BEFORE THE HEARING COMMISSIONERS
APPOINTED BY CANTERBURY REGIONAL COUNCIL

UNDER THE	Resource Management Act 1991
AND	
IN THE MATTER	of application CRC190445 by the Christchurch City Council for a comprehensive resource consent to discharge stormwater from within the Christchurch City area and Banks Peninsula settlements on or into land, water and into coastal environments

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SUMMARY OF SECTION 42A OFFICER REPORT OF MICHAEL CHARLES LAW

FOR CANTERBURY REGIONAL COUNCIL

14 November 2018

INTRODUCTION

1 My name is Michael Charles Law. I am summarising key points of my Section 42A Officer Report, highlighting areas of agreement and disagreement between my opinion and that expressed by or on behalf of the Applicant and submitters.

2 My qualifications and experience are as stated in my Section 42A report dated 28 September 2018

3 This report:

(a) Summarises the evidence contained in my Section 42A report on Christchurch City Council's application for a Combined Stormwater Network Discharge Consent (CSNDC) to discharge stormwater from the reticulated stormwater network within the Christchurch City boundaries.

(b) Responds to:

(i) Evidence in Chief and Rebuttal Evidence provided by Christchurch City Council; particularly that of Graham Harrington and Tom Parsons

(ii) Evidence in Chief from Rob Potts, provided on behalf of submitters A and K Rodrigues, and relating to the Styx catchment

(iii) The updated Environmental Monitoring Programme, October 2018

(iv) Summarises area of agreement and disagreement between Christchurch City Council's experts and me.

CORRECTIONS TO REPORT

4 I wish to inform the Commissioners of one change in terminology between my Section 42A report and this Summary. The term "monitoring location" has been replaced by "reporting location", as water quantity performance will be measured against modelled flood levels rather than monitored or recorded flood levels.

SUMMARY OF SECTION 42A EVIDENCE

Background

5 The CSNDC covers a large area incorporating a diverse range of catchments, including large low-lying catchments such as the Avon and Heathcote, as well as small, steep catchments such as those that characterise Lyttelton Harbour and the Banks Peninsula. This diversity presents a challenge in assessing the effects of stormwater discharge and defining performance measures that will adequately protect against unacceptable increases in flood risk, as reporting of stormwater quantity performance can only be measured with reference to flood events.

6 Generally, it is not appropriate to include absolute performance measures, such as requiring that an area does not flood under any conditions, or that a given water level is never exceeded at a certain location. This is due to the variability of flood inducing rainfall, and the risk of events greater than the design standard for stormwater systems. Rather, the performance of the stormwater network is measured using modelled performance against design storm events of a defined rarity.

7 To model performance changes over time, environmental inputs (such as rainfall) are kept the same, while changes in land use, development, the drainage network, and stormwater mitigation measures are incorporated in flood models. The results of these models are compared against baseline (also referred to as existing or pre-development) model results. The difference in model results being the relative effects of the catchment changes.

8 CCC have (or are in the process of completing) computer flood models of the four main catchments draining the metropolitan area of Christchurch; the Styx, Avon, Heathcote and Halswell catchments. In their CSNDC application, CCC propose that the performance of the stormwater network in the four modelled catchments is to be:

(a) Assessed at one location within each catchment, as an allowable increase in the modelled 50-year ARI (2% AEP) flood level. The details are presented in Schedule 7 of the proposed CSNDC conditions and in Appendix A of this document but have been summarised in Table 1 below.

Table 1 - Summary of CSNDC conditions Schedule 7 (July 2018)

Item	Modelled catchment			
	Pūharakekenui/ Styx	**Otākaro/ Avon**	**Ōpāwaho/ Heathcote**	**Huritīni/ Halswell**
Baseline year	2012	2014	1991	2016
Reporting location	Harbour Road Bridge	Gloucester Street	Ferniehurst Street	Minsons Drain confluence
Allowable increase in 50-year ARI water level (mm)	100 +/20%	50	30	0

(b) Re-assessed every five years[1]. This means that changes in catchment land use and development during the five-year interval will be incorporated into the model and the model re-run for the design events. The updated model results will be compared against the baseline model results for the catchment to assess performance against the conditions in Schedule 7 of the consent.

9 Alternative approaches are to be taken in the un-modelled catchments (Otukaikino, and Te Pātaka o Pākaihautū / Banks Peninsula), where an emphasis will be placed on ensuring acceptable effects at the catchment scale by requiring adequate mitigation at the development site scale.

