

AK C PPCs 48, 49 & 50 – JWS Stormwater (Technical & Planning) – 17 September 2021.

AUCKLAND COUNCIL:

PRIVATE PLAN CHANGE 48: DRURY CENTRE PRECINCT – KIWI PROPERTY HOLDINGS

PRIVATE PLAN CHANGE 49: DRURY EAST PRECINCT – FULTON HOGAN LAND DEVELOPMENT LTD

PRIVATE PLAN CHANGE 50: WAIHOEHOE PRECINCT – OYSTER CAPITAL

**JOINT WITNESS STATEMENT (JWS) OF EXPERTS IN RELATION TO STORMWATER
(TECHNICAL & PLANNING)**

17 SEPTEMBER 2021

Expert Witness Conferencing Topic: Stormwater (Technical & Planning)

Held on: 17 September 2021

Venue: 2:00pm online via Microsoft Teams during COVID-19 Level 4 Lockdown

Independent Facilitator: Marlene Oliver

Admin Support: Cosette Saville

1 Attendance:

1.1 The list of expert participants is included in the schedule to this Statement.

2 Basis of Attendance and Environment Court Practice Note 2014

2.1 All participants agree as follows:

- (a) The Environment Court Practice Note 2014 provides relevant guidance and protocols for the expert conferencing session.
- (b) They will comply with the relevant provisions of the Environment Court Practice Note 2014.
- (c) They will make themselves available to appear at the hearing in person if required to do so by the Hearing Panel (as directed by the Hearing Panel's directions).
- (d) This report is to be filed with the Hearing Panel.

3 Agenda – Issues considered at Conferencing

3.1 The issues identified as forming the agenda for conferencing were:

Technical Stormwater material

- 1) Discuss pre-circulated technical material for Plan Change 48 and Plan Change 49
- 2) Update on stormwater technical discussion on Plan Change 50

Planning

- 3) Stormwater treatment - discuss pre-circulated memo setting out PC52 provisions
- 4) Other provisions

3.2 The following sections of this Joint Witness Statement address each of these issues, noting where agreement has been reached and, in the event of disagreement, the nature of the disagreement and the reasons for that disagreement.

4 Issue One: Stormwater technical material for Plan Change 48 and Plan Change 49

4.1 The experts agree that there is a technical solution to flooding, for the purposes of the Plan Changes, as set out in 4.2 and 4.3 below.

4.2 Agreement on the technical solution for interim flood management by attenuation devices as demonstrated in Technical Memorandum – Interim Flood Management dated 17 September 2021 (copy attached to this JWS as **Appendix 1**).

4.3 Agreement on amendments to the Drury Stormwater Management Plan section 8.2.6 Flood Management on the application of interim flood management approach, to give effect to 4.2 above (copy attached to this JWS as **Appendix 2**). The full SMP will still need review for consistency and alignment to this section change. The flood modelling assessments referred to will be for events up to and including the 100-year ARI event.

4.4 The full SMP will still undergo a review by Healthy Waters against the NDC schedules prior to adoption into the consent.

5 Issue Two: Update on stormwater technical discussion on Plan Change 50

5.1 Tim Fisher for the Applicant has committed to bring back to the conferencing group following information:

- An updated plan showing the indicative location and extent of permanent flood attenuation devices, building on the plan attached to his rebuttal evidence; and
- Additional assessment of flooding effects due to development on the area upstream of the railway culvert.
- The SMP will be updated accordingly.

5.2 Further expert conferencing will be scheduled to complete this discussion.

6 Issue Three: Stormwater treatment

6.1 The Network Discharge Consent water quality requirements are treatment of all impervious areas by a water quality device designed in accordance with GD01 for the relevant contaminants, or an alternative level of mitigation which is demonstrated to be the Best Practical Option (BPO). All experts agree with the treatment approach for high risk contaminant generating areas, and Public roads and publicly accessible car parks and lower risk contaminant generating areas.

6.2 The area of contention between the Applicant and Auckland Council (as a submitter) is as described below.

6.3 Agreement could not be reached on the following sub paragraphs in section 8.2.3 of the SMP:

Mixed risk contaminant generating areas relating to:

- *Private or jointly owned driveways and carparks/vehicle hardstand (<30 carparks) require risk-based devices requiring water quality treatment for lower contaminant loading and lower risk frequency.*

6.4 Paula Vincent and Danny Curtis do not consider that the approach described above in 6.3 is adequate for the receiving environment. They understate the risks of the activities that may take place, and there isn't enough guidance of the performance standard that would be applied. Paula and Danny consider that contaminant generating surfaces are the trafficked surfaces, including 6.3 above, and are those needing treatment to GD01 level.

6.5 Tim Fisher, Charlotte Peyroux, Pranil Wadan and Trent Sunich agree that a form of treatment is required for 6.3 above, however this is not required at a blanket GD01 level. We consider treatment to a GD01 level is not appropriate as it would be an over design and costly in these circumstances, and does not provide the desired water quality benefit. A risk-based approach to water quality treatment is appropriate for areas identified as potentially lower contaminant loading and lower risk frequency in the SMP. They acknowledged that a 'risk-based' approach sounds good in principle, but can be subjective. To resolve this, an explanation of the 'risk-based' methodology, risk factors to consider (e.g., unique receiving environment, base load contaminants, risks, consequences and mitigation) and application examples will be provided in the SMP by the Applicants experts. These will be drafted for circulation ahead of the next conferencing session.

6.6 At this stage the issue remains unresolved.

7 Issue Four: Stormwater provisions

7.1 This topic was not addressed and subsequent caucusing will be required.

7.2 The experts agree to schedule a further conferencing session on outstanding issues identified in this JWS for 7 October 2021.

8 PARTIES TO JOINT WITNESS STATEMENT

8.1 The participants to this Joint Witness Statement confirm that:

- (a) They agree with the outcome of the expert conference as recorded in this statement. As this session was held online and there is an existing evidence exchange timetable, in the interests of efficiency, it was agreed that each expert would verbally confirm their position to the facilitator. This is recorded in the schedule below;
- (b) They have read Appendix 3 of the Environment Court's Practice Note 2014 and agree to comply with it; and
- (c) The matters addressed in this statement are within their area of expertise.

Confirmed on 17 September 2021:

EXPERT NAME	PARTIES	EXPERTS CONFIRMATION REFER PARA 8.1
Danny Curtis	Auckland Council (as submitter)	Yes
Paula Vincent	Auckland Council (as submitter)	Yes
David Mead (Plg)	Auckland Council (as regulator)	Yes
Trent Sunich	Auckland Council (as regulator)	Yes
Tim Fisher	Kiwi Property Holdings No2 Limited Oyster Capital	Yes
Charlotte Peyroux	Kiwi Property Holdings No2 Limited Oyster Capital	Yes
Pranil Wadan	Fulton Hogan Land Development Ltd	Yes
Nick Roberts (Plg)	Kiwi Property Holdings No2 Limited Oyster Capital Fulton Hogan Land Development Ltd	Yes
Rachel Morgan (Plg)	Kiwi Property Holdings No2 Limited Oyster Capital Fulton Hogan Land Development Ltd	Yes

Appendix 1

Appendix 2

To

Marlene Oliver, Danny Curtis,
Paula Vincent, Trent Sunich,
David Mead, Nick Roberts,
Rachel Morgan

From

Pranil Wadan (Woods);
Tim Fisher (Tonkin + Taylor)

W-REF: P16-335
17 September 2021

Technical Memorandum - Interim Flood Management

1. Introduction

Technical stormwater discussions relating to the interim flood management approach for the Fitzgerald Stream catchment were discussed at the following stormwater expert conferencing sessions:

- 16 August 2021 (Unfacilitated)
- 17th August 2021 (Unfacilitated)
- 9th September 2021 (Facilitated)
- 17th September 2021 (Facilitated)

During these sessions it was agreed by all experts agree that upgrading the Flanagan/railway/Great South Road culverts is the best technical solution and that an interim flood management approach is required prior to the culverts being upgraded.

Auckland Council (as the SMP approver under the NDC and as the network utility operator) highlighted that for provisional approval of the SMP and supporting the Plan Change, there needs to be some certainty of an interim technical solution, which does not worsen flood risk upstream and downstream or within the Drury Centre and Drury East precincts with the existing culverts operational in their current condition and capacity.

This memo sets out the technical support for the interim flood management solution for the Fitzgerald Stream catchment. The application of this is explained in the Stormwater Management Plan for PC48 and PC49

2. Interim Flood Management Approach

Assessments to demonstrate the interim technical solution were discussed at the conferencing sessions on the 16th and 17th of August and subsequently agreed on the 9th of September. The assessments are detailed as follows:

Assessment 1 – Impervious Trigger Point

Purpose of this assessment was to determine what the effects of development would be within PC48 & PC49 on the basis that the Flanagan/railway/Great South Road culverts are not upgraded

This assessment is summarised as follows:

- Four model scenarios were simulated based on the following growth triggers:
 - 25% Growth – Allowance for 25% of the PC48 & PC49 areas developed.
 - 50% Growth – Allowance for 50% of the PC48 & PC49 areas developed.

