Attachment A
Section 92 Response, parts 1, 2, 3

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Attachment A: Section 92 response

Part 1: Overall methodology

This section clarifies the overall approach to the Te Tupu Ngātahi (TTN) North Notices of Requirement (NoRs) and future consenting process with respect to stormwater and flooding. This future process relates to the future Outline Plan of Works (OPW) process, design and future regional consenting processes.

The NoRs seek to designate (route protect) land for future transport corridors/stations, including sufficient space to mitigate effects. They seek to authorise district plan matters, which include flood hazards. Sufficient flexibility is also sought to treat and manage stormwater; although the designations do not authorise stormwater discharges or diversions or structures in streams as these will be subject to a future regional consenting phase. The key provisions for NoRs are those set out in s171 of the Resource Management Act 1991, where relevant matters of the various policy and plans are to be considered, along with the effects of allowing the NoRs, considering alternative sites route and methods and whether the designation is reasonably necessary to achieve the Requiring Authority's objectives. In terms of the Auckland Unitary Plan, Natural Hazards E36.2 (4), (5) and (6), relate to flooding and are considered relevant.From a design perspective, and with consideration of effects to be considered by future resource consents the stormwater design philosophy can be paraphrased as "can the future works be designed and constructed in a way that appropriately manages flooding effects and stormwater management effects and "is there sufficient land to construct the future transport corridor and mitigate effects" ..

As we want to have contain the majority of effects within the future corridor, the amount of land required depends upon the definition of "effects" and where those effects are spatially. If "effects of concern" at the NoR boundary were defined as very small or "nil effects", the NoR would need to be bigger to contain those effects or works proposed will be bigger and more expensive (as waterway crossings will need to be bigger with longer bridges to achieve very small or "nil effects"). The more that the effects need to be contained within the designation boundary – the more that bridges or culverts will need to be set back from the boundary and land increased within the designation to allow space for any change in flood levels to be contained.

Quite simply, structures across waterways require some hydraulic head to push them through a constriction like a bridge or culvert – bigger, longer structures are more expensive but have smaller head losses. It is impractical and not cost effective to design structures with very little head loss. To have certainty on the levels of effect the whole design needs to be progressed as there is a lot of integration and interplay between different design disciplines – the Flood Hazard Assessment is

therefore necessarily high level and some flexibility for the future design process (such as sizing culverts and bridges) needs to be retained. The allowable 50mm change at the boundary proposed as part of the Flood Hazard condition is set based on our knowledge of hydraulics and experience of working with similar consent/NoR conditions. It is considered that 50mm is the minimum change that is generally achievable. Greater allowances to allow greater flexibility would be preferred; however this can only occur where effects on adjacent property are acceptable.

To limit the scale of off-site effects further afield, flood performance standards/outcomes have been identified in the proposed condition, of which we consider the most important to be the reduction in freeboard to habitable floors that already flood or have limited freeboard. During future detailed design at the OPW stage, the Requiring Authorities (Ras) will apply both the change in head loss at the boundary (being up to 50mm) and the reduction in freeboard at the habitable floor level to identify which is the more restrictive case.

The design of the transport corridors/stations is an ongoing process and one that will iterate with increasing understanding of constraints, effects and design certainty. The key mitigation that the Ras are proposing at this stage for the OPW process is the criteria set out in the Flood Hazard condition (see Section 1.4). We believe that this condition addresses the key potential effects associated with flooding and compliance with the condition ensures that effects beyond the designation boundary will be appropriately managed. This condition has been framed so that there is a balance between managing the effects to the extent practicable while retaining a small amount of flexibility for the future designers. The OPW will present the outcomes of hydraulic flood modelling for the detailed design at that time. To retain flexibility outside the specified outcomes in the Flood Hazard Condition, the final clause of the Flood Hazard Condition allows the Ras to negotiate a different outcome at a specific location with the landowner's agreement.

The future regional resource consent process gives Council another opportunity to review the potential effects in the future. Our view is that consents will be required under sections 13, 14 and 15 of the RMA for culverts and bridges, stormwater diversion and discharge and flood diversion. We note the requirements under the AUP Section E3 (A19, A29, A32, A33 – bridges and culverts), Section E8 (A5 – diversion and discharge from an impervious area of more than 5000m^2 – Restricted Discretionary), E9 (A7, A9 -development of a new high use road greater than 5000m^2 – Controlled, Discretionary), E10 (A3, A4 – development of a new road greater than 50 m^2 in a SMAF 1 or SMAF 2 – Restricted Discretionary/Discretionary) and E36 (A33 – construction of land drainage devices and flood mitigation works in the 1% AEP flood plain- Restricted Discretionary and A37 – new structures in the 1% AEP floodplain – Restricted Discretionary). We expect that this process will consider waterway crossings and stormwater diversion and discharges in more detail and will require Waka Kotahi and Auckland Transport to address stormwater management requirements and effects relating to water quantity attenuation, flood mitigation, overland flow, storm water quality and retention and detention. Auckland Council will therefore be able to review the proposed works and effects at that stage in greater detail and consider the application of the planning and engineering criteria that apply at that time.

Part 2: Key themes

1.1 Technical assessment method

1.1.1 Modelling method clarifications

We have clarified Section 3 of the lodged Assessment of Flooding Effects within the Supplementary Flood Hazard Assessment to address s92 queries relating to the modelling method. Two key points are:

a) Both the pre-project model and the post-project model use the same hydrology and catchment development assumptions – namely full development in accordance with the AUP and 1% AEP rainfall including 2.1 degrees of climate change. The only difference is the terrain used – in the post project model, the terrain for the proposed works have been overlaid on the existing terrain.
b) Where the post project terrain has been modelled, the effects are the relative change in flood levels. The use of 2.1 or 3.8 ° of climate change hydrology makes little difference to the change in flood levels for wide floodplains.

In relation to stormwater management devices our device sizing estimates have assumed that:

- Water quality treatment and retention/ detention could be required everywhere.
- Flood attenuation is not required in the lower half of a catchment unless we have identified a specific local problem nearby and this will be confirmed in the later modelling and design stages.
- Stormwater management devices will provide treatment for the total future carriageway area within the corridor (shared pedestrian and cycle paths excluded).
- The geometry of the devices has been 3D modelled into the existing terrain to identify the extent of earthworks associated with each wetland and identify the land extent required.

A summary of the treatment device characteristics has been included in Attachment C to assist in understanding the sizing.

It is anticipated that Healthy Waters (HW) would be consulted through the development of the detailed design and could assist during the implementation phase of each NoR by:

- Advising locations where it is considered peak flow attenuation is not, or is unlikely to, be required.
- Confirming that the type of treatment device proposed is generally appropriate.

Consultation would typically be undertaken with HW during the design development and prior to the flood modelling to work through these issues.

1.1.2 Process for screening/identifying potential effects.

To identify effects and determine whether they are able to be appropriately managed, we used the following process:

- Flood modelling of the pre-project (baseline) case;

- Overlay the pre-project flood results on GIS with aerial photographs, land use zones, contours and the proposed work footprint to identify potential effects. The overlays allow us to see where the flooding overtops the existing road alignment (an existing effect), how the floodplain interacts with the existing topography (i.e. a change in flood level could be limited in steeper terrain or widespread in extent in a wide flat floodplain) and where the new works could restrict flows where waterways or overland flow paths cross the alignment or occupy space in the floodplain (a potential new effect).
- Post lodgement of the NoR, our flood and stormwater specialists completed further assessment and identified existing buildings that were within the existing floodplain from aerial photographs, and there is potential for a building to have insufficient freeboard. We then initiated a series of site inspections (Nov and Dec 2023) to estimate the amount of existing freeboard and determine, based on the proximity of the building to the NoR corridor, whether the NoR works were likely to cause an effect. Where we determined there was potential for an effect, we then considered whether such an effect could be avoided – primarily this meant that if the conveyance under the corridor could be increased, the effect could be avoided. In situations where we considered there was a greater loss of floodplain storage due to a road embankment, we made a judgement on whether this needed to be avoided by incorporating a bridge into the concept design.
- The pre-project flood model also gave us water levels along the alignment which allowed us to see whether the hydraulic grade is flatter or steeper at the proposed crossing points and whether the upstream and downstream floodplain is wide and flat and likely to be more sensitive to change for both the 2.1 and 3.8°climate change predicted 1% AEP water levels. Refer Appendix 1 of the Assessment of Flooding Effects for flood levels extracted from the pre-project model at various points.
- It is recognised that some earlier flood assessments for TTN (other packages) included modelling of the post project scenario. The current approach is not to model all of the proposed works and rely on the judgement of our flood and stormwater specialists to identify where effects could occur. As part of this approach, we intend to provide GIS access to Council officers so they can view the combined constraints and proposed corridor works. TTN is organising for the GIS viewer access to be available to allow HW to undertake an assessment.
- Note that where the existing floodplain overtops the road, raising the road will require an increase in the cross-sectional area of flow under the corridor – so that flood effects remain relatively unchanged. We assumed this would occur so that potential effects were avoided.
- Post-project modelling was undertaken where, the existing road overtopped and the flood levels had limited hydraulic grade, which could affect flood levels on multiple properties.

1.2 Effects

In response to the queries in the s92, the following is a summary of key clarifications around flood hazard effects, with NoR-specific effects.

1.2.1 Positive Effects

The main positive effects associated with the North Project NoRs are:

- proposed new transport corridors / stations will be above the predicted future flood plains (including allowance for climate change)

- proposed widened and improved corridors are to be above the predicted future floodplains, particularly existing overtopping roads which provides improved resilience for these roads (allowing emergency vehicles to get through and avoid traffic disruption effects)
- the ability to convey flows without worsening flooding impacts upstream or downstream of the works within the proposed designation conditions, and
- added water quality treatment and attenuation of the total roadway impervious area as opposed to just the additional roadway area for upgraded roads.

HW and private property owners may also identify works as part of the overall catchment management and urban development process to improve pre- Project flood levels. There may be potential to implement these in conjunction with any works required to mitigate the effects associated with the project works.

HW's local knowledge is important. It is anticipated that HW would be consulted through the development of the detailed design during the implementation phase of each NoR by:

- Advising where there are specific habitable buildings that are known to experience flooding;
- Identifying any specific waterway crossing locations that are considered constrictions that could cause significant potential effects; and
- Identifying any existing crossings or future development areas where works are proposed as part of wider catchment management initiatives to improve cross conveyance.

1.2.2 Summary of effects, by NoR and by chainage

Our review of the existing flooding, AUP land use zones, contours and proposed roading works has identified the following locations where there is potential for greater flooding effects than the Pre-Project scenario and therefore potential mitigation has been identified. For clarity, other locations are expected to be able to be managed by increasing the amount of cross conveyance – these sites were primarily existing roads that are predicted to head up culverts or restrict flow at bridges in the pre-Project scenario which will require greater conveyance beneath the raised road to achieve the flood conditions.