Key Points Raised

10 In my Section 42A report, I raised concerns about the following issues:

(a) Number of performance reporting locations;

(b) Use of a single design event;

(c) Allowable increase in water level and baseline year;

(d) Absence of design flood levels

(e) Re-assessment interval; and

(f) Performance measurement in non-modelled catchments

[1] Section 4.3, ***Environmental Monitoring Programme*** for the CSNDC, October 2018

Section 42A Conclusions and Recommendations

11 The key conclusions and recommendation from the review of the draft CSNDC and other relevant information are:

(a) Setting allowable increases in flood water level in the modelled catchments is an appropriate approach, but:

(i) Additional performance reporting locations are required.

(ii) Performance should be measured against the 5-year ARI (20% AEP) and 50-year ARI (2%AEP) design events

(iii) More information is required as to how the allowable increases in water level are set for each catchment, and whether the baseline conditions are appropriate.

(b) Controlling stormwater runoff from development sites is a pragmatic approach to managing catchment-wide flood risk in unmodelled catchments.

(c) If stormwater models are developed for any of the catchments that are not currently modelled, then the consent conditions should be amended to incorporate performance reporting locations and targets for those catchments.

RESPONCE TO EVIDENCE

Evidence in Chief, Rebuttal Evidence, and Hearing Summaries

12 I have reviewed the Evidence-in-Chief (dated 15 October 2018) and Rebuttal Evidence (dated 30 October 2018) relating to water quantity provided by Christchurch City Council; particularly that of Graham Harrington and Tom Parsons. I have also considered the summaries provided by Mr Harrington and Mr Parsons to this Hearing.

13 As noted above, there are six issues about which I have concerns or made recommendation. Below I summarise these concerns, provide my understanding of Mr Harrington's and Mr Parson's current position on each of the issues, and I provide a response.

Number of performance reporting locations;

14 With performance only being measured at one location in each of the four modelled catchments, this will not reflect variations in effect across the catchment. Indeed, where the proposed target location is not at the outfall of the catchment, there is no mechanism by which Canterbury Regional Council (CRC) can control increases in downstream flood level, which could occur with unmitigated development downstream of the target location.

15 For example, the control location for the Avon catchment is Gloucester Street Bridge in the city centre. Approximately 75% of the Avon's stream network is downstream of this location (Figure 1) which means that the CSNDC will not control stormwater in the Avon catchment downstream of this point.

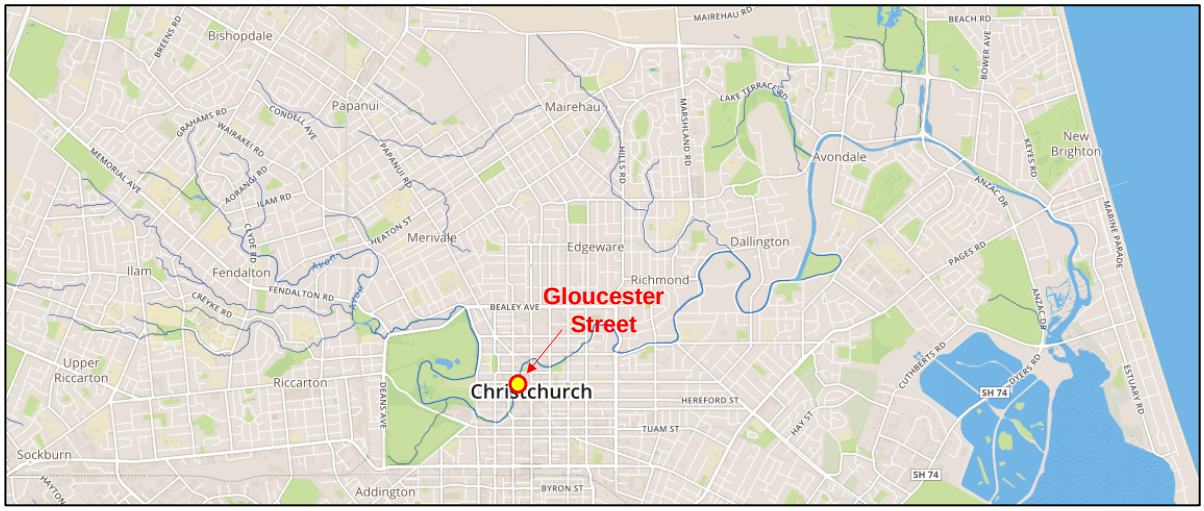


Figure 1 – Avon surface water network

16 In Table 2 of my Section 42a report, I recommended multiple performance reporting locations within each catchment. The aim being to provide a network of performance reporting locations that safeguard the catchments, while providing robust results where the effects of land use change and development can be clearly disaggregated from changes due to other effects, such as climate change induced changes in sea level.

17 As performance will be measured by comparing modelled flood levels (which may be extracted for any node in the river or pipe network, or anywhere on the modelled 2D surface), there is no absolute requirement for the reporting locations to be the same as river level or flow recording locations. However, it makes sense to use recorder locations, as they are points around which the models are likely to be calibrated and hence are likely to be at their most accurate.