- 75% Growth – Allowance for 75% of the PC48 & PC49 areas developed.
- 100% Growth – PC48 & PC49 areas fully developed.
- Key model assumptions for these scenarios are as follows:
 - Allowance for climate change (2.1°C) and future rainfall.
 - No upgrade of the Flanagan/railway/Great South Road culverts (i.e., structures remain as is).
 - Other structures/culverts within PC48 & PC49 are able to be upgraded, structures that are assumed to be upgraded / opened are highlighted in the attached plans provided in Appendix A.
 - Model based on existing sub-catchments with no flow diversions.
- A OneDrive link download the models and model result files was circulated to all experts on the 6th September 2021.
- It is noted that Auckland Council (Healthy Waters) are yet to undertake a review of these models.

Afflux plots highlighting the model results for each of the growth scenarios can be found in **Appendix A**, the model results are summarised in Tables 1 & 2. Overall, the results indicate that there is an increase in peak flood depths for each of the growth scenarios, however the increases are limited to predevelopment flood extents. This indicates that for the 100yr storm with future rainfall, the increased flood risk or flood hazard to neighbouring properties is less than minor.

Table 1: Model Results – Peak Flood Depths (m)

100yr MPD with CC scenarios	Upstream of Great South Road/Railway culvert <i>Peak Flood Depth (m)</i>	Downstream of Fitzgerald Road <i>Peak Flood Depth (m)</i>	South of Fitzgerald Road (Towards Drury South development) <i>Peak Flood Depth (m)</i>
Pre-Development	2.15	1.3	0.65
Post Development – 25%	2.34	1.46	0.65
Post Development – 50%	2.41	1.53	0.65
Post Development – 75%	2.47	1.59	0.7
Post Development – 100%	2.52	1.64	0.72

Table 2: Model Results – Peak Flood Level Differences (m)

100yr MPD with CC scenarios	Upstream of Great South Road/Railway culvert <i>Peak Flood level differences (m)</i>	Downstream of Fitzgerald Road <i>Peak Flood level differences (m)</i>	South of Fitzgerald Road (towards Drury South development) <i>Peak Flood level differences (m)</i>	Comments/effects
Pre Development	-	-	-	-
Post Development – 25%	0.19	0.16	0	Minor increases in water levels in areas between Fitzgerald Road and Flanagan Road with no increases in flood extents
Post Development – 50%	0.26	0.23	0	Minor increases in water levels in areas between Fitzgerald Road and Flanagan Road with no increases in flood extents
Post Development – 75%	0.32	0.29	0.05	Minor increases in water levels in areas between Fitzgerald Road and Flanagan Road with no increases in flood extents
Post Development – 100%	0.37	0.34	0.07	Minor increases in water levels in areas between Fitzgerald Road and Flanagan Road with no increases in flood extents

Assessment 2 – Stormwater Attenuation

Purpose of this assessment was to provide guidance on the size of interim attenuation devices for plan changes 48 & 49, this was calculated on a subcatchment basis and simplified to a m³ per hectare requirement.

The assessment was undertaken by exporting the volume differences between the pre and post development models with the difference in accumulated volume being the indicative attenuation volume required.

Subcatchment plans identifying the attenuation requirements for plan change 48 & 49 can be found in **Appendix B**, the attenuation requirements and model exports are summarised in Tables 1 & 2.

Table 3: Attenuation Requirements by Subcatchments– Plan Change 49

Subcatchment ID	Area Total [ha]	Area within Plan Change [ha]	Pre development - ED		Post Development - MPD		Difference Impervious [%]	Difference Accumulated Volume [m ³]	Volume Attenuation [m ³ /ha]
			Impervious [%]	Accumulated Volume 24hr [m ³]	Impervious [%]	Accumulated Volume 24hr [m ³]			
HING101	7.7	7.7	10%	11220	61%	13674	51%	2454	317
HING103	16.9	16.9	11%	25264	61%	30106	50%	4842	287
HING114	38.5	21.5	13%	57111	65%	68962	52%	11852	308
HING118	3.5	3.4	13%	5138	60%	6160	47%	1022	292
HING119	2.0	1.9	14%	3011	60%	3622	46%	611	300
HING21	8.8	8.7	15%	13482	61%	15911	46%	2429	277
HING22	10.9	10.4	17%	16606	60%	19519	43%	2913	268
HING24	6.1	5.6	20%	9006	60%	10518	40%	1512	246
HING25	13.2	3.8	15%	19268	68%	23389	53%	4120	311
HING27	9.4	8.8	15%	13953	66%	16929	51%	2976	316
HING30	7.3	7.3	10%	10823	61%	13104	51%	2281	314
HING33	34.3	4.4	15%	52690	30%	55978	15%	3288	294 *
HING352	7.1	7.1	10%	10587	60%	12799	50%	2212	310
HING353	30.6	8.3	18%	46865	39%	50716	20%	3851	302 *
HING355	4.7	4.5	13%	7083	60%	8472	47%	1388	294
HING356	10.3	9.8	15%	15579	60%	18437	45%	2858	278
HING357	4.7	4.7	14%	7124	60%	8485	46%	1361	288
HING382	2.5	2.5	20%	3768	60%	4378	40%	610	245
HING383	20.3	20.3	12%	29525	62%	35862	51%	6336	312
HING9	16.1	14.1	16%	24527	67%	29651	51%	5124	317
HING99	11.9	11.9	12%	17479	60%	20998	48%	3519	295
Area not included in the model but within plan change									278 *

Table 4: Attenuation Requirements by Subcatchments – Plan Change 48

Subcatchment ID	Area Total [ha]	Area within Plan Change [ha]	Pre development - ED		Post Development - MPD		Difference Impervious [%]	Difference Accumulated Volume [m ³]	Volume Attenuation [m ³ /ha]
			Impervious [%]	Accumulated Volume 24hr [m ³]	Impervious [%]	Accumulated Volume 24hr [m ³]			
HING98	6.7	6.1	16%	9970	81%	12657	65%	2687.1	400.7
HING95	1.1	1.0	39%	1719	98%	2101	59%	382.0	362.5
HING94	27.6	27.6	14%	39309	93%	52652	79%	13342.6	483.8
HING413	3.8	3.8	10%	5498	80%	7123	70%	1624.3	429.4
HING19	1.7	1.7	10%	2526	80%	3279	70%	752.9	432.2
HING18	6.0	5.6	24%	9216	81%	11343	57%	2126.6	354.3
HING16	4.5	4.0	18%	6979	81%	8761	63%	1781.3	391.5
HING100	7.1	7.1	10%	10326	80%	13405	70%	3078.8	432.2

Assessment 3 – Indicative Attenuation Device Locations

Purpose of this assessment was to identify indicative locations for these interim attenuation devices. It is noted that a plan showing these indicative attenuation device locations was tabled at the facilitated caucusing session on the 9th September 2021. It is noted that these plans only identified spatial locations with an indicative volume requirement. Auckland Council requested that plans be updated to not only show indicative locations and volume but also the indicative spatial location/extent.

The plans attached in **Appendix C**, have been further updated to address Auckland Councils request and now provide both a spatial location/extent, with volume and area requirements.

It is important to however note that the location and extent of the preliminary attenuation devices shown are subject to change and will be confirmed at subdivision consent stage.

Overall, the assessment demonstrates that there is adequate space available within plan changes 48 & 49 to allow for an interim attenuation to be provided (if required) to enable development prior to the downstream culverts being upgraded.

3. Conclusion

Upgrading the Flanagan/railway/Great South Road culverts is the best technical solution, but that an interim flood management approach may be required prior to the culverts being upgraded.

The additional work undertaken demonstrates that an interim flood management to support plan changes 48 & 49 is technically feasible. It is noted with the interim approaches will be demonstrated with detailed designs and supporting analysis as part of resource consent applications.

The approach to flood management in the Fitzgerald Stream areas of PC48 and PC49 is set out in the Stormwater Management Plan.