State Highway 1 improvements (NoR 4, as well as parts of NoR 1 and NoR 13):

- The Pre-project model shows ponding on east side of SH1 2300 to 2500 caused by limited capacity in the culvert at NoR 4 chainage 2500. The proposed embankment extends east, partially into the existing ponding area, where there is a house within the existing flood plain. If flood mitigation for the project is required, additional culvert capacity could be provided at chainage 2500 to reduce / maintain existing flood levels. (Refer Supplementary Flood Hazard Assessment report section 5.5).
- The pre-Project ponding on west side of SH1 between chainage 2900 to 3200 is caused by culvert capacity at NoR 4 chainage 3200 (there is 2.31m head difference in the pre-project model). There is an ancillary building at chainage 2920 outside existing flooding extents. If flood mitigation for the project was required, additional culvert capacity could be provided at chainage 3200 to reduce/maintain existing flood levels.
- At the Okura Stream South branch under East Coast Road near chainage 3400, the stream east of SH1 and on the south-west (upstream) side of East Coast Road overtops its banks (but not across East Coast Road) and runs north toward existing glasshouses due to limited capacity in the culvert under East Coast Road (4.42m existing head loss). The post lodgement site floor level assessment indicated that the predicted 1% AEP flood level with 2.1° of climate change water at

1370 East Coast Road was above the floor level. Refer Supplementary Flood Hazard Assessment report Appendix 1. A construction yard and treatment device may be constructed for the Project nearby. If flood mitigation for the project works was required, additional culvert capacity could be provided under East Coast Road to reduce/maintain existing flood levels as part of NOR 1 and 4.

- In the Pre-Project case overland flow is predicted to cross SH1 and East Coast Rd at chainage 4700 SH1 and runs through 1513 East Coast Road where there are existing buildings. The Project works (NoR4) maintain the existing eastern boundary of SH1. Diversion of the overland flow within the NoR 4 is required without increasing flood levels on the property at 1513 East Coast Road.
- The Upper Dairy Stream runs from east to west across East Coast Road at the SH1 / O Mahurangi Penlink interchange (chainage 6400). Overland flow also runs north to Dairy Stream and crosses SH1 at chainage 7050m. There are buildings that may have limited freeboard flooding downstream on Top Road and at 1746 East Coast Road. The proposed SH1 southbound off ramp route for NoR 4 is through the floodplain of the channel from Penlink. The pre-project model shows there is 3.8 m of head loss between the upstream side of East Coast Rd to the downstream side of SH1. There are no buildings close to the upstream NoR 13 boundary and this space could be used for flood attenuation if downstream flood mitigation was required as a result of the works. A diversion drain has been allowed for in the Project works and the potential effects are expected to be contained within the NoR boundary.
- The proposed cycleway embankment for NoR 4 is routed over the existing stream immediately west of the SH1 Motorway Service Centre (BP site), between chainage 7400 to 7500. Space for a rerouted stream alignment has been allowed and potential effects on a nearby dwelling will need to be considered. An alternative would make the cycleway a bridge or boardwalk over the floodplain.
- From the Wilks Road interchange, flow runs north on both the east and west sides of SH1, with the western side having a wider flood extent on relatively gentle terrain. The proposed alignment does not encroach on the flooding on the western side except near the southern side of the Silverdale Interchange (chainage 11,100 to 11,300m). To accommodate the additional lanes and the cycle way and not exacerbate existing flooding, the culverts will be extended and capacity set to maintain the existing hydrology. To the east of SH1, the additional lane may encroach on an existing channel and restrict flow between chainage 8800 and 9000m. At chainages 10,000, 10,100 and 10,650, culverts (which will need to be lengthened) allow water to run from east to west and may need to be adjusted in size to compensate for the additional friction caused by lengthening. Flows from new impervious areas will be attenuated to maintain peak flows from the corridor. Space for a new diversion drain between chainage 8,800 and 10,650 has been allowed for to realign the eastern channel and distribute flow if this is necessary to mitigate effects. Between chainage 10,650 and 11,300, further space for a diversion drain is allowed for, to enable a portion of peak flow to be diverted further north if required.

Rapid Transit Corridor (RTC, part NoR 1- north of the deviation from SH1 – chainage 5500 northwards):

- The Dairy Stream crosses the RTC alignment at chainage 9300m. A 300m long bridge (NoR 8) has been modelled over Bawden Road underpass and the Dairy Stream crossing and shows limited increase in upstream flood levels. The future design and modelling will optimise the concept.

- Rangitopuni Stream crosses the RTC alignment at chainage 11350. The western embankment is within the floodplain and therefore removes storage and has the potential to increase flood levels. Modelling has shown the change in flood levels is 20 mm at the proposed NoR boundary.

Milldale Station (NoR 2):

- We consider the potential effects can be appropriately managed.

Pine Valley East Station (NoR 3):

- We consider the potential effects can be appropriately managed.

New SH1 crossing at Dairy Stream (East Coast Road to Top Road – NoR 5):

The new East Coast Road/Worsnop Road intersection may encroach on the main stem of the Dairy Stream. A stream realignment has been allowed for and will need to be sized to not adversely affect freeboard for a nearby house to achieve the proposed flood conditions. The western embankment may encroach on a straightened tributary of the Dairy Stream running south around the SH1 Motorway Service Centre (BP site). A culvert or tributary realignment is feasible.

New connection between Wainui Road and Grand Drive (NoR 6):

- A crossing of the Orewa River and four crossings of tributaries to the Orewa River are proposed. The current design has assumed two bridges and three culverts. Sufficient cross conveyance capacity will be provided to limit upstream effects.

Upgrade to Pine Valley Road (NoR 7):

- A stream flows from west to east along the southern side of Pine Valley Road, until Young Access Road where it crosses to the north side. The road embankment is located within the floodplain between chainage 0 to 400m, the existing culverts are undersized and stretches of the existing road overtop in the 1% AEP event. The road is to be raised to improve resilience (eliminate overtopping). Modelling shows that changes in flood level can be maintained to +/- 10mm in the main channel by appropriate sizing of bridges. The existing culverts are undersized and will need to be upgraded to minimise changes in flood levels. Refer to Figure 5 in the “Silverdale South – Pine Valley Design Flood Modelling” memorandum, 31/08/2023 in Appendix 3 of the lodged Assessment of Flooding Effects and Appendix 2 of the Supplementary Flood Report in Attachment B.

Upgrade to Dairy Flat Highway between Silverdale and Dairy Flat (NoR 8):

- A new bridge crossing of the Dairy Stream is proposed on the Dairy Flat Highway at chainage 2750. The existing road currently overtops and has 2.16m of head difference either side of the road. There are several existing buildings on properties adjoining the north-eastern side of the NoR. Modelling has used the existing terrain and a limited bridge opening for the stretch of road between chainage 2440 and 3000m. On this basis the road continues to overtop and there is no change to the existing flood levels as a result of the Project works. Changing the vertical alignment could improve the road flood resilience but this will need to be done in conjunction with increasing the cross-conveyance capacity. There is potential for improvement in the upstream flood levels by increasing the bridge span further.
- A new bridge crossing of a tributary to the Dairy Stream is proposed on the Dairy Flat Highway at chainage 1900 near the intersection with Bawden Road. The existing road currently overtops and

has 1.02m of head difference either side of the road. Modelling shows that the proposed bridge can convey water through the crossing with a +/- 10mm difference in water level outside the designation boundary. There is potential for improvement in the upstream flood levels (south of the crossing) also – the current configuration showed a 10 to 50mm reduction in flood water levels upstream of chainage 1900m. Refer to Figure 5 in the "Dairy Flat Design Flood Modelling" memorandum, 31/08/2023 in Appendix 2 of the lodged Flood Hazard Assessment lodged in August 2023.

- A culvert at chainage 4300 near Dairy Flat school has limited capacity with 2.74m of head difference either side of the road in the pre-project model. Sufficient cross conveyance capacity will be provided to limit upstream effects.

Dairy Flat Highway – Durey Road to Albany (NoR 9):

- We consider the potential effects can be appropriately managed.

Upgrade to Wainui Road (NoR 10):

- A bridge is proposed over the tributary to the Orewa River. However, the channel is incised and the proposed bridge is relatively long. We consider the potential effects can be appropriately managed.

New connection between Dairy Flat Highway and Wilks Road (NoR 11):

- A culvert is proposed at chainage 280m with relatively flat terrain upstream. Sufficient cross conveyance capacity will be provided to limit upstream effects.

Upgrade and extension to Bawden Road (NoR 12):

- The western end of Bawden Road is adjacent to the RTC crossing of Dairy Stream (NoR1) and the Dairy Flat highway upgrade crossing of Dairy Stream (NoR 8).
- At chainage 1650 a bridge is proposed over a tributary of the Dairy stream. Modelling shows some increase in upstream flood levels and the bridge span will need to be increased.
- At chainage 2300 to 2400m part of the road is within the existing flooding extents. Modelling of the post project terrain shows no change to the pre-project flood levels.
- At chainage 3100 a bridge is proposed to cross the tributary of the Dairy Stream. This has been modelled in conjunction with the works on the RTC and Dairy Flat Highway. Modelling shows that the proposed bridge can convey water through the crossing with a +/- 10mm difference in water level outside the designation boundary. Refer to Figure 5 in the "Dairy Flat Design Flood Modelling" memorandum, 31/08/2023 in Appendix 2 of the lodged Assessment of Flooding Effects.

East Coast Road upgrade (NoR 13):

- There is a crossing of the Upper Dairy Stream at chainage 470m, near Worsnop Way (refer NoR 10). A bridge is proposed and will be sized to limit upstream and downstream effects. There is potential to reduce the flood extent or attenuate flows on upstream land.

1.3 Mitigation/management of effects

In response to the queries in the s92, the following is a summary of key clarifications around mitigation/management of effects.

The general flood mitigation approach is to manage flooding so that there are appropriate effects on property or buildings outside the designation while retaining a small amount of flexibility in water levels for the future detailed design. The approach applies to the maximum level of development in the catchment and is a relative assessment with and without the Project works in place. The hydrological criteria used in the model runs will be the same with and without Project works – in terms of assessing the change in effects on other property, it does not matter whether 2.1 or 3.8 degrees of climate change is allowed for (in the pre and post project works modelling runs) as long as it is consistent.

