pipe. Missing manholes inverts were taken from the invert of the lowest connected pipe. 							
CULVERT INPUTS	Culverts ar	e incorporated	in the model	where a significant wa	terway occurs			
LIDAR	The DEM provided had a resolution of 1m x 1m that forms the base information for the hydraulic model. This data was assumed to be accurate, and no adjustments have been made other than adding the proposed surface for the Post development scenario. LIDAR datum is NZVD2016 and collection was in 2022.							
GRID SIZE	The 2D TUFLOW model uses a 2m x 2m grid with the ground level applied within each grid cell as the average of the LiDAR points.							

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	The Sub-Grid Sampling (SGS) approach has been utilized in the TUFLOW software for the model. The SGS approach samples the bathymetric data at a finer resolution than the 2D grid (0.5m x 0.5m), generating depth-varying hydraulic properties for each cell.
BOUNDARIES	A downstream boundary was set as a normal depth of 0.5%, consistent with the area's slope.
SENSITIVITY RUNS	Sensitivity analysis has been undertaken on previous runs and thus has not been adopted for this model.
ASSUMPTION AND LIMITATIONS	The Digital elevation model (DEM) is assumed to be accurate and acceptable for use in the study. The DEM presents higher elevations than the ground level in dense vegetation areas. In these cases, the LIDAR was lowered with break lines according to the data available from the survey.
	Where possible, the model aligns with the Waikato Stormwater Runoff Modelling Guidelines (Jun 2018).

Author	Reviewer
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26/05/23	26/05/23