Appendix A



LEGEND

- Plan Change 48
 - Plan Change 49
 - Future Urban Zone
 - NZ River Line
 - Structures Unchanged
 - Structures Opened
- Post Development Scenario
25% Growth**
- Increase in Water Level [m]
- 0.05-0.1
 - 0.1-0.15
 - 0.15-0.2
 - 0.2-0.25
 - 0.25-0.6
 - 0.6-1
 - 1-2
 - 2-3
 - 3-6

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

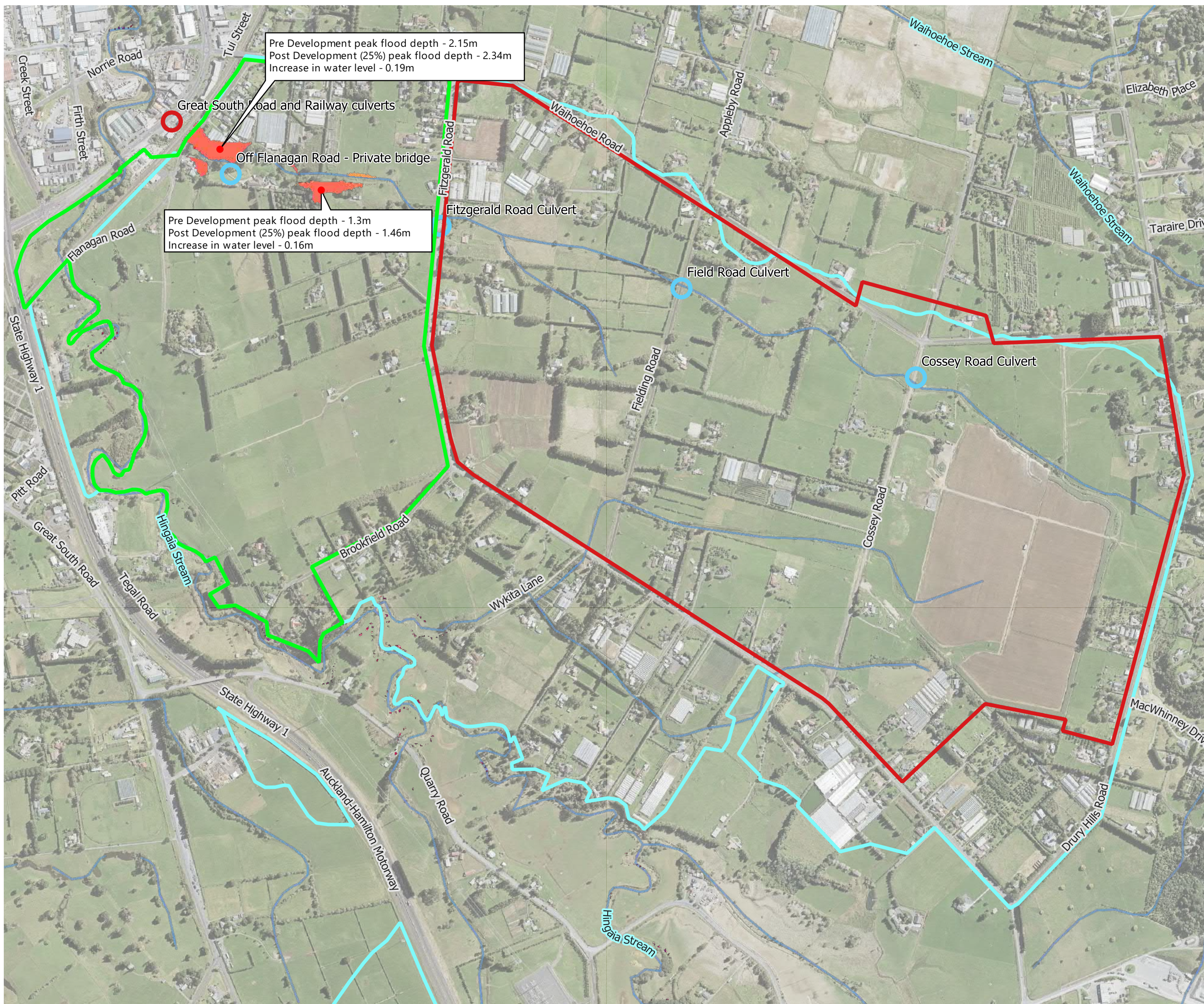
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DESIGNED	MH	
DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ



**Fitzgerald Stream
Interim Flood Management**

**Post Development Scenario
25% Growth**

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:9000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0001	



LEGEND

- Plan Change 48
 - Plan Change 49
 - Future Urban Zone
 - NZ River Line
 - Structures Unchanged
 - Structures Opened
- Post Development Scenario
50% Growth**
- Increase in Water Level [m]
- 0.05-0.1
 - 0.1-0.15
 - 0.15-0.2
 - 0.2-0.25
 - 0.25-0.6
 - 0.6-1
 - 1-2
 - 2-3
 - 3-6

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

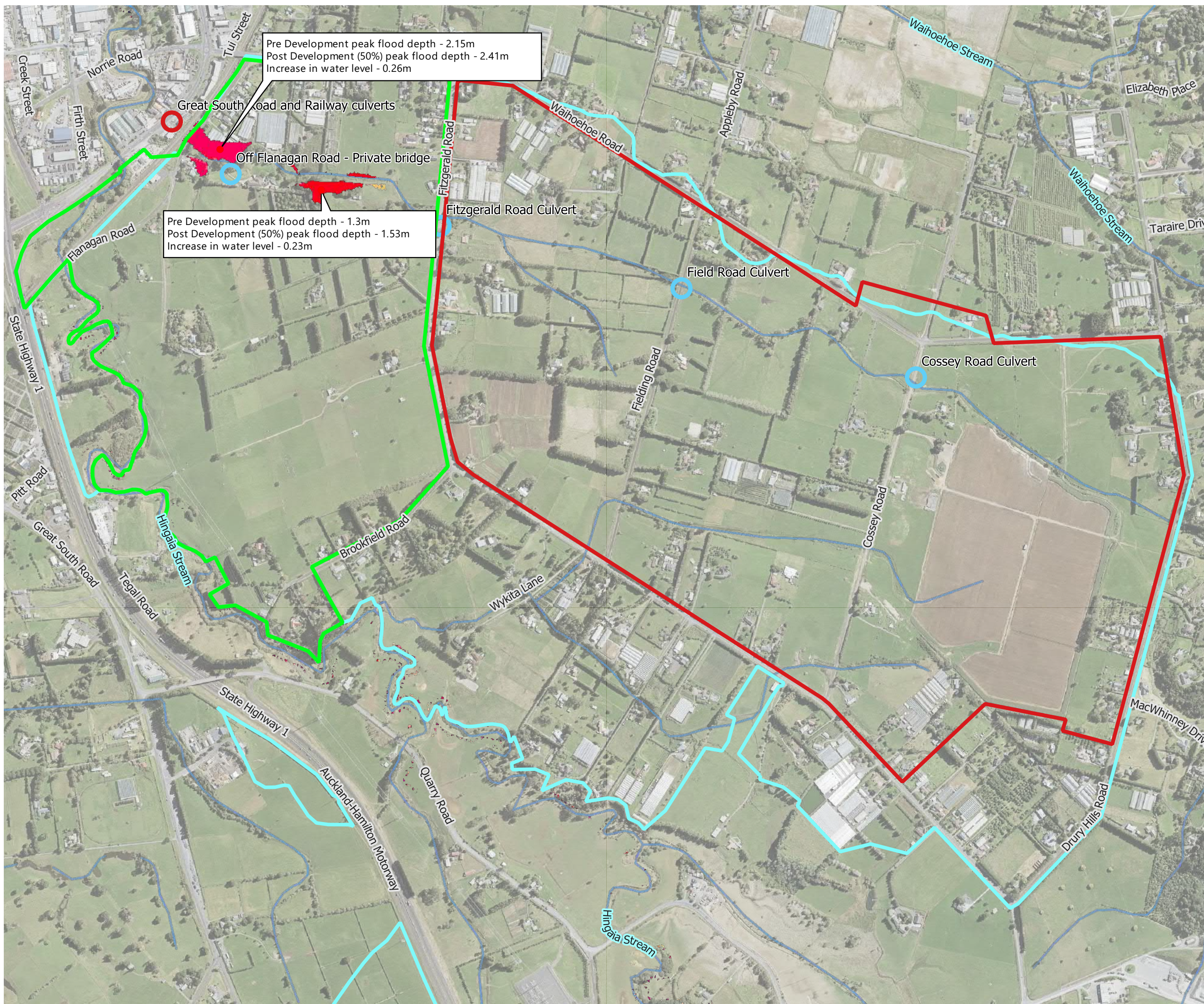
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DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ



**Fitzgerald Stream
Interim Flood Management**

**Post Development Scenario
50% Growth**

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:9000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0002	



LEGEND

- Plan Change 48
 - Plan Change 49
 - Future Urban Zone
 - NZ River Line
 - Structures Unchanged
 - Structures Opened
- Post Development Scenario
75% Growth**
- Increase in Water Level [m]
- 0.05-0.1
 - 0.1-0.15
 - 0.15-0.2
 - 0.2-0.25
 - 0.25-0.6
 - 0.6-1
 - 1-2
 - 2-3
 - 3-6