The key method to manage effects on property outside the designation is to match or change the amount of cross conveyance capacity – such as by changing the span of a bridge across a floodplain or changing the cross-sectional area of a culvert. The following examples cover the majority of the scenarios possible:

- *The works will upgrade and widen an existing road crossing a stream. The road does not overtop in the 1% AEP event and all flow passes through a culvert.* Lengthening the culvert slightly increases the frictional resistance or head required to pass the same flow. Replacing the culvert with one of a slightly larger diameter allows the same (or greater) amount of flow to be conveyed and therefore the upstream flood levels are the same or less.
- *The works will upgrade and widen an existing road crossing a stream.* The road overtops in the *1% AEP* event and the upstream flood level is therefore set by the flood overtopping the road. To improve road resilience to flooding it is preferred to raise the road crest above the flood level. The flow that previously passed over the road in the *1% AEP* event is often larger than can reasonably be conveyed by additional culvert capacity and therefore a bridge may be proposed. The span of the new bridge is set so that a similar upstream flood level is achieved in the *1% AEP* event.
- *There is the opportunity for betterment or a positive effect in the previous scenario.* As the peak flow across the existing road is set by a combination of culvert and overtopping flow, the same peak flow could be achieved at a lower upstream flood level using a bridge span (which has a greater cross-sectional area at a lower elevation).
- *The works will install a new road and crossing of a stream where flood flows are within a defined channel at a moderate to steep grade.* As the channel is well defined, the required bridge span is typically matched to the top of channel width. Alternatively, the moderate grade available means that some heading up can occur within or mostly within the designation boundary.
- *The works will install a new road and crossing of a stream where flood flows are spread wide across a floodplain with a flatter hydraulic grade.* As the floodplain is wide, a bridge is potentially long and of substantial cost. Deciding on the bridge span is a balance between the cost of the bridge and the degree of effects on other property upstream. Given the flatter gradient, there is less scope to head up water within the designation boundary but a small amount of effect outside the boundary can have an appreciable effect on the bridge span length required.

In addition to the effects of the terrain / constriction / flood storage changes on flood levels, there are also potential effects associated with the increase in impervious area from the Project works – which will increase the amount of peak flow from the corridors/area. However, these are usually small effects compared to the potential changes from restricting stream flows at bridges and culverts. Notwithstanding the relative size of effect, allowance has been made for providing flood attenuation in

the future stormwater management devices where the corridor is within the top half of the overall catchment. We have provided a summary table of the stormwater management devices and catchment characteristics for your information as Attachment C.

1.4 Flood condition

We have defined the mitigation approach in the Flood Hazard Condition in three parts:

Part a) requires further modelling to be carried out on the design once it is developed further. This condition is necessary because it is not possible to do detailed modelling now without a detailed design of the proposed terrain which will need to integrate design criteria for a number of disciplines) and, because it is not intended to build the Project works for some years, there is a reasonable likelihood that the scope and design geometry will change.

Part b) sets out the flood outcomes that need to be achieved / criteria that we consider will appropriately manage effects on other property. This condition is necessary to provide surety that the effects identified at the detailed modelling stage will be appropriately mitigated.

Part c) provides an alternative pathway for mitigating flood effects by using agreed works outside the designation boundary. This condition is necessary to provide a back-up flexibility if it is found later that some specific locations cannot be mitigated by works within the designation or it is more cost effective to mitigate via agreed works outside the boundary.

The table below sets out the Flood Hazard condition proposed at lodgment, the changes proposed as a result of a review of the condition carried out in December 2023 and our reasons for those changes.

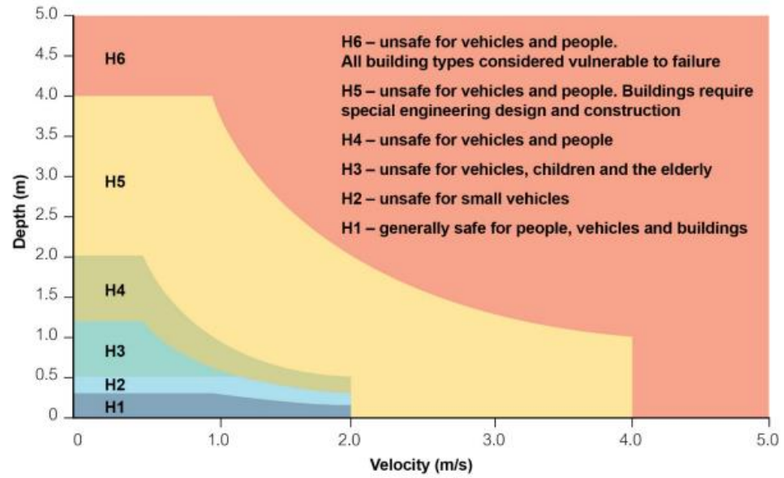
A series of maps and tables are provided with this section 92 response in Appendix 1 of Attachment B comparing flood levels to estimated floor levels for selected houses. Freeboard has been estimated using lidar terrain and surveyed floor levels (where these are available) or estimates of the dwelling floor level above ground level. The maps help identify the number of existing houses that are potentially affected by flooding and the proposed changes to freeboard, as outlined in the proposed flood condition. This gives a scale to the potential effects on other property both for the pre-Project and post-Project cases.

Table 1: Proposed Flood Hazard Condition – changes since lodgement and rationale

	Proposed Flood Hazard condition	**Rationale for change from conditions as lodged**
	For the purpose of the Flood Hazard condition: (a) ARI – means Average Recurrence Interval. (b) AEP – Means Annual Exceedance Probability. (c) Existing authorised habitable floor – means the floor level of any room (floor) in a residential building which is authorised ~~by building consent~~ and exists at the time the outline plan is submitted, excluding a laundry, bathroom, toilet or any room used solely as an entrance hall, passageway or garage. (d) Flood prone area – means a potential ponding areas that may flood and commonly comprise of topographical depression areas. The areas can occur naturally or as a result of constructed features. ~~Relies on a single culvert for drainage and does not have an overland flow path.~~ (e) Maximum Probable Development – is the design case for consideration of future flows allowing for development within a catchment that takes into account the maximum impervious surface limits of the current zone or if the land is zoned Future Urban in the AUP, the probable level of development arising from zone changes. (f) Pre-Project development – means existing site condition prior to the Project (including existing buildings and roadways). (g) Post-Project development – means site condition after the Project has been completed (including existing and new buildings and roadways).	The change to c) makes the scope of the condition wider by allowing the condition to apply to buildings that were authorised before the Building Act came into effect. The change to d) provides some additional clarification and will be consistent with Auckland Council GIS definition of Flood prone area.

Condition as lodged Sept 2023 (Appendix B, condition 10)	**Proposed change to condition**	**Rationale for change from conditions as lodged**
(a) The Project shall be designed to achieve the following flood risk outcomes:	The Project shall be designed to achieve the following flood risk outcomes:	N/A
i. no increase in flood levels in a 1% AEP event for existing authorised habitable floors that are already subject to flooding or have a freeboard less than 150mm;	no increase in flood levels in a 1% AEP event for existing authorised habitable floors that are already subject to flooding or have a freeboard less than ~~150mm~~500mm;	A site assessment was carried out to estimate the amount of freeboard at buildings that might be affected by flooding close to the proposed NoR boundary (refer Section 4 and the maps in Appendix 1 of the Supplementary Flood Hazard Assessment). When the freeboard was estimated, the majority of those existing floors assessed were either flooded or within 150mm of flooding. Changing to 500mm had a minor increase in the number of floors subject to this condition but the controlling criteria was typically the building with freeboard less than 150mm. The new criteria also provides better protection for relatively new buildings that may be constructed prior to lodgement of the OPW– which is relevant to NoRs near flooding within the Future Urban Zone. Increasing freeboard to 500mm for these types of buildings aligns with freeboard standards in the AC Stormwater Code of Practice for new builds. It is not intended to protect all future buildings – those constructed after the OPW are lodged are expected to set appropriate freeboard above the Post project flood level.
ii. no more than a 10% reduction in freeboard in a 1% AEP event for existing authorised habitable floors with a freeboard over 150mm;	~~no more than a 10% reduction in freeboard in a 1% AEP event for existing authorised habitable floors to maintain a minimum with a freeboard of over 150mm;~~	A percentage freeboard reduction is not needed if a freeboard of 500mm is utilised in criteria i.

Condition as lodged Sept 2023 (Appendix B, condition 10)		Proposed change to condition	Rationale for change from conditions as lodged
iii.	no increase in 1% AEP flood levels for existing authorised community, commercial and industrial building floors that are already subject to flooding;	no increase in 1% AEP flood levels for existing authorised community, commercial, industrial and network utility building floors that are already subject to flooding or have a freeboard of less than 300mm;	This criterion has been introduced to address flood effects as these types of building are present in the Project area – such as east of SH1 (NoR4). Increasing the freeboard to 300mm for these types of buildings aligns with freeboard standards in the AC Stormwater Code of Practice for new builds. Given the potential town centre areas in the Future Urban Zone there is potential for more of them to be constructed prior to the lodgement of the OPW. The new criteria provides better protection for relatively new buildings.
iv.	no more than a 10% reduction in freeboard in a 1% AEP event for existing authorised community, commercial and industrial building floors;	~~no more than a 10% reduction in freeboard in a 1% AEP event for existing authorised community, commercial, and industrial and network utility building floors;~~	A percentage freeboard reduction is not needed if a freeboard of 300mm is utilised in criteria iii.
v.	No increase of more than 50mm in flood level in a 1% AEP event on land zoned for urban or future urban development where there is no existing dwelling;	maximum of 50mm increase in water level in a 1% AEP event outside and adjacent to the designation boundaries between the pre and post Project scenarios; ~~no increase of more than 50mm in flood level in a 1% AEP event on land zoned for urban or future urban development where there is no existing dwelling~~	The application of this criterion has been clarified and the wording has been updated to reflect that. It is intended that the changes in flood water level are tested against all criteria in the flood condition for key receptors and the more stringent one would apply. For example, a habitable floor with less than 500mm freeboard, but some distance from the NoR, would require no change in freeboard at that building, but up to 50mm change in flood water level would still be allowed at the NoR boundary itself. The pre and post Project flood flows will not be changed upstream or downstream of the designations in the pre and post project flood modelling scenarios. With a maximum of 50mm increase at the designation boundary the flood effects will be limited to within a very short distance upstream and downstream of the designation boundary before returning to pre-Project flood levels.
vi.	no new flood prone areas;	no new flood prone areas; and	No change.
vii.	no more than a 10% average increase of flood hazard (defined as flow depth times velocity) for main access to authorised habitable dwellings existing at time the Outline Plan is submitted. The assessment shall be undertaken for the 1% AEP rainfall event.	No increase of flood hazard for main vehicle access to authorised habitable dwellings existing at time the Outline Plan is submitted. The assessment shall be undertaken for the 1% AEP rainfall event. Where Flood Hazard is: • Velocity x depth > = 0.6 or • depth > 0.5m, or • velocity >2m/s. ~~no more than a 10% average increase of flood hazard (defined as flow depth times velocity) for main access to authorised habitable dwellings existing at time the Outline Plan is submitted. The assessment shall be undertaken for the 1% AEP rainfall event.~~	The wording has been changed to reflect the change from category H2 to H3 in the Australian Institute of Disaster Resilience 2017, Handbook 7, Managing the Floodplain. Using categories of protection, allows some changes to depth or velocity within category 2 while providing appropriate protection. The protection of both pedestrians and small vehicles are covered within category H2.