18 In their evidence, Mr Harrington and Mr Parsons maintained that one location in each catchment was enough; the single reporting locations, allowable increases in flood level and baseline conditions having been defined during the SMP process, and that they are all that is needed to manage each catchment.

19 Mr Parsons mentions the risk of infilling/intensification of existing development areas, which can result in additional stormwater runoff. This is the biggest risk to the lower Avon and Heathcote catchments below CCC's proposed reporting locations. However, CCC argue that downstream water levels are tidally dominated and so reporting locations in the lower catchment are not appropriate, despite the acceptance that tidal effects can be removed from models to allow the effects of development to be isolated.

20 Regarding additional reporting locations in the upper catchments (particularly relevant to Styx catchment) to isolate effects at the sub-catchment level, Mr Harrington argued in his evidence that it would not be appropriate to set targets outside of that SMP framework, and that as priorities and critical locations may change, any additional reporting locations could become irrelevant during the lifetime of the consent. I disagree with that.

21 Slide 23 of his evidence summary included a proposed amendment to Condition 6, that indicated a willingness to consider additional sites. I welcome that, but am still the opinion that sites could be identified now. CCC's officers, including Mr Harrington, have long standing knowledge of the catchments. They are well placed to identify appropriate additional reporting locations that are relevant now and can be used until any revised SMP process is concluded.

Use of a single design event

22 CCC propose only reporting performance against the 50-year ARI (2% AEP) design flood, preferring to rely on what Mr Harrington calls the "public surveillance system" in paragraphs 138 and 140 of his Evidence-in-Chief to assess performance during more frequent events, such as the 5-year ARI flood. This seems to promote subjective opinion on the severity/effects of flooding, rather than a readily available objective measure. It is at odds with CCC's assertions that performance should only be measured against changes in urbanisation and development.

23 Measuring performance against only one design event risks increases to flood depths, extents and hazard in other magnitude events occurring, but with CRC not having a means to trigger remedial action. Particularly, this would be an issue if there is an increase in flooding in frequent events, such as those up to the 10-year ARI event.

24 I accept that requiring CCC to report performance against multiple flood events covering a wide range of ARI (from the mean annual flood to the 100-year ARI) would be onerous. However, I recommend that the targets are based on performance measured against two design events. These would be the:

(a) 5-year ARI (20% AEP) event to reflect performance in smaller, more frequent, events that are likely to represent recent experience.

(b) 50-year ARI (2% AEP) event reflecting design standards and performance in larger, less frequent events.

25 As with additional reporting locations, I noted Mr Harrington's willingness to consider incorporating other design events into the reporting process following the next round of SMPs.

Allowable increase in water level and baseline year;

26 As noted in Table 1, performance is monitored as an allowable increase in 50-year ARI (2%AEP) flood level when compared to a baseline condition, with different values for each catchment. While CCC confirm that the allowable increases and reference years were defined through the Stormwater Management Plans (SMP) process and set to not increase flood risk, the provenance of these decisions is not clearly stated.

27 The variability in allowable increases in flood water level and different baseline years presents a source of potential misunderstanding and lack of credibility to the community.

28 A lot of effort has been put into the CSNDC and it is subject to scrutiny from the public, as well as CRC and other stakeholders. As such I would have expected CCC to be very clear about the providence of the proposed targets and conditions, and would have included a brief technical explanation (not just a reference back to the relevant SMP) as to why they are appropriate. In my opinion that has not been provided by CCC.

29 For example, and as clearly demonstrated by the concerns expresses by submitters in the lower Styx catchment, there are community concerns that the target water level increases can still represent an unacceptable increase in flood risk to those affected. As clearly articulated in Mr Potts evidence, flooding in the lower Styx is affected by the combined effects of catchment runoff, high tides, sea level rise, and operational channel management (weed cutting and sediment removal), but exacerbated by lower ground levels following the Canterbury earthquakes.

30 In setting a target water level increase of no more than 100 mm (+/-20%) compared to the 2014 baseline, CCC's target removes the earthquake ground-lowering effect from the baseline. Fixing model boundary conditions and not accounting for operation channel management in the model means that the water level target focuses solely on the effects of changes in catchment runoff as a result of upstream development and potential cross-catchment transfers from the Avon's Cranford basin.

31 Mr Harrington's Rebuttal Evidence considers these issues in the lower Styx catchment, with the focus of the CSNDC limited to managing the effects of urbanisation solely by attenuation and soakage infrastructure within, or clos to, the development area. According to Mr Harrington (Rebuttal Evidence paragraph 26), operational mitigation of flooding, such as weed removal and dredging, falls outside the scope of the application.

32 I suggest that while it is important to differentiate