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

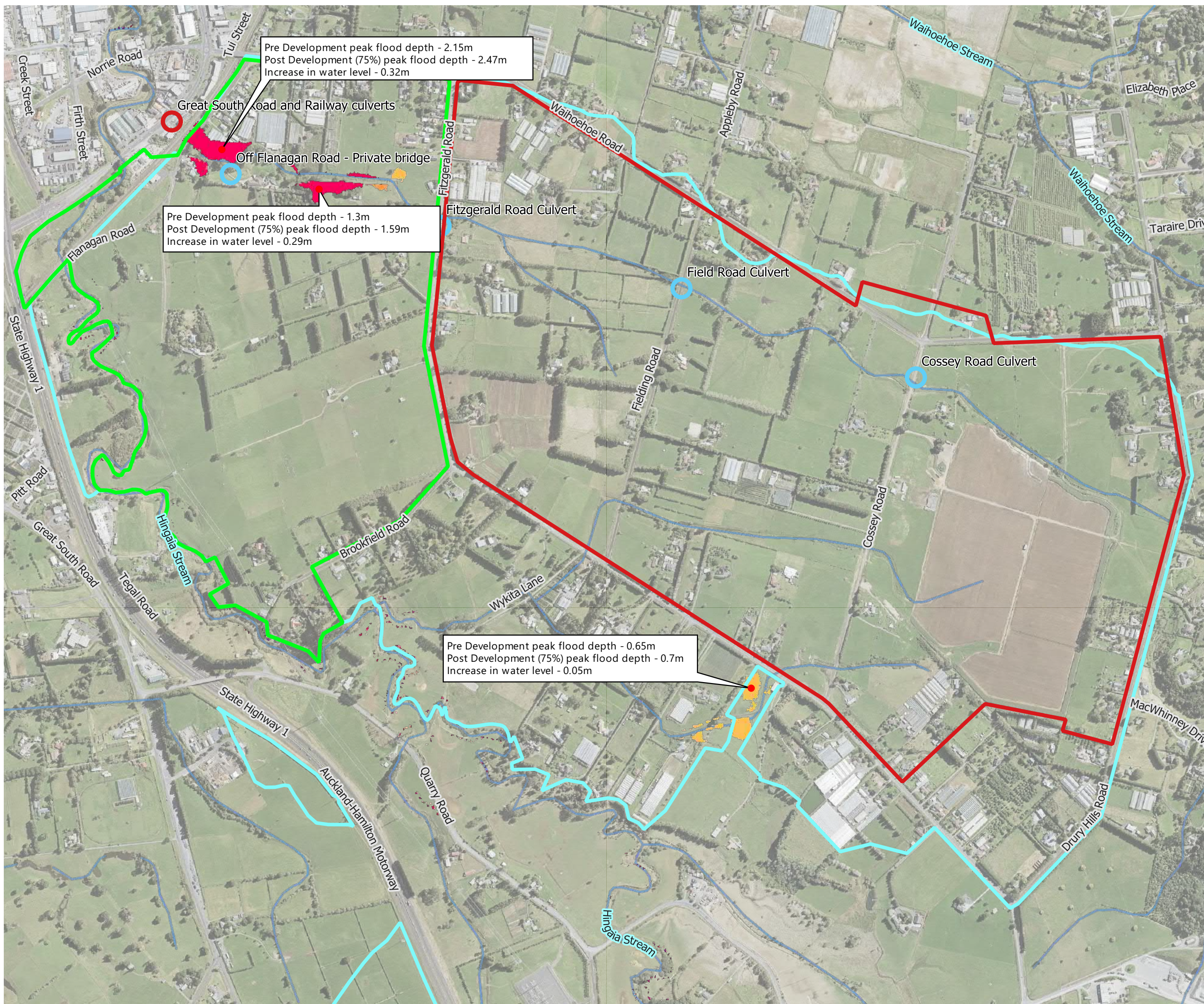
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DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ



**Fitzgerald Stream
Interim Flood Management**

Post Development Scenario
75% Growth

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:9000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0003	



LEGEND

- Plan Change 48
 - Plan Change 49
 - Future Urban Zone
 - NZ River Line
 - Structures Unchanged
 - Structures Opened
- Post Development Scenario
100% Growth
Increase in Water Level [m]**
- 0.05-0.1
 - 0.1-0.15
 - 0.15-0.2
 - 0.2-0.25
 - 0.25-0.6
 - 0.6-1
 - 1-2
 - 2-3
 - 3-6

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

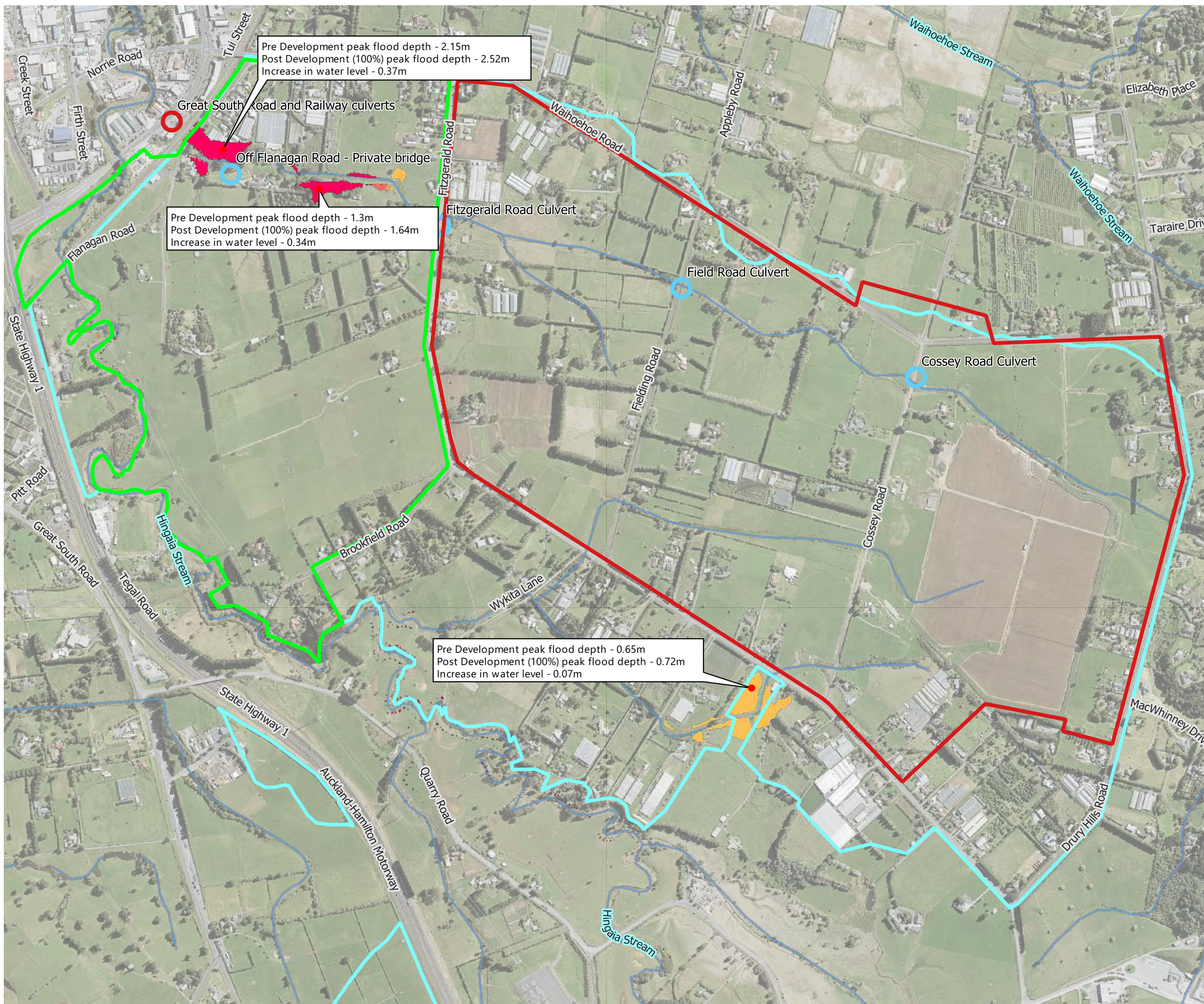
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DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ



**Fitzgerald Stream
Interim Flood Management**

**Post Development Scenario
100% Growth**

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:9000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0004	



Appendix B

LEGEND

- Model subcatchments within plan change 48
- Model subcatchments within plan change 48 draining to Hingaia Stream
- Model subcatchments fully outside plan change
- Model subcatchments partly outside plan change 48
- Model subcatchments partly outside plan change 48 draining to Hingaia Stream
- Kiwi Property Plan Change
- Streams