Condition as lodged Sept 2023 (Appendix B, condition 10)	Proposed change to condition	Rationale for change from conditions as lodged
		 **Figure 1 General flood hazard vulnerability curve** Source: Figure 6 AIDR 2017b
(b) Compliance with this condition shall be demonstrated in the Outline Plan, which shall include flood modelling of the pre-Project and post-Project 10% and 1% AEP flood levels (for Maximum Probable Development land use and including climate change).	Compliance with this condition shall be demonstrated in the Outline Plan, which shall include flood modelling of the pre-Project and post-Project ~~100 year ARI 10% and~~ 1% AEP flood levels (for Maximum Probable Development land use and including climate change).	Terminology changed to be consistent with the event identified in part a of the condition.
(c) Where the above outcomes can be achieved through alternative measures outside of the designation such as flood stop banks, flood walls, raising existing authorised habitable floor level and new overland flow paths or varied through agreement with the relevant landowner, the Outline Plan shall include confirmation that any necessary landowner and statutory approvals have been obtained for that work or alternative outcome.	Where the above outcomes can be achieved through alternative measures outside of the designation such as flood stop banks, flood walls, raising existing authorised habitable floor level and new overland flow paths or varied through agreement with the relevant landowner, the Outline Plan shall include confirmation that any necessary landowner and statutory approvals have been obtained for that work or alternative outcome.	No change.

Part 3: Response to specific s92 requests for further information

Ref	Request	Response
HW general comment 1	*"the NoRs for Designations is more around establishing sufficient land to facilitate the concept design and ensuring that it incorporates stormwater management infrastructure"*	We agree that the designation needs to provide sufficient land for the future corridors/stations and supporting infrastructure, as well as appropriately mitigating effects that are subject to district plan requirements including flood hazards. We have assessed stormwater treatment and attenuation land requirements within the designations as part of the NoR process with the size and location of stormwater management devices and waterway crossings developed further as part of the later Regional Consenting stage.
HW general comment 2	*"Because there is limited technical information relating to the proposed projects, it will be necessary for robust conditions to be defined to allow flooding effects to be quantitively assessed whilst still retaining flexibility around potential changes in design criteria required by Healthy Waters (or the subsequent Stormwater Network Utility Operator agency) in the future.* *Healthy Waters does not consider it acceptable to fix design performance standards now for projects that may be decades away from construction."*	We agree that the conditions need to be developed to manage effects appropriately and that is why we have proposed the Flood Hazard condition. We do not however see the need for it to address all flooding effects in detail, as there will be a future resource consent process that will assess the effects of a more detailed design and will address flooding effects. We agree that flexibility is required for the future design. However, we think this needs to be considered alongside giving an envelope of acceptable effects to progress the NoR process.
HW general comment 3	*"It is not clear from the report whether flooding effects are being assessed within the designation or extending further."*	The focus of the assessment has been those effects at or beyond the designation boundary as this is where any potential residual flooding effects resulting from the project works are required to be considered. Compliance with the Flood Hazard condition will ensure that potential effects on land adjacent to the corridors will be appropriately managed. To assist in identifying those effects, we have mapped the pre-project floodplain extents, selected representative properties at risk of flooding and made estimates of their floor levels. The maps are in Appendix 1 of Attachment B and are also available on the GIS platform that we are organising for HW to have access to.
HW general comment 4	*"The absence of any modelling assessment means that conditions need to be sufficiently detailed to enable a processing planner and specialist to know how flood effects should be assessed."*	We agree that the conditions need to be clear so that they are easily understood in the future.
HW general comment 5	*"The applicant is required to undertake a holistic review of the comments with the context around the entire Assessment of Flooding Effects report (all volumes) and amend as is required."*	We have reviewed various sections of the lodged Assessment of Flooding Effects in light of HW comments overall and have appended a Supplementary Flood Hazard Assessment report in Attachment B.
1	*Executive Summary, Assessment Undertaken, 3rd bullet point:* The bullet point states that flood level maps have been produced to show flood levels and extents (greater than 50mm) that need to be considered. Please provide clarification on what needs to be considered as it is not clear. *Rationale: This will provide clarification of what this needs to be considered for.*	In the context of the mapped model results, floodplain extents and depths are not shown where the depth of flooding is less than 50mm. This is standard modelling practice and reflects uncertainty in the terrain model. The term "needs to be considered" refers to the base model flood information that was used to identify potential effects. The flood maps show areas where there are pre-project flooding problems and we have considered how these problems could be exacerbated by the proposed designation works – i.e., the consideration is whether pre-project flooding could be exacerbated by the future works and how to manage this. The flood maps show the extent of predicted flooding that needs to be considered in the pre-project Project case and what properties / buildings may already be impacted. It is recognised that the number of buildings may change in the future should development occur before the NoR projects are built. The flood maps were provided to the roading design team to develop the vertical alignment of the concept design for the NoRs to achieve freeboard above the pre-project Project flood plain at the proposed bridge / culvert crossings.

Ref	Request	Response
2	*Executive Summary, Assessment Undertaken, 5th bullet point:* The bullet point states that Modelling of concept design for areas that are identified as having the greatest flood hazard risk. Please provide clarification on what this means. Is this related to flood risk to the proposed Designation, property flooding outside of the Designation, impact to developable land outside of the designation? *Rationale: This will provide clarification on how the flood risk is being assessed.*	This bullet relates to our assessment process. We used the maps of pre-project flooding and our judgement to identify where we considered the proposed works could have the greatest potential effects to areas outside the NoR. This does not necessarily mean the greatest change in flood levels, but rather a change in flood levels where greater effects could be experienced. For example, in flat terrain with habitable buildings with limited freeboard close to the pre-project flood plain. Following review of the pre-development flood hazard across the full extent of the Projects we identified selected areas where we considered that there was a higher risk of the Project(s) causing flood effects on existing buildings on other property.
3	*Executive Summary, Assessment Undertaken, first paragraph, page xi:* The pre-project model is described as being the existing network, without the proposed Designation development, Maximum Probable Development elsewhere in the catchment, 2016 LiDAR, larger existing pipes and bridges with climate change rainfall. [correct] Please provide clarification on what the base model actually is presenting, as the description appears to say the base case is the future with the proposed Designation network upgrades in place [incorrect]. *Rationale: This will clarify the modelling scenario that is being used to identify the flood effects (i.e., the base model) as what is described appears to describe the post development scenario.*	The pre-Project models are based on the future land-use scenario (outside the corridor) without the NoR physical works constructed, that is: • The future fully developed impervious coverage allowances as per AUP: OP zonings and HW memo of 4 Sept 2019 • The 2016 LiDAR as the surface terrain (which includes the existing road geometry) • 1% AEP future rainfall with climate change of 2.1 and 3.8° • More detail for each model used is provided in Section 3 of the Supplementary Flood Hazard Assessment in Attachment B
4	*Executive Summary, Assessment Undertaken, second paragraph, page xi:* It is stated that the post development has not been modelled for nine of the NoRs because flooding standards may change in the future. However, post development modelling has been undertaken for four of the NoRs. Please provide clarification if the intention is to fix the design criteria for the four post development models today, or whether these will be remodelled in the future and include any updated flood standards / performance criteria. *Rationale: This will clarify why four of the NoRs have had post development models simulated now whilst the remaining nine NoRs have not.*	The reason for post-project modelling of some NoRs now is to provide certainty that there is a workable solution in areas of flooding in which it is difficult to identify the scale of potential effects close to receptors and therefore there is uncertainty about the amount of land required. These post project models are not the final version of the post project works to be modelled. Modelling of the post project scenario for all NoRs would be undertaken for the OPW. In terms of the NoRs for which the post project scenario was modelled, clarification is required. Flood modelling of the post-project Project case as noted in 2 above was only done for Dairy Flat / Bawden Road intersection (NoR 12, NoR 8) and Pine Valley Rd upgrade (NoR 7). Results are presented in Appendix 2 and 3 to the Flood AEE from August 2023. For Bawden Road, this identified that more land was needed to provide for recontouring within the designation to achieve the minimal water level change between the with and without the project works. Further assessment of Pine Valley Road has been recently carried out with the results presented in Appendix 2 of the Supplementary Flood report – this shows that the effects of the proposed works can be mitigated. In terms of performance criteria it is intended to use the flood condition outcomes as the compliance criteria to be met in the future Outline Plan of Works. Prior to modelling for the OPW we expect that consultation with HW and AC would occur to identify if there were additional relevant criteria to consider. These could arise from the AC Stormwater Code of Practice or the AT/WK Codes of Practice (or other relevant documents) at that time. As the OPW preparation is likely to occur in conjunction with the regional consent applications for waterways crossings and stormwater discharge and diversion, we expect that any relevant additional criteria would be modelled and assessed at the same time (as this would be the most efficient design/modelling process).

Ref	Request	Response
5	*Executive Summary, Assessment Undertaken, third paragraph, page xi*: Please provide clarification of why post development modelling of four NoRs provides confidence that the remaining nine can meet conditions despite them not having been modelled. Also clarify what conditions this is referring to as the only condition mentioned in the Executive Summary relates to flooding. *<u>Rationale:</u> This will clarify the appropriateness of assuming that all NoRs can meet conditions based on post development modelling of four NoRs.* *This will clarify what condition is being referred to as being able to be met.*	This is because those locations for post project modelling have been chosen based on the review of the pre-project flood problems with receptors close to the flooding i.e. – we have chosen to carry out post project modelling of areas which we consider are more sensitive to flooding effects. Our review of the potential effects of flooding in the other areas did not identify likely future adverse effects that could not be mitigated and our view is that the future design will be able to meet the flood hazard outcomes identified in the proposed condition. The conditions referred to are the Flood Hazard Conditions.
6	*Executive Summary, Results of assessment and recommended measures, first bullet point, page xi:* Considering the indicated timeframe for these projects (10 – 30+ years) is it appropriate to consider 2.1 degrees climate change when it is understood by industry that Auckland Council will likely require consideration of the 3.8 degrees in response to the latest RCP guidance? Provide justification for designing to the 2.1-degree climate change adjustment. *<u>Rationale</u>: This will justify why design considerations are only looking at 2.1 degrees climate change effects for projects that are indicated as having up to a 30+ year design and construction lifespan.*	The final design will need to comply with whatever the climate change and freeboard requirement is at the time that regional consents are applied for and detailed design is finalised. The requirements will be those set out in the regional consents and the WK and AT Codes of Practice at that time. If the vertical alignment needs to increase to achieve freeboard, there is flexibility to accommodate this within the designation. The assessment and flood hazard effects outcomes sought are framed in terms of flood conditions which will be controlled by the Project works to achieve. That is, the Projects are responsible for addressing the potential effects due to the difference in flood levels due to the Project works for the same hydrological event – not for mitigating the absolute increase in effects due to 3.8° of climate change. We consider that the flood afflux in the 2.1° cases (with and without the Project works) and the flood afflux in the 3.8° cases (with and without the Project works) will be similar. Therefore, if the design needs to achieve regional flood conditions in terms of the change in flood levels for the 3.8° cases in the future, we are confident it can do so. The current AC design standard requires 2.1° to be used and it is acknowledged by AT and Waka Kotahi that 3.8° will provide greater certainty for future flood risk and that is why at this stage 3.8° was used to understand the increased risk of greater climate change. Mapping was therefore done of the 2.1 and 3.8° at most of the stream and river crossings the NoR traverses (refer Appendix 1 of the Flood AEE from August 2023).
7	*Executive Summary, Results of assessment and recommended measures, second bullet point, page xi:* The proposed works are identified as providing resilience for the roads but there is no indication what this actually means. Please clarify how the proposed Designations development will provide resilience. *<u>Rationale</u>: This will clarify whether the report is saying that the road themselves is resilient, or*	Flood resilience within the corridor is protecting the road from overtopping in the 1% AEP rainfall event with freeboard – with different standards dependent on the type of road and owner. Waka Kotahi require a minimum of 500mm freeboard for State Highways or roads under their control whilst for AT it is dependent on the road classification (with arterial roads required to remain open). Improved flood resilience in the case of overtopping roads allows the routes to remain open to traffic (avoiding consequential problems) and allows emergency vehicles to get through. The designations allow for the road level to be above the floodplain whilst providing sufficient land to ensure that the flood conditions are achieved. If the flooding effects of a raised road cannot be adequately mitigated, it may be necessary to accept continued overtopping of the road – but we have not identified any locations where we expect this to be the case.

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	whether the infrastructure required to service it will be resilient.	
8	*Executive Summary, Results of assessment and recommended measures, Operational Effects, page xii:* The condition is generic and is a copy of that used by Te Tupu Ngātahi before on Drury and Auckland to Botany projects. Whilst I acknowledge that development may lead to flood effects, conditions should be addressed to the particular location of effect. For example, channelized sections (like in Drury) would allow for increases in water level to occur with minimal impact to buildings and developable land because the water is contained. Where there are wide floodplains allowing any increase in depth can result in significant increases in flood extents. The condition ignores overland flow paths management and how existing private stormwater discharges will be picked up and managed by the proposed Designations. *<u>Rationale</u>: On its own this condition is not sufficient to direct the applicant to not make flood matters worse and therefore more direction is required around overland flow paths and private discharge management to manage flooding.* *This will provide a review of the proposed condition or justification as to why overland flow paths and private discharges are not being included.*	We agree that there may be different environments across the TTN projects where changes to the outcomes in the flood condition may be appropriate – such as the protection of industrial and commercial properties in Manukau in the A2B hearings. However, we do not agree that the Flood Hazard condition is insufficient – as noted there will be a future OPW and regional resource consent phase where more detail will be known and where effects will be assessed further. We have carried out a site assessment of estimated freeboard at various buildings adjacent to the NoRs (refer Appendix 1 of Attachment B) and reviewed the number of building locations where a 15 to 50mm change in flood freeboard would be governing the future design. We found that in most cases it is the protection of existing habitable floors that have little or no freeboard that are likely to govern the future design. Therefore, we are willing to accept the AC proposed change where no change in flood level is allowed where the freeboard is less than 500mm. While we agree with the point that more steeply sided stream channel sections are typically not affected by larger changes in flood levels, we do not agree with the characterisation of the Drury NoRs, - these did include wide, flat floodplains – such as on the Waihoehoe and Mangapu Streams crossed by the future arterial in NoR D4. We also do not agree that changes in the floodplain extents restrict development. Our view is that a new building is not limited by a small change in flood height of 50mm resulting in a change in flood extents – as the new building floor level would simply be slightly higher than previously to maintain freeboard and a flood water depth of 50mm does not represent any significant change to flood hazard that would prohibit a building being located in the same place. The flood levels in overland flow paths and private discharges are considered within the scope of proposed NoR condition outcomes. For example, where an overland flow path potentially affects a habitable floor level, the condition will now maintain 500 freeboard. Where an overland flow path changes but does not directly affect a building covered by the condition, any change is limited to the 50mm change on adjacent land.
9	*Executive Summary, Results of assessment and recommended measures, Conclusions, second paragraph page xiii:* The paragraph is unclear about what flood effects are in response to the proposed Designations, flood effects on the proposed Designations and the stormwater management required to mitigate the effects of the development. As such it is not actually clear what is being said. Please revise the paragraph to clearly articulate what the assessment has shown. *<u>Rationale</u>: This will confirm what the Te Tupu Ngātahi assessment shows and what is required to be completed during the Outline Plan stage.*	We have clarified this section of the Aug 2023 report with a new summary and more detailed assessment of operational phase flooding effects in the Executive Summary and Section 5 of the Supplementary Flood Hazard Assessment in Attachment B. We have also more clearly articulated the conclusions. Namely that: 1. We conclude from our assessment of the potential flooding effects that the expected changes in flood levels on adjoining property due to the Project works can be appropriately managed. 2. We consider that the proposed flood condition sets appropriate outcomes for managing future flooding effects due to the Project Works and subject to these being designed and implemented, the effects can be minor or less. Flood modelling will be required at the Outline Plan phase to confirm the detailed design will comply with the NOR conditions. The existing paragraph specifically asked about in the question refers to the positive effects arising from the Projects. A key positive flood effect on existing roads that overtop is raising that road out of the floodplain and providing resilience. Refer also to item 23 below.

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10	There is no information provided in the executive summary or the general report about how stormwater will actually be managed from the proposed Designation itself (in terms of this flood effect report this would relate to attenuation and whether it is required or not at relevant locations). Please clarify what stormwater management is to be provided to manage post development flows from the proposed Designation itself. *Rationale: This will clarify what stormwater management is to be provided to impact the flooding assessment.*	Wetland locations and device sizes have allowed for flow attenuation when the road corridor is in the upper half of the catchment. Wetlands and swale sizes allow for treatment and retention of both existing and future impervious areas within the transport corridors - these will be refined in the later detailed design and Regional Consenting stage. A summary table is provided in Attachment C.
11	*Section 3.1 Assessment of Flooding Effects, First paragraph, page 8:* The descriptions of the pre and post development models are confusing. The text suggests that the only difference between the pre and post development scenarios are the NoRs. One element of major concern is that the text states that in the pre-project (base case) scenario the pipe and bridge structures have been enlarged. If this is the case, then there is no way that a reliable impact of development could be assessed as it will only be looking at the vertical alignment of the proposed road structures. *Rationale: This will clarify the base model that is being used to assess effects.*	We have changed the terminology to “pre-project” and post-project” in this response and the Supplementary report to clarify this. The only difference between pre project and post project model scenarios is that the post project model includes the major elements of the post project terrain/physical works. Both models use the same hydrology - being the future catchment land use and imperviousness and rainfall for the climate change scenario. The difference in the two sets of model results is therefore the change in flood levels caused by the key project works (such as new bridges). Pre-Project (base case) models were completed for all stormwater catchments associated with the NoRs except for NoR 9 and the middle portion of NoR13, as both of these NoR are on ridgelines and flooding is not an issue (apart from attenuation of increased impervious areas). Please refer to the Supplementary Flood Hazard Assessment Section 3 in Attachment B as it provides more information on this issue for each stormwater catchment.
12	*Section 3.2 Model used for the assessment of flooding effects, second paragraph, page 9:* The section provides information on two Healthy Waters models for two stormwater catchments, then ends by saying the four Te Tupu Ngātahi models were submitted to Council for review. There is no information provided on what modelling was undertaken by Te Tupu Ngātahi models. *Rationale: This will provide clarity on what modelling was undertaken as part of the flood assessment for the NoRs.*	Please refer to the Supplementary Flood Hazard Assessment report Section 3 in Attachment B as this will clarify the level of modelling completed for each catchment and existing culvert diameters included in each model.
13	*Section 3.2.2 Model Assumptions, second bullet point, page 9:* The report states larger culverts were included in the 1D model; however, there is no actual quantitative	Please refer to the Supplementary Flood Hazard Assessment report Section 3 (Attachment B) as this will clarify this issue for each catchment model.

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	definition of what larger means. Is this diameter based, length based? What about bridge structures? Please provide clarification on what constitutes a larger culvert. *Rationale: This will provide clarification on the modelling approach to allow a better understanding.*	

Ref	Request	Response

14	*Section 3.2.2 Model Assumptions, second bullet point, page 9:*
	
	The wording refers to authorised habitable floors.
	
	Please clarify what authorised means and how any investigations determined whether properties visited during the investigation were determined to have an authorised habitable floor.
	
	Please clarify where this assessment of habitable floors is.
	
	Rationale: This will provide clarification of authorised habitable floors and how this has featured in the assessment undertaken by Te Tupu Ngātahi.
		After lodgement of the August 2023 AEE, site assessment maps and tables of estimated flood freeboard were collated and are provided in Appendix 1 of the Supplementary Flood Hazard Assessment report in Attachment B.
		
		The site assessment of existing habitable floor levels (above adjoining ground levels) was completed within the 1% AEP with 2.1°of climate change pre-Project flood extent. Buildings chosen were generally those close to the NoRs and expected to be more at risk. The site assessment provided an existing estimated height of floor which when added to the LiDAR ground level provided an estimated habitable floor level. This site assessment was done from public property only and our assessors did not enter private property (so not all floors could be assessed). The site estimated floor level was compared to the predicted 1% AEP with 2.1°and 3.8° of climate change pre-Project flood level to estimate freeboard and identify which criteria in the flood condition may apply. We note that this assessment only applies to floors that exist now, some of which may not exist in future.
		
		The assumption was that the front door of the house was connected to an authorised habitable floor.
		
		Garages that were separate to the house were not included.
		