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

SURVEYED	-	
DESIGNED	MH	
DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ



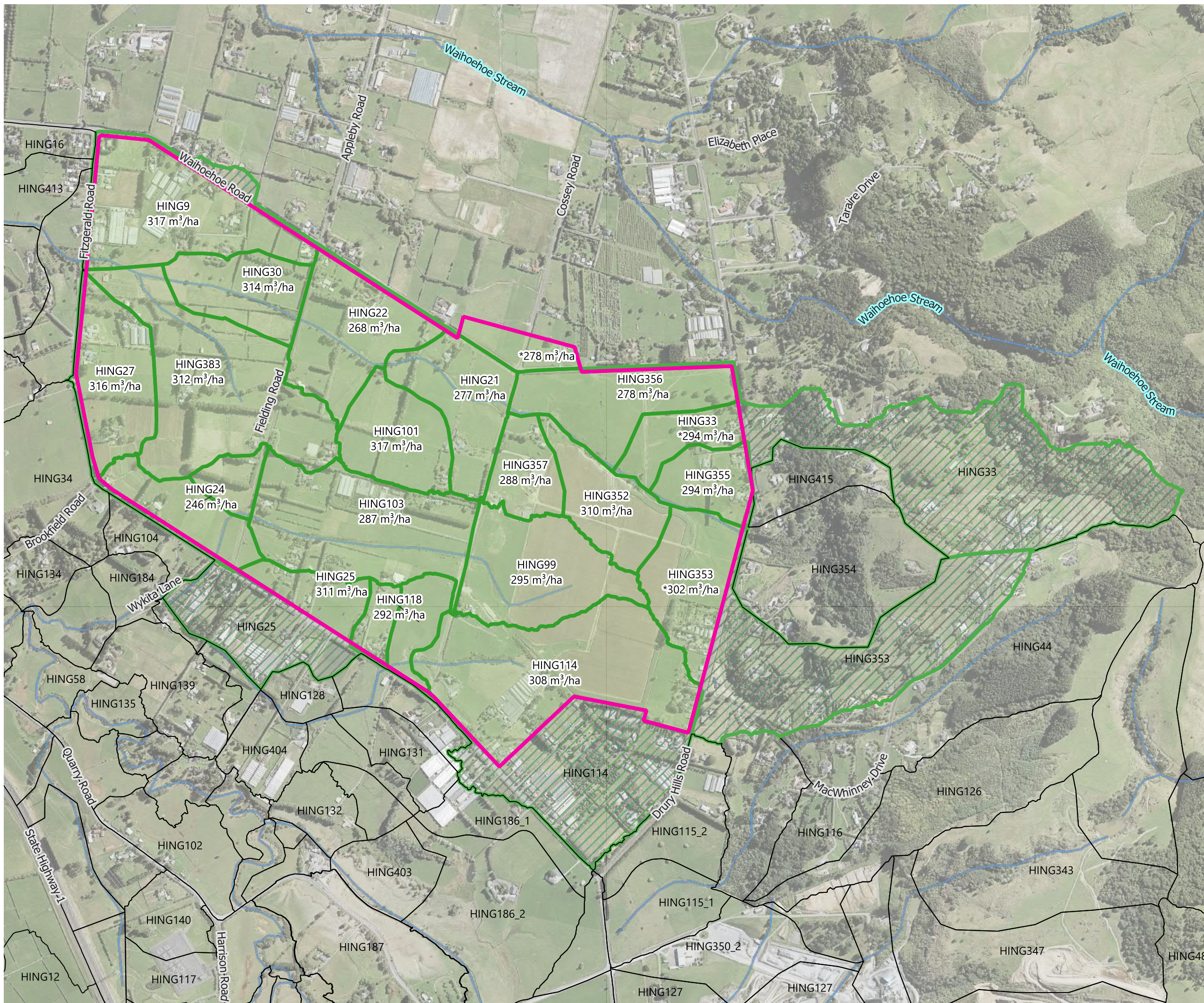
Interim Flood Management
(if required)

Stormwater Attenuation
Requirement for
Plan Change 48

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0005	

LEGEND

- Model subcatchments within plan change 49
- Model subcatchments fully outside plan change
- Model subcatchments partly outside plan change 49
- Plan change 49 extent
- Streams



Note:
 (*) These attenuation values have been interpolated based on the values of the surrounded subcatchments.

REVISION DETAILS		BY	DATE
1.0	Issued for information	PW	06/09/2021

SURVEYED	-	
DESIGNED	MH	
DRAWN	MH	
CHECKED	AD	
APPROVED	PW	WOODS.CO.NZ










Interim Flood Management
 (if required)

Stormwater Attenuation
 Requirement for
 Plan Change 49

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:10000 @ A3	1.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0006	

Appendix C

LEGEND

-  Indicative Watercourses (*)
-  Indicative Neighbourhood / Suburb Park (*)
-  Indicative Location and Size of Device
-  Kiwi Property Plan Change
-  Device Contributing Catchment
-  Indicative Riparian Margin (*)
-  Hingaia Stream Catchment

Note:
(*) These attenuation values have been interpolated based on the values of the surrounded subcatchments.

REVISION DETAILS		BY	DATE
1.0	ISSUED FOR INFORMATION	PW	15/09/21

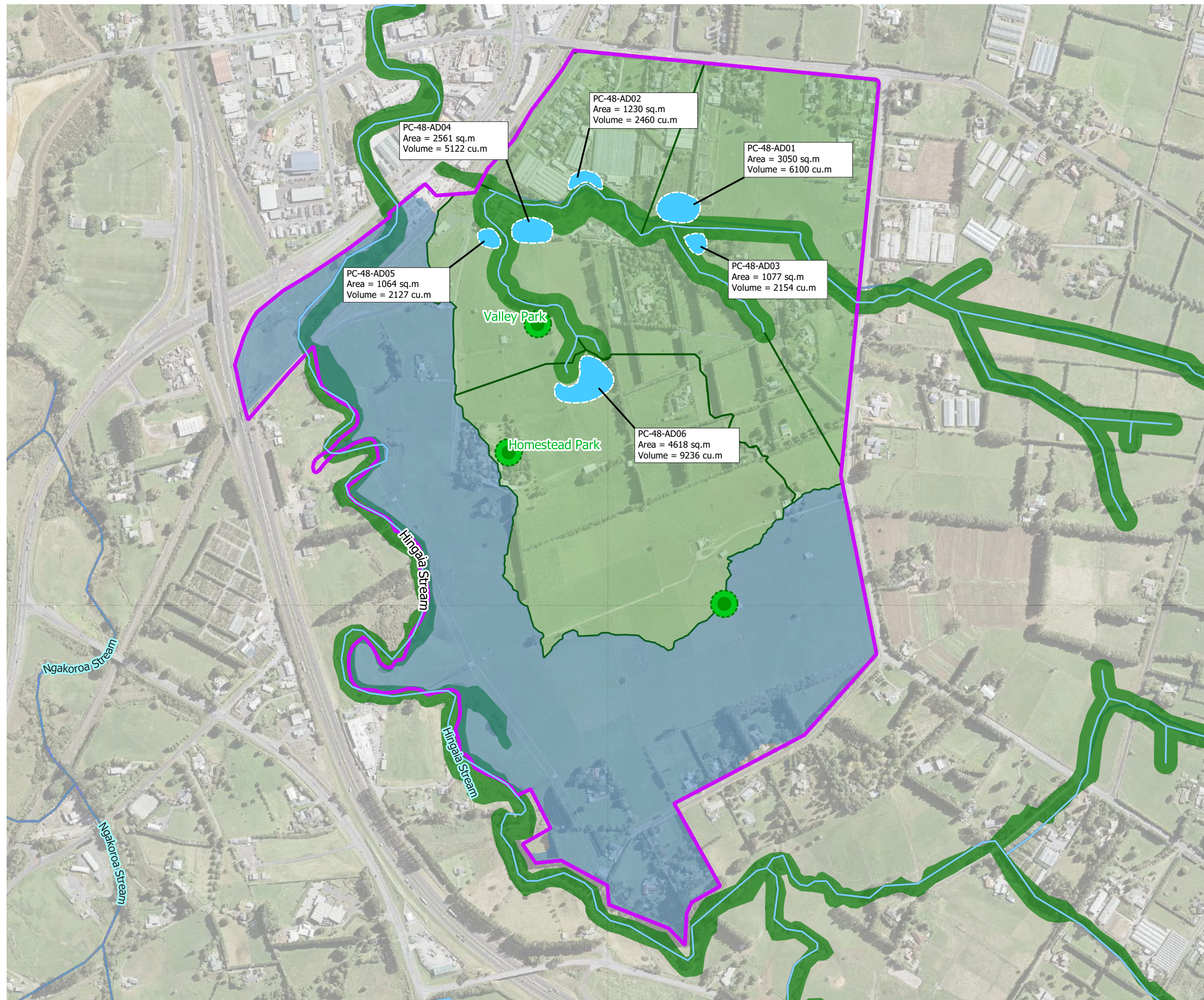
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DESIGNED	SS	
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CHECKED	PW	
APPROVED	PW	