		The assessed floor levels and flood data was compiled into an Excel spreadsheet showing all of the applicable flood freeboard conditions that apply to that building. This spreadsheet included the following data:
		
		• Assessed existing freeboard (ground level to floor level).
		• LiDAR ground level at the location the floor level was assessed.
		• Assessed floor level (freeboard + ground level).
		• Predicted 1% AEP with 2.1 and 3.8°of climate change at the same location as the floor and ground level.
		• Which flood freeboard condition applies to that building.
		
		This was graphically represented showing the predicted 1% AEP flood plain for 2.1° climate change with the NoR designation boundary in the following format;
		
		• Designation boundary in black
		• 1% AEP with 2.1° climate change in light blue
		• The building outlines were shown with the following colour scheme:
		  ○ Red when the predicted water level is within 150mm of the estimated floor or above the floor;
		  ○ Yellow when the predicted water level is between 150 and 500mm below the floor level, and;
		  ○ Green when the predicted water level is > 500mm below the floor level.
		
		Future survey will be needed on existing authorised habitable floors that exist at the time of the Outline Plan. This may also include searching of the Auckland Council Property files to establish the building layout and location of the habitable floor.
		
		The site mapping and freeboard assessment has refined our assessment of which of the Flood Hazard condition outcomes are likely to be the limiting criteria.
		
		This assessment has confirmed that the revised Flood Condition detailed in Section 1.4 will be appropriate for the North NoRs in the future design and flood modelling and has allowed us to understand that in the many cases the potential effects are governed by buildings with limited freeboard.

Ref	Request	Response
15	*Section 3.5 Outcomes based approach, page 10:* The section is headed Outcomes based approach but does not mention any outcomes that need to be addressed. Please provide a summary of the outcomes that the proposed Designations are to meet with respect to the stormwater management of the runoff changes from the development and the flood impacts on the wider catchment. The text suggests that where there may be impacts as a result of the Designations it may be appropriate for Auckland Council and private landowners to agree on potential mitigation. This is not appropriate as mitigation is to be provided by the applicant and although Auckland Council may act as an intermediary it will not be their responsibility to mitigate the impacts of the Designations. *Rationale: This will confirm the outcomes that are to be met.* *This will remove the direction that mitigation outside of the Designation will need to be agreed between Auckland Council and private landowners and clarify the responsibility for stormwater mitigation for the project.*	The outcomes are those identified in the proposed Flood Condition. We consider that changes to the amount of impervious area within the corridor will not be the major cause of changes to flood levels arising from the projects works and we do not propose to put criteria on these for the NoR. Future design stages will consider increases in runoff and these will need to be assessed for the regional resource consents and appropriately attenuated. We agree that the Requiring Authorities are responsible for appropriately mitigating effects arising from the works. Item c) in the Flood Hazard Condition provides an alternative pathway for the Requiring Authorities to mitigate effects by works or methods outside the designation. It is not AC who would be responsible for mitigating effects. AC is mentioned solely as a party that would have an interest in determining what mitigation was appropriate.
16	*Section 4.1.1 Stormwater Catchment Overview, Figures 4-2 to 4-6:* Please provide coloured extents of the proposed Designation projects to allow this to be understood by the reader. *This will provide further keys that address all features on the Figures to allow better understanding of the Figures.*	We are arranging access for AC processing officers to the SGA GIS platform so that the flood extents can be overlaid with the various proposed works extents, land-use, contours etc. A legend is shown on the GIS.
17	*Section 4.2.1 Planning and land use context, third paragraph, page 17:* The report states that the majority of the NoRs are within or adjacent to Future Urban Zoned areas. This makes the provision of appropriate flooding conditions critical to optimise developable land. Please provide justification of why the single flood condition is considered appropriate to ensure effects of the NoRs can be mitigated. *Rationale: This will confirm whether the proposed conditions used across all 13 North NoRs is appropriate.*	In general, the effects outside the NoR boundary are limited either by a change of water level of up to 50mm at the boundary of the designation or there is an authorised habitable floor with less than 500mm of freeboard (based on the revised Flood Hazard condition set out in Section 1.4). Our view, as noted above in response to item 8, is that a 50mm change in water level at the NoR boundary is minor and does not limit future development. Our assessment of the existing effects on buildings near the various NoRs is in Appendix 1 of the Supplementary Flood Hazard Assessment. Our view is that existing buildings with limited freeboard, will typically be the governing factor in assessing effect on other property and that a specific condition on future urban zoned land is not required. Where an existing flood floor does not limit effects, the change in flood level will be governed by the 50mm change at the boundary of the NoR.
18	*Table 4-1, page 21:* Table 4-1 AC Healthy Waters recommended maximum impervious coverage based on AUP:OP zonings have Road: Strategic transport corridor zone as 60%, please check this as it is 100%. Only Sports and Active Recreation zone is 40%, however Informal	The impervious coverages were used in the models – there was an error in the tables which has been corrected. Zone 59 is coastal transition zone.

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	Recreation zone is also included in the heading. Only Cemetery is 60%, however School and North Shore Airport is also included in the heading. *Rationale: Please make any required changes to assessment and update information accordingly. It appears the correct value is used based on Table 4-2 - 4-5. In Table 4-2 zone 59 is that meant to be coastal transition zone.*	
19	*Section 4.2.2 Future flooding environment, Figures 4-8 to 4-11, page 24-25:* The scale of the plans provides no context around the potential areas of flood risk relevant to the NoRs, or areas of flood risk that will need to be assessed in response to future modelling. *Rationale: There is no flooding information provided in these plans , this will provide clarification of the purpose of their inclusion is required. Please include further information and provide keys with the Figures to allow better understanding of the Figures.*	We are arranging access for AC processing officers to the SGA GIS platform so that the flood extents can be overlaid with the various proposed works extents, land-use, contours etc and viewed at meaningful scales.
20	*Section 4.2.2 Future flooding environment, Figure 4-12, page 26:* The floodplain presented in Figure 4-12 is simply an extract from the Auckland Council GeoMaps viewer. This floodplain is a 2009 floodplain and will therefore not consider Unitary Plan land uses and an inconsistent application of climate change to currently applied. Please justify the reason for the inclusion of this image and what it is supposed to show. *Rationale: This will provide justification of why GeoMaps data is being presented and not specific modelling results by Te Tupu Ngātahi.*	NoR1 and 4 (south of Lonely Track Road) have potential impacts on Lucas Creek. As both corridors do not directly impact the flood plains and attenuation of flow from these two NoRs is proposed in future under the Regional Consenting stage, peak flows will not increase from these NoRs; therefore flood effects can be managed. As the Lucas Creek model is 1D, mapping of the flood extents is time consuming and the flood extent is not expected to be greatly different to that shown in the AC Geomaps site.
21	*Section 5.5 Assessment of potential operational effects, bullet point heading sentence, page 30:* The sentence reads 'For the Projects the assessment of operational flooding effect considered.' The bullet points then list out a number of different statements that does not indicate whether they have been considered or will be considered. As such it is not clear what the purpose of this list achieves. *Rationale: This will provide clarification of the assessment of operational flood effects considerations.*	We have amended this list and updated it in the Supplementary Flood Hazard Assessment (Attachment B) to clarify matters. It now reads: The assessment considered: - Where new culverts and bridges would be required to maintain flow patterns. Note these were not sized unless the post-project scenario was modelled. - Areas where new road embankments would encroach on to floodplains or flood prone land and take up flood storage, thereby potentially changing routing relationships and changing discharge rates. Note this was assessed qualitatively and used as an input to when modelling of the post Project terrain would be carried out. - Potential bridge spans were set qualitatively based on a proportion of floodplain width. - Selected culverts were sized where the Post Project model terrain was modelled. - The extent of land required for stormwater wetlands based on the need for retention/treatment and the need for flow attenuation. - Whether there was potential for off site overland flows to enter the corridor and the need for it to be diverted around the Project works. - The location and level of properties and buildings adjacent to the Project works relative to the terrain and existing flood levels – and therefore whether the Project works were likely to exacerbate or cause flooding.
22	*Section 5.5 Assessment of potential operational effects, third bullet point, page 30:*	Please refer to the responses for items 3 and 11 above.

Ref	Request	Response
	The potential bridge / culvert infrastructure sizing will; consider a 'future' scenario with climate change of 2.1 degrees. There is no definition of what a future scenario actually is and again there is no mention of considering 3.8 degrees climate change. Please confirm what is meant by Future scenario and climate change design criteria. *Rationale: This will provide further information on what scenarios are to be used to assess the effects of development on flooding.*	The future existing (pre-Project) scenario is defined in the Assessment of Flooding Effects Section 3.1 para 2 and 3 (lodged in 2023) although it is acknowledged that "larger" after 2016 terrain is misleading as only culverts above a certain diameter were included in the pre-Project models as clarified in the Supplementary Flood Hazard Assessment report. 2.1 and 3.8° of climate change is also mentioned in these two paragraphs. Both the pre-project and post-project scenarios allow for the maximum impervious development according to the AUP: OP (which is the worst-case scenario) and not what exists at the time of the OPW.
23	*Section 6.2 Positive Flooding and stormwater effects, page 34:* The text states that there are no positive flooding effects apart from the new road formation being constructed above the predicted floodplain. This is a very concerning statement and clarification is required on the word 'positive'. *Rationale: This will provide further information on what the 'no positive' effects are on flooding.*	We have clarified this in the Supplementary Flood Hazard Assessment (Attachment B) . Also refer to the Item 9 above. The main positive effects that could be designed in the future works for the North NoRs are: • proposed new roadways to be above the predicted future flood levels • proposed widened and improved roadways to be above the predicted future flood levels, particularly existing overtopping roads, thereby improving road resilience and ensuring there are lifeline routes for emergency vehicles and minimising disruption to other traffic • added water quality treatment and attenuation of the total roadway impervious area as opposed to just the additional roadway area for upgraded roads, and • conveying water across existing corridors with less headwater so that upstream flood effects are reduced (subject to checks on downstream flooding effects).
24	There is no information provided on the stormwater management required to mitigate the effects of the development. *Rationale: This will provide clarity on what stormwater management is required for each section of the NoRs, or what it will be to achieve.*	Please refer to the response for items 10 and 15 above. We have also prepared a set of plans which show the catchment to each treatment device and a summary table of information (catchment size, stormwater management purpose (treatment/retention/attenuation), permanent water area size and ratio of catchment to device size). Please refer to Attachment C. The summary table shows that the size of each device is appropriate for the chosen stormwater management purpose.
25	Please review the plans throughout the report and ensure that the legends are meaningful, and the mapped data are relevant to each location mentioned in the report. *Rationale: This will provide information on the Figures used.*	We are arranging access for AC processing officers to the SGA GIS platform so that the flood extents can be overlaid with the various proposed works extents, land-use, contours etc and viewed at meaningful scales and legends provided.
26	In some subsections for each NoR there is mention that wetlands will provide treatment for impervious areas. There is no confirmation on whether attenuation will also be provided. *Rationale: This will provide description of what stormwater management is considered appropriate for each relevant location within the NoR boundaries together with what stormwater management principles and performance standards are to be met.*	Please refer to the summary table prepared for item 10 and the information included in Attachment C.
27	At a number of locations within the report there is mention of 3.8 degrees climate change being considered; however, there is no information provided in the specific NoR sections on whether this has been considered or how it has been considered. As such it is not clear what design parameters are being used in the assessment of flooding effects.	Please refer to the responses for items 3 and 6 above.

Ref	Request	Response
	<u>Rationale</u>: This will provide information on where and how has a 3.8 degrees climate change been considered.	
28	No information is provided in the report about how culverts, bridges or proposed stormwater infrastructure has been conceptually sized. *<u>Rationale</u>: There is no information provided about any stormwater infrastructure required to address the Te Tupu Ngātahi proposed Designations as such it is not possible to assess whether what is proposed is adequate or whether the proposed flooding conditions can be met. The flood assessment information appears limited to land within the proposed designation and ignores impacts outside. This is required to assess whether there is adequate space allowed for within the proposed designation for stormwater management.*	Please refer to the response for item 21. Assessment of the sizing adequacy of the culverts and bridges is not required at this stage – this will occur at later detailed design and consenting stages. We consider the appropriate question is rather whether a culvert or bridge span could be set big enough within the corridor for the potential effects to be managed. From this point of view, if a bridge could span the whole existing floodplain, effects will be mitigated upstream. If a culvert is upsized or more barrels added, the cross conveyance capacity is increased and upstream flooding effects can be mitigated. The flood hazard condition provides the means of managing and limiting the effects outside the corridors. The OPW provides the check that these have been sized appropriately to meet the flood condition.
29	A number of NoRs locations appear to rely on GeoMaps data without any justification of why this is considered appropriate. Whilst the use of this data may be appropriate (depending on the model build data supporting the floodplain mapping) there is no discussion provided within the report about potential flood risks in the vicinity of the proposed Designation or direction on what needs to be looked at in the future modelling to comply with the proposed conditions. *<u>Rationale</u>: This will provide guidance on how the existing floodplains can be used to identify where there are important effects that need to be assessed in relation to the proposed condition, such as FUZ land, existing properties, over flowpaths, private discharges, etc.*	Lucas Creek utilised the Geomaps flood plains as there is expected to be little change. The future design and modelling will be aimed at achieving the Flood Hazard Conditions and Regional Consenting requirements at that time.
30	*Section 19 Conclusion, final paragraph, page 83:* The final conclusion is that a flood condition is proposed which will require future detailed modelling to achieve specific outcomes. It is difficult to know whether this is correct as the proposed conditions are not included in this section of the assessment document. If there is a reliance on conditions to guide further work, then these conditions should be presented in the assessment as these will ultimately guide what the future assessment is required to achieve. *<u>Rationale</u>: In the absence of technical solutions and a reliance on conditions to assess impacts at some point in the future then the conditions are required to be presented in this section of the assessment, to ensure information is easily located in the report.*	The general approach for all TTN technical reports is that technical reports set out recommended mitigation measures and the AEE outlines the wording of proposed conditions. We disagree that the conditions need to be included within technical reports. Notwithstanding that general approach there is ongoing discussion between AC/HW and TTN about the Flood condition wording. Our current version was developed in Dec 2023, with revisions and the rationale for revisions is set out in Section 1.4 in Attachment A and in the Supplementary Report in Attachment B. The wording is also set out below. <u>Proposed Flood Hazard Condition (updated Dec 2023)</u> *a) The Project shall be designed to achieve the following flood risk outcomes:* *a. no increase in flood levels in a 1% AEP event for existing authorised habitable floors that are already subject to flooding or have a freeboard less than 500mm;* *b. no increase in 1% AEP flood levels for existing authorised community, commercial, industrial and network utility building floors that are already subject to flooding or have a freeboard of less than 300mm;* *c. maximum of 50mm increase in water level in a 1% AEP event outside and adjacent to the designation boundaries between the pre and post Project scenarios;* *d. no new flood prone areas; and* *e. No increase of flood hazard for main vehicle access to authorised habitable dwellings existing at time the Outline Plan is submitted. The assessment shall be undertaken for the 1% AEP rainfall event. Where Flood Hazard is:* *a) Velocity x depth > = 0.6 or* *b) depth > 0.5m, or* *c) velocity >2m/s.*

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		b) Compliance with this condition shall be demonstrated in the Outline Plan, which shall include flood modelling of the pre-Project and post-Project 1% AEP flood levels (for Maximum Probable Development land use and including climate change). *c) Where the above outcomes can be achieved through alternative measures outside of the designation such as flood stop banks, flood walls, raising existing authorised habitable floor level and new overland flow paths or varied through agreement with the relevant landowner, the Outline Plan shall include confirmation that any necessary landowner and statutory approvals have been obtained for that work or alternative outcome.*
31	*Section 19, Construction and operational comments, page 84-85:* Each NoR subsection provides a section on construction risks. Neither of these sections mention overland flowpath management and considers each NoR as a single project entity. It is generic and does not provide site specific information. *Rationale: This will provide information on specific risks at specific locations along each NoR.*	The main construction flood risks are associated with bridge and culvert building - such as diversion of flood water. Potential effects are well known and can be appropriately managed via typical construction management. The effect cannot be quantified until the method of construction is decided which will be later on in the design process. Other flood risks, such as diversion of overland flow paths in storage yards and laydown areas, are identified generically but cannot be confirmed or quantified until the construction site locations and the design is confirmed. As such we consider a Construction Environmental Management Plan (CEMP) type approach is best to appropriately manage potential flood hazard effects during the construction period, including the consideration of overland flowpaths. The CEMP condition proposed ensures that measures to mitigate flood hazard effects such as siting stockpiles out of floodplains, minimising obstruction to flood flows and actions to respond to warnings of heavy rain will be incorporated in to CEMPs during the implementation phase of each NoR.
32	*Section 20 References:* GD01 is included as a reference used in this report. Please clarify where GD01 has been used in the Flood Assessment report. *Rationale: This will provide further information on where GD01 is applicable to understand how it is used.*	GD01 has been used as the basis for sizing stormwater management devices for the concept design in terms of treatment and retention.
33	*Appendix 1 Water level comparisons for the pre-Project 1% AEP rainfall with 2.1 and 3.8 degreed climate change scenarios.* Please provide clarification on the reason for including this information when it is not presented in any of the NoRs sections and has no text within the main body to explain the relevance. *Rationale: This will clarify why this data is presented and the purpose of it.*	The water level difference data in Appendix 1 of the Flood AEE from August 2023 shows: - Relatively small changes in flood level between the 2.1 and 3.8° climate change scenarios in many cases and therefore no significant changes in the overall vertical alignment are required to provide freeboard to the 3.8° scenario. - The hydraulic grade can be worked out by comparison of points upstream and downstream of the alignment. Where there is limited hydraulic grade in the base case, there is more potential for flooding effects due to the Project works – particularly where it is a new stream crossing. The information has been included in Section 5 of the Supplementary Flood AEE where we consider it is particularly relevant. For example, with respect to the second bullet point if you refer to Appendix 1 sheet SGA-FL-N-005 you will note the following: Points 43 and 44 for example are either side of the new RTC corridor and have only 30mm of hydraulic grade in the base case as there is no existing culvert or bridge at this location. With 50mm additional head allowed at the NoR boundary by the proposed flood condition, the new bridge needs to pass the flood flow with 80mm of hydraulic grade. This is relatively small and we expect the future bridge span will need to be longer rather than shorter to pass the flood flow and the flood plain is reasonably wide at this location. Conversely, points 31 and 32 show a narrow floodplain downstream and a wide floodplain upstream with 2.76m (49.49m upstream and 46.73m downstream of Dairy Flat Highway) of water level difference. This shows that the existing conveyance under Dairy Flat Highway (900mm culvert) is insufficient to pass flood flows and is causing raised flood levels upstream. It also indicates that there is plenty of hydraulic grade to design new cross conveyance structures and the future design has the potential to reduce upstream flood levels and increase developable land (assuming any downstream effects can be appropriately managed).
34	*Appendix 2 Dairy Flat Highway (NOR8)/ Bawden Road (NOR12) post Project concept design modelling and discussion memo:* It is not clear what the purpose of this memo is. The results of the analysis appear to be truncated floodplains with greater than 50mm increased in flood levels at numerous locations outside of	The purpose of this memo is to demonstrate that the Flood Hazard condition is able to be achieved with minor refinements to the post Project design. The predicted water level difference is a result of the difference in the proposed and existing road formation levels at this intersection. Any water depth on the proposed road due to the rain on grid approach will show a water level difference greater than 50mm which as noted is driven by the road level change.