INTERIM FLOOD MANAGEMENT
(IF REQUIRED)

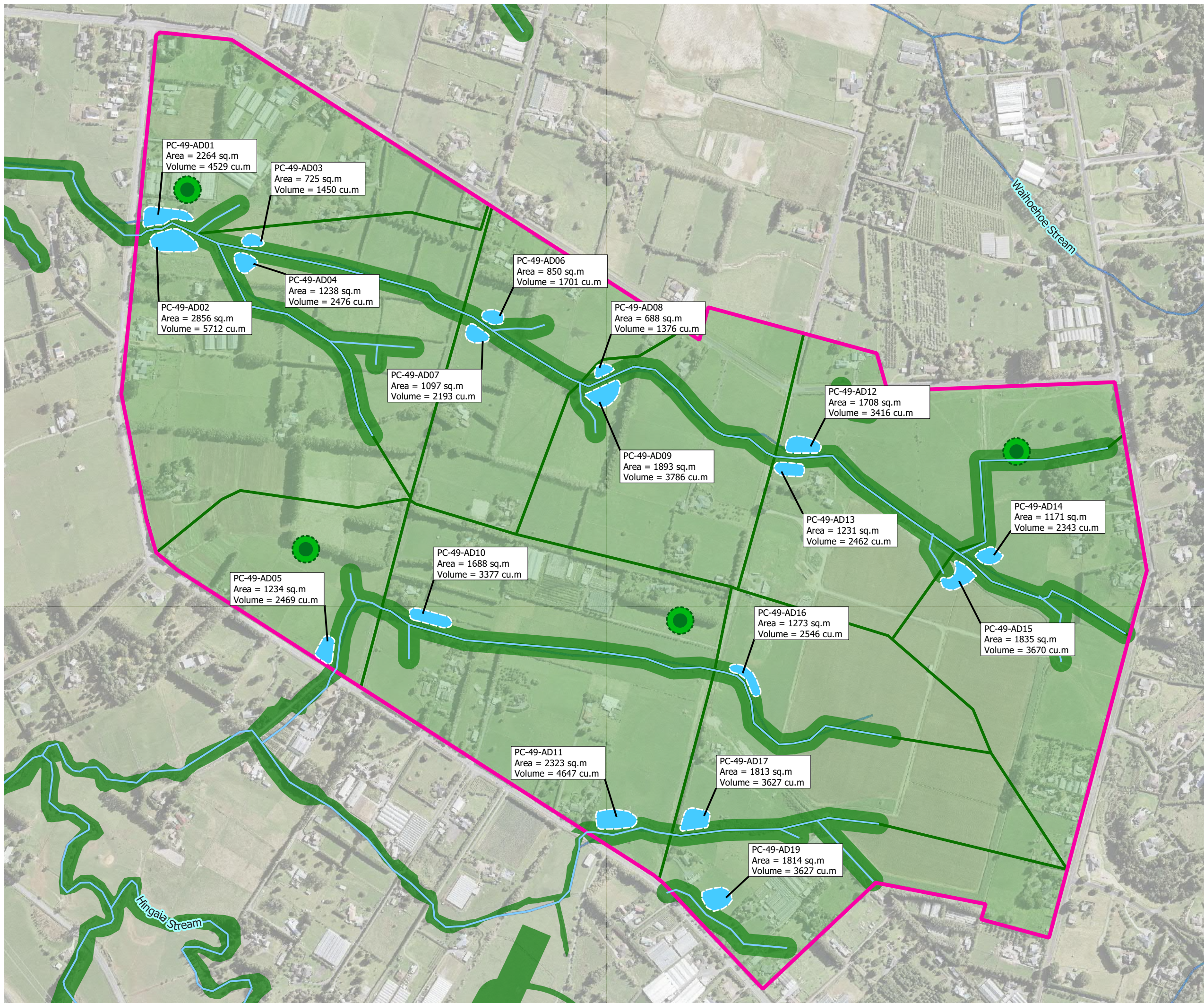
INDICATIVE ATTENUATION DEVICE
LOCATIONS FOR PLAN CHANGE 48

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:6000 @ A3	2.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0005	



LEGEND

- Fullton Hogan Development
- Indicative Watercourses (*)
- Indicative Neighbourhood / Suburb Park (*)
- Indicative Location and Size of Device
- Indicative Riparian Margin (*)
- Device Contributing Catchment



Note:
(*) These attenuation values have been interpolated based on the values of the surrounded subcatchments.

REVISION DETAILS		BY	DATE
1.0	ISSUED FOR INFORMATION	PW	15/09/21

SURVEYED	-	WOODS.CO.NZ
DESIGNED	SS	
DRAWN	SS	
CHECKED	PW	
APPROVED	PW	



**INTERIM FLOOD MANAGEMENT
(IF REQUIRED)**

**INDICATIVE ATTENUATION DEVICE
LOCATION FOR PLAN CHANGE 49**

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:6600 @ A3	2.0
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P16-335-SKT-0006	

Extract from Drury East Stormwater Management Plan – Drury Centre and Drury East Plan Change Areas (Section 8.2.6)

1.1.1 Flood management

1.1.1.1 Flood effects outside the PCA

A performance-based flood risk management approach is proposed for the Drury Centre and Drury East PCAs. It requires that **the development does not worsen flood risk upstream and downstream of the Drury Centre and Drury East precincts** so that the risks to people and property are not increased. Compliance with this performance standard **must be demonstrated through a flood modelling assessment at every resource consent for subdivision/earthworks**. This performance standard is applicable to both changes in runoff from development and any changes to the landform in the 100 year ARI floodplain.

As mentioned in Section XX, the general flood management approach outlined in the FUZ SMP for the Hingaia catchment is to pass forward large storm event flows. The flooding assessment summarised in Section XX has demonstrated that the Drury Centre and Drury East PCAs can adopt a “pass flows forward” approach, subject to infrastructure upgrades for the Fitzgerald Stream (see Section XX below). This means that after water quality and hydrological mitigation treatment, flows from the site will be discharged without further attenuation in order that they discharge through the Hingaia floodplain before the peak flows from the upper catchment reach the area.

1.1.1.2 Fitzgerald Stream special requirements –summary

The management of flooding in the Fitzgerald Stream catchment follows these steps:

- 1 Upgrade all culverts for “pass flows forward” approach (as per Section XX below).
- 2 If culverts (some or all) are not up-graded then consider interim flood management (as per Section XX below). The suggested attenuation requirements and indicative attenuation device maps are a starting point for options, but different options or no mitigation may be necessary subject to the flood modelling assessment 3) below.
- 3 For all approaches demonstrate the performance standards are met with a with flood modelling assessment for every resource consent for subdivision/earthworks.

1.1.1.3 Fitzgerald Stream special requirements - upgrade all culverts

The SMP approach is to upgrade all culverts along the Fitzgerald stream to enable the “pass flows forward” approach.

There are a number of structures and culverts downstream and along Fitzgerald stream:

- Four private culverts within the Drury East PCA
- The Fitzgerald Road culvert, located between the Drury Centre and Drury East PCA
- One structure (a private bridge off Flanagan Road) within the Drury Centre PCA
- Three structures (Flanagan Road Culvert, Kiwi Rail Culvert and the Great South Road Culvert) located on the Fitzgerald stream downstream of the Drury Centre PCA.

It is expected that the four private culverts within the Drury East PCA will be upgraded by the developer. This can be achieved through subdivision and related consents and Engineering Plan Approval and coordinated with the development.

The public structures are shown in Figure 1 below.

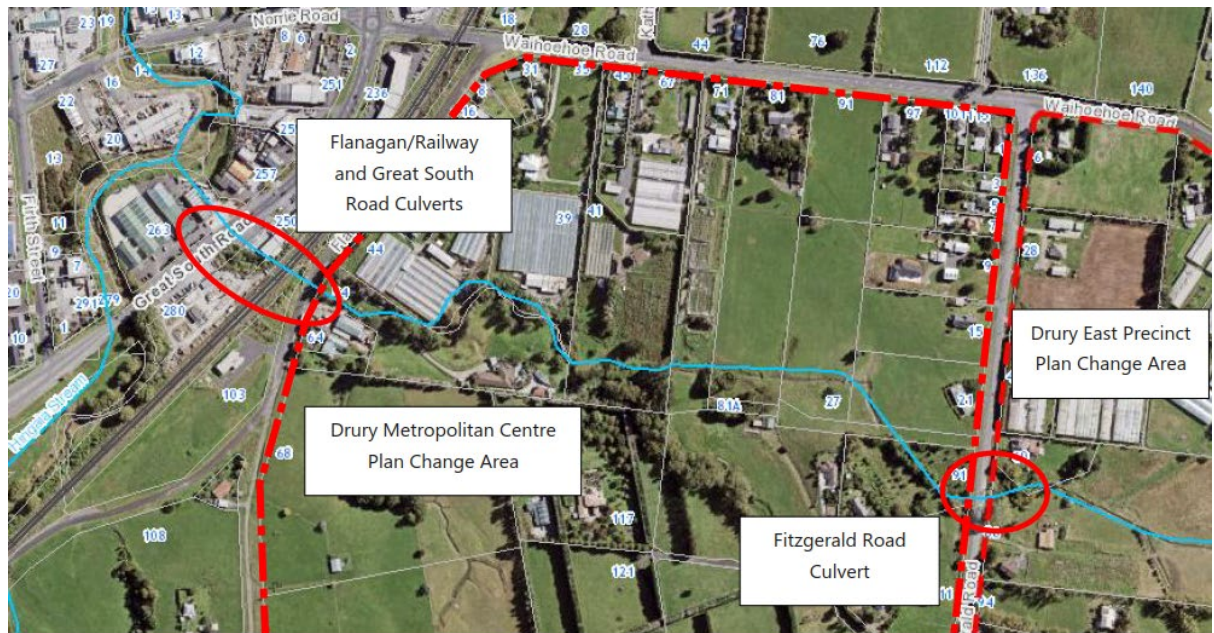


Figure 1: Flanagan/ Railway/ Great South Rd Culverts and Fitzgerald Culvert

The upgrade of public assets will be lead and coordinated by Auckland Council. The Flanagan Road Culvert, Kiwi Rail Culvert and the Great South Road Culvert are owned by Auckland Council and Kiwi Rail. MPD modelling of the pre-development scenarios indicate that, in their current state, these culverts are undersized and throttle the upstream flows, exacerbating upstream flood risk. The SMP solution is to upgrade of these three culverts to remove the flow restriction/constraint and enable the pass forward approach. The Fitzgerald Road Culvert may also need to be upgraded.

It is yet to be determined when and how these four existing structures public culverts will be upgraded (i.e. they may be retained and supplemented by new additional culverts or replaced with entirely new larger culverts). These upgrades will likely require third party investment and an infrastructure funding agreement. The ultimate solution will be informed by the condition of these assets, site investigations, design, construction, and operational considerations.

1.1.1.4 Fitzgerald Stream special requirements - interim flood management

Prior to these culvert upgrades, an interim flood management approach may be required to support partial development within the Fitzgerald Stream sub-catchments. This aspect of the SMP is supported by the Technical Memorandum in Appendix ??.

If an interim flood management approach is required, there are a number of mechanisms available to allow for the first stages of development of the Drury Centre and Drury East PCAs, including onsite flood attenuation, utilising existing capacity in the floodplain and sub-catchment management. The need and solution for this interim flood management approach will be influenced by the location and extent of each stage, which will be decided as part of the master and subdivision planning for Resource Consents.

Any temporary measures are required to meet the flood risk management performance standard outlined above i.e. it must be demonstrated through modelling that partial development does not worsen flood risk upstream and downstream of the Drury Centre and Drury East precincts.

It should also be noted that flows resulting from partial development of these sub-catchments could possibly be passed forward without culvert upgrades, but this approach needs to be tested with a

flood modelling assessment at the resource consent stage. The Technical Memorandum (refer Appendix ??) demonstrates that there are only minor increases in flood depths, which are limited to predevelopment floodplains. This indicates that for the 100yr scenario the increased flood risk or hazard to neighbouring properties is less than minor.

To provide guidance to future developers, a conceptual interim attenuation solution for the Fitzgerald Stream has been developed. Attenuation requirements per hectare of development have been determined based on existing topography, proposed plan change land uses and associated maximum impervious coverage. The attenuation requirements for each sub-catchment are shown on Figures 2 and 3. Refer to Technical Memorandum in Appendix ?? for details.

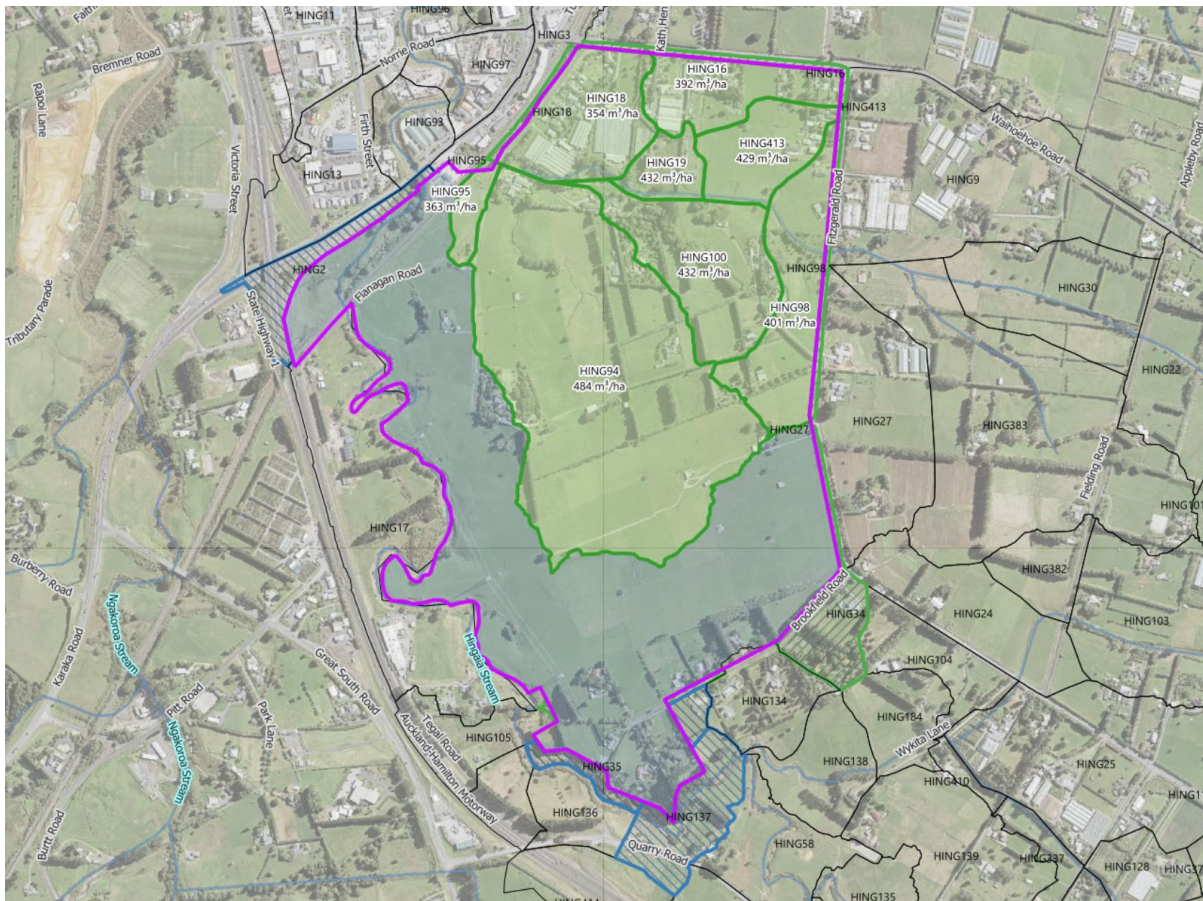


Figure 2: Drury Centre Precinct sub-catchments and attenuation requirements per hectare of development