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	the NoR boundary. Clarify the purpose of including this information. *<u>Rationale</u>: The current concept design of the Dairy Flat / Bawden Road intersection area appears to show increases in flood depth exceeding 50mm which may not satisfy the proposed condition. This will provide clarify on why this memo has been included or the purpose it serves.*	There is a minor water level difference (approx. 65mm) between the proposed and existing Bawden Roads and Dairy Flat Highway which can be reduced by recontouring the land in this area to reduce the existing ground level and therefore the post Project water level. This reduction in post Project water level will then be within the 50mm difference proposed in the flood condition.
35	*AEE, page 306:* Please provide an assessment against the Auckland Water Strategy 2022-2050. Please include in Table 24.1 under Regional. *<u>Rationale</u>: This will assess whether the NoRs will be consistent with the Auckland Water Strategy.*	The Auckland Water Strategy 2022-2050 (or subsequent Auckland Council strategies) will be considered in further detail through the regional resource consent phase of the Projects. Although resource consents are not being sought at this time, ecological effects arising in respect of activities that require consents have been considered to inform alternatives assessment, transport corridor design and the proposed designation footprints. In light of this, generally, the transport corridors within the North network have sought to avoid or minimise impacts on streams and high value wetlands. This is demonstrated through the comprehensive alternatives assessment process undertaken and design refinement. Specifically, high value wetland environments have been avoided and / or reduced where practicable, and new bridge structures are proposed over high value streams. Some freshwater environments may be impacted where there is a functional and operational need to do so. The proposed transport infrastructure is critical to enable existing and future communities to provide for their social, economic, and cultural well-being. In considering the potential future effects arising from activities that may require resource consent in the future, the Assessment of Ecological Effects identified that any potential effects of the North network on ecological features within or adjacent to transport corridors, can be adequately managed, and will be subject of assessment as part of any future consent processes. Additionally, there is flexibility in the proposed designation to further minimise impacts at detailed design.
36	*Appendix B Conditions Flood Hazard:* Please provide information why the definition of 'Flood prone area' was selected and why the Auckland Council GeoMaps description of Flood prone area was not used. Are there any scenarios where the proposed definition would not capture ponding? *<u>Rationale</u>: This will provide information on the definition of 'Flood prone area'.*	We considered that the definition was consistent with the Geomaps definition. Notwithstanding this, we have amended the definition. New flood prone areas (FPA) created by the transport corridors would be associated new formations and suitably designed bridges or culverts to reduce the FPA risk through sizing or duplication. Existing FPA areas associated with road formations that are to be widened and potentially raised would also be dealt with suitably designed bridges or culverts to reduce the FPA risk through sizing or duplication. Where the road formation for existing overtopping roads is not to be raised then there would be no change to the existing FPA. Any flood prone area created by the Projects would be managed as part of the Flood Conditions and Regional Consenting; therefore there should be no situation where FPA adversely affected or created by the post Project design are not addressed.
37	*10 Flood Hazard:* Please provide information on why 150mm is used for conditions (i) and (ii). *<u>Rationale</u>: It is recommended that a freeboard level of 500mm is used for vulnerable activities to be consistent with the Stormwater Code of Practice (SWCoP).*	This was to make the proposed North NoRs Flood Hazard Condition consistent with the changes that Healthy Waters sought to the flood condition during the A2B hearing process. We note that 150 mm is the minimum freeboard required in the Building Code and also the Auckland Council Code of Practise V3 2021. Therefore, changes to freeboard less than 150mm were excluded so that the Project works would not make a currently compliant habitable building non-compliant. The clause has subsequently been revised following further assessment, the rationale for which is detailed in Attachment A, Section 1.4.
38	*10 Flood Hazard:* Please provide information on why a freeboard level is not used for less vulnerable activities for conditions (iii) and (iv). *<u>Rationale</u>: It is recommended that a freeboard level of 300mm is used for less vulnerable activities to be consistent with the Stormwater Code of Practice (SWCoP).*	The revision to the proposed Flood Hazard condition, detailed in Section 1.4, allows for the 500mm freeboard for habitable floors and 300mm for commercial buildings. We considered that controls on the most important buildings are included in the condition and that the 50mm control at the NoR boundary will generally protect other buildings.

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39	*10 Flood Hazard:* Please provide information on where the 10% is derived from for condition (ii) and (iv). *Rationale: This will provide information on the condition.*	The revision to the proposed Flood Hazard condition, detailed in Section 1.4 allows for the 500mm freeboard for habitable floors and 300mm for commercial buildings and therefore removes the need for these freeboard reduction conditions.
40	*10 Flood Hazard:* Please clarify how other buildings or structures that are part of network utilities will be considered when doing assessments. *Rationale: This will provide information on how network utilities related buildings and structures will be considered.*	As detailed in Section 1.4, the Flood Hazard condition has been revised so that network utilities buildings that are already subject to flooding or have a freeboard of less than 300mm are appropriately considered.
41	*10 Flood Hazard:* Please provide information on where the 50mm is derived from for condition (v). Will this 50mm be suitable for all the sites affected by the NoRs if so why? *Rationale: This will provide information on the condition.*	This issue is also discussed in Part 1 of Attachment A. We have worked with a range of Flood Hazard conditions and allowable changes in flood levels on linear infrastructure projects – these typically range from 0 to 100mm. Our experience is that “no change” conditions are not practicable, and that some flexibility is required. We considered that a 50mm change was at the bottom end of the range of what could be made hydraulically workable while minimising upstream effects. A larger change at the boundary is desirable where it does not cause unacceptable effects on adjacent property. In the Drury Arterials condition a 500mm change at boundary was allowed with rural properties. This has subsequently been removed in the later NoRs where the adjacent land is zoned for urban development/ future urban zoning.
42	*10 Flood Hazard:* Please provide information on why 'where there is no existing dwelling' is used and how rural use land will be considered in assessment. *Rationale: This will provide information on the condition.*	Refer to the response to item 41. In the Drury Arterials NoRs, we had an allowable 500mm change on the boundary of the NoR (typically with rural land). The term “no existing dwelling” was added as context to clarify that the outcome applied only to the land not a dwelling - i.e. a paddock could get more flooded. Where there was an existing dwelling, the outcome related to freeboard would supersede the rural land outcome. Rural land use is also allowed for with habitable floor freeboard and also the flood hazard criteria (D x V < 0.6) should a building occur in future. This outcome has now been superseded by the allowable 50mm change as the adjoining environment is more typically future urban zoned land.
43	*10 Flood Hazard:* Please provide information on how overland flow paths will be assess and managed as it was identified as a flood hazard for this project. *Rationale: Please provide a condition that will address how overland flow paths are managed to ensure any changes to overland flow paths are appropriately managed and there are no increase in flooding effects to private properties.*	Overland flow paths and their 1% AEP flood levels are part of the effects that will be considered as part of the outcomes set out in the Flood Hazard Condition. For example, where an overland flow path potentially affects a habitable floor level, the condition will now maintain 500mm freeboard to the floor. Where an overland flow path changes but does not directly affect a building covered by the condition, any change is limited to the 50mm change on adjacent land. Overland flow paths will be further assessed in the development of the Outline Plan and as part of the future regional resource consent process.
44	*10 Flood Hazard:* Please provide information on where the 10% is derived from for condition (vii). A ‘10% average increase’ will be site specific and a 10% increase at some sites will have a more significant effect than at other sites where there is no flood hazard.	This wording was developed for the allowable change in floor freeboard. The latest version of the Flood Hazard condition has removed the reference to 10% increase.

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	<u>Rationale</u>: This will provide information on the condition and a review of the use of a '10% average increase'.	
45	*10 Flood Hazard:* Is main access in condition (vii) for vehicles or pedestrian? As the flood assessment stated access to property by residents and emergency vehicles as a consideration. *<u>Rationale</u>: Flood hazards are different for vehicles and pedestrians, how will this condition address both? It is recommended that there is no increase in flood hazards for main access for vehicle and pedestrians.*	Both issues are covered by the descriptions of the flood hazard category H1, H2 and H3 as defined in the Australian Disaster Resilience Handbook. The Flood Hazard condition has been revised to reflect the change from category H2 to H3 in the Australian Institute of Disaster Resilience 2017, Handbook 7, Managing the Floodplain. Using categories of protection, allows some changes to depth or velocity within category H2 while providing appropriate protection. The protection of both pedestrians and vehicles are covered within category H2. Refer to the definitions for the H2 and H3 conditions in Attachment A, Section 1.4 Note also that the other flood criteria on flood level and freeboard will also provide de facto controls on flood hazard. For example, if no more than a 50mm change in flood level is required at the NoR boundary it is unlikely that the overall hazard category will change.
46	*10 Flood Hazard:* In condition (vii) why is 1% AEP rainfall event used and what are the effects of lesser event. *<u>Rationale</u>: It is recommended that assessment is carried out for other AEP events to better understand the flooding effects.*	Flood hazard is considered in terms of extreme events and therefore the 1% AEP event is appropriate as this is the event predominately used for assessing the effects of extreme flooding. Lesser events will have smaller depths and velocities and therefore managing the 1% event will also manage lesser events.
47	*10 Flood Hazard:* Condition (b) states 'compliance with this condition', it is unclear if this includes condition (a). *<u>Rationale</u>: Please include condition (a) in condition (b). For example, compliance with (a) shall be demonstrated in the outline plan. The outline plan, which shall include… This will ensure the condition is clear.*	The condition shall be considered as a whole and therefore "compliance with this condition" means the Flood Hazard condition,
48	*10 Flood Hazard:* What are the details required in the outline plan for condition (b)? How will this be decided. The requiring authorities agree that there will be consultation with Healthy Waters, if so, how can this be certain? It is important Healthy Waters is consulted to ensure flood modelling methodology and information used will be consistent with requirements form Healthy Waters and accurate catchment specific information is used. *<u>Rationale</u>: Please clarify in condition (b) the details to be included in the outline plan and flood modelling.* *It is recommended that consultation with Healthy Waters is specifically stated in this condition to ensure Healthy Waters is involved at the Outline Plan stage.*	A Flood Modelling Report would be prepared that demonstrates compliance with the flood risk outcomes in (a) for the stage of work. The Flood Modelling Report will be submitted to Auckland Council along with the detailed design as part of the OPW, Consultation would typically be undertaken with HW during the design development and prior to the flood modelling to work through any matters specific to the project area.
49	*10 Flood Hazard:* The requiring authority agrees that consultation with Healthy Water will be carried out however this is not addressed specifically in the conditions, please state why.	It is common practice that HW would be consulted through the development of the detailed design during the implementation phase of each NoR. Auckland Council will be identified as a Stakeholder prior to the start of detailed design as required under the condition set. This will be clarified in the revised condition set, which is still being confirmed. This will ensure that all appropriate Auckland Council departments are identified and the methods to engage with all stakeholders are developed in the lead up to detailed design.

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	<u>Rationale</u>: It is recommended that consultation with Healthy Water is addressed specifically in the conditions to give certainty that will occur. Depending on the review process at the time, who the private consultant/developer is, who Auckland Council staff is and the long term timeframe for the project there will be changes and consultation with Healthy Waters may not occur.	
50	*10 Flood Hazard:* How will the existing stormwater network be affected? As it was highlighted in the flood assessment that there may be effects to existing infrastructure and possible blockages of stormwater drains. *<u>Rationale</u>: Please provide a condition that ensures the proposed development and stormwater management does not negatively affect the existing stormwater network for private properties.*	This will be assessed during the resource consent phase and any applications for Engineering Plan Approval.
51	*12 Construction Environmental Management Plan (CEMP):* Condition (a)(vii) is used to manage construction effects, however in 5.4 Recommended measures to avoid, remedy or mitigate construction effects in Appendix E Assessment of Flooding Effects has more details, why is this is not captured in condition (a)(vii). Flood hazard is a district matter and conditions related to flood hazard management in construction is relevant for the designation. *<u>Rationale</u>: Please amend condition (a)(vii) to include the details outline in 5.4 of the Assessment of Flooding Effects. It is important the person preparing the CEMP is appropriately qualified and has experienced with flooding effects, as the project relies on the construction effect to be appropriately managed by the CEMP to manage the environmental effects. And the Assessment of Flooding Effects has highlighted several potential flooding effects during construction.*	The condition has been worded more generically as a list of potential effects may not be relevant to all construction phase works. This give flexibility for the specific effects to be identified and addressed during preparation of the CEMP. Refer also to the response for item 31.