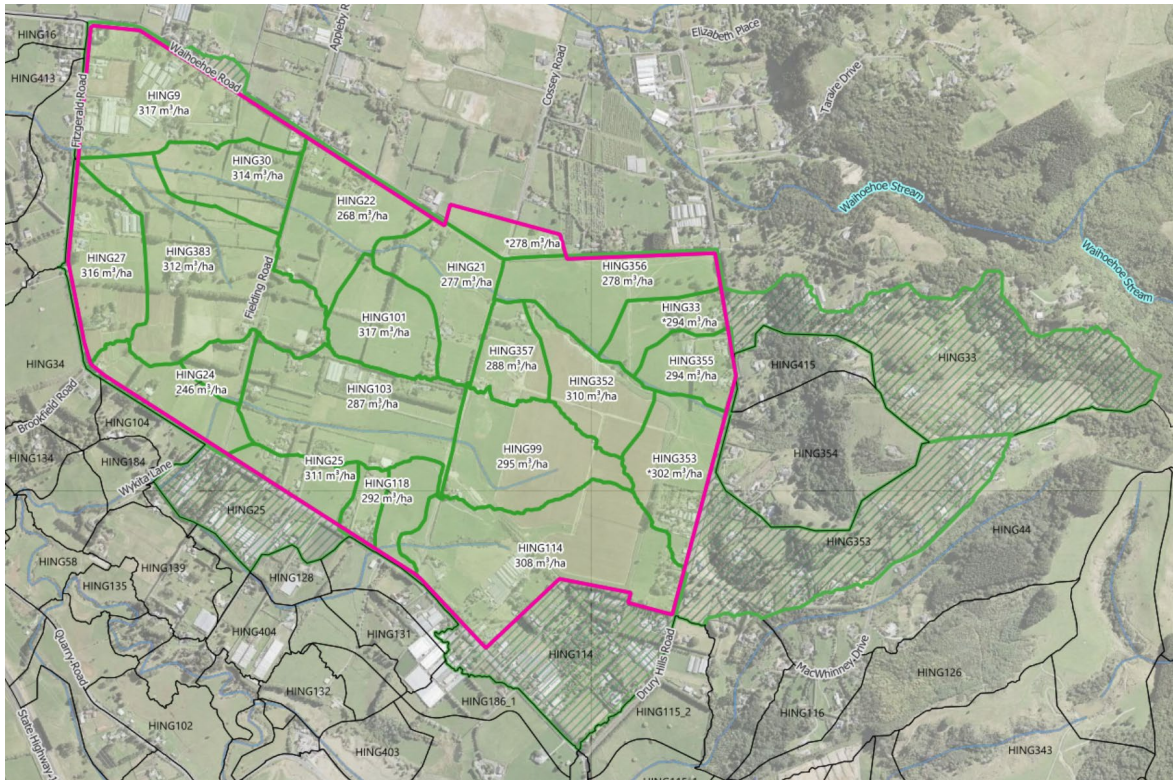


Figure 3: Drury East Precinct sub-catchments and attenuation requirements per hectare of development

Figure 4 and Figure 5 show a spatial illustration of onsite flood attenuation devices which achieve the attenuation requirements. The number and size of flood attenuation devices is conservative and correspond to maximum development of the sub-catchments and the full difference between pre and post development runoff volumes for the 100 year ARI rainfall. Refer to Technical Memorandum in Appendix ?? for details. Whether flood attenuation devices are required or not, and the extent of these if required, will be determined by the flood modelling assessment.

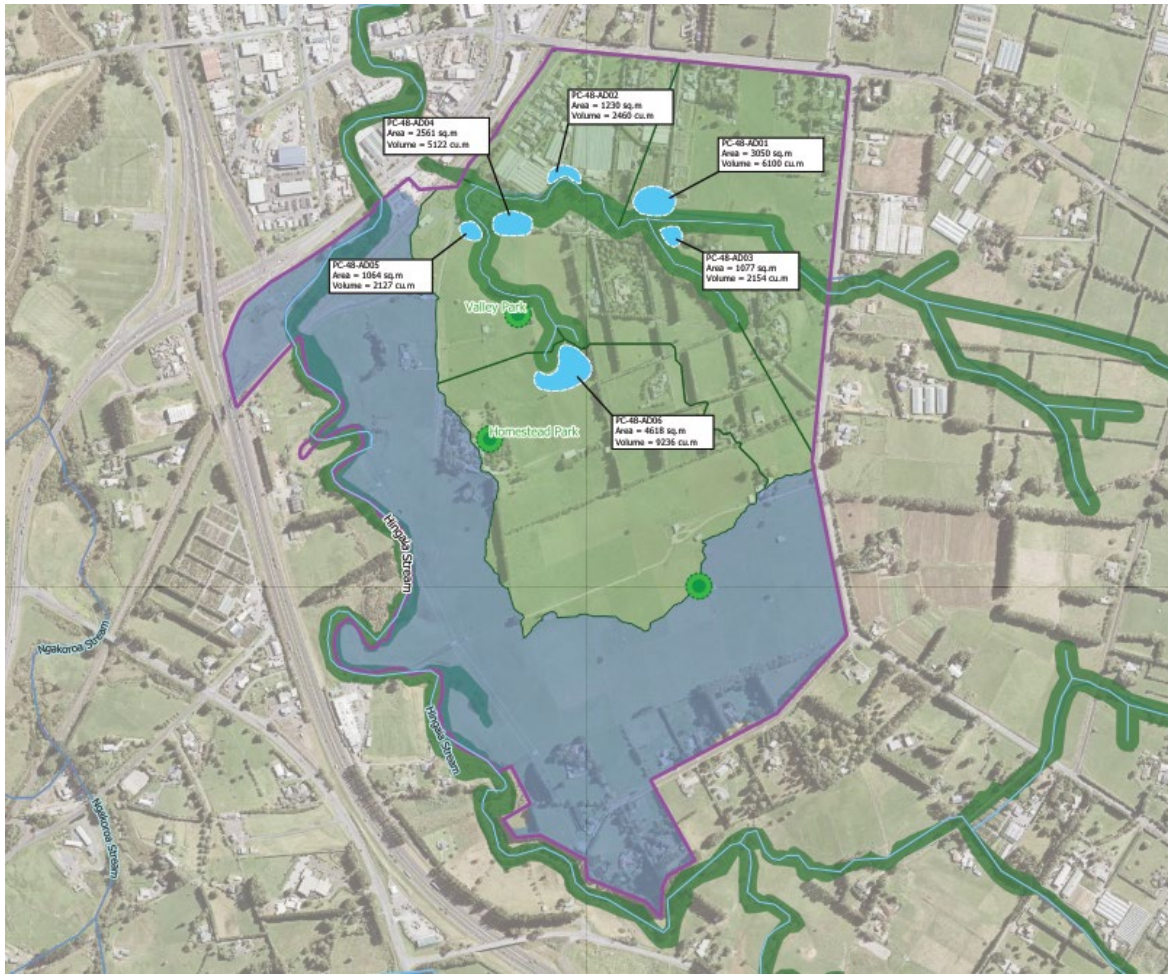


Figure 4: Indicative attenuation device locations for Drury Centre Precinct

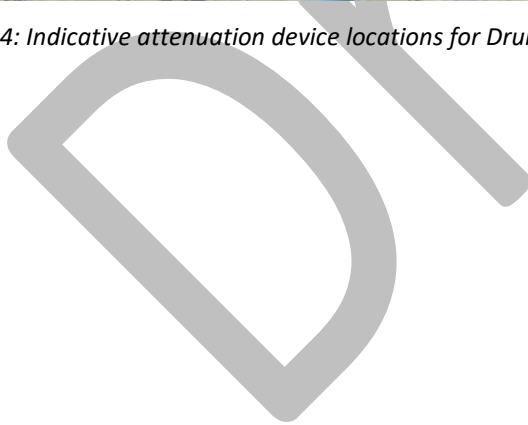




Figure 5: Indicative attenuation device locations for Drury East Precinct

While the location and extent of attenuation devices are indicative and subject to change through master planning and resource consent process, they demonstrate an intention to aggregate devices to achieve an integrated stormwater management approach across each sub-catchment and throughout the Precincts. Development of future interim solutions (if required) should be cognisant of these conceptual layouts, however each sub-catchment should be assessed on its own merits. As noted above, any interim solution must meet the flood risk management performance standard outlined in Section XX and compliance must be demonstrated through a flood modelling assessment.

1.1.1.5 Flood effects inside the PCAs

It is also a requirement to **not worsen flooding on land inside the PCAs** without property owner agreement, which applies to both interim and permanent flood management approaches.

In addition, to ensure that there are no adverse flooding effects within the PCAs itself, the following measures are also recommended to manage flood risk:

- All roads, car parks and building platforms to be located outside of and set above the 100 year ARI MPD climate change flood plain, with a suitable allowance for freeboard. It is also recommended that infrastructure is located outside this extent, unless it can be designed to be resilient to flood damage. Riparian margins will be provided within floodplain extents.
- For rainfall events greater than a 10 year ARI storm event and up to a 100 year ARI storm event, secondary flows will be conveyed along road corridors into existing overland flow

paths. All overland flow paths will be retained or redirected with allowance for adequate conveyance capacity and will be located within public areas (roads and parks) and not private properties.

- Protection of 100 year flood plain within the Blue-Green network also enables enhancement of riparian corridors around intermittent streams. As well as providing enhanced stormwater management functions and public amenity, and contributing to the ecological value of stream corridors, riparian margins assist management of flood waters as they provide capacity for the secondary conveyance system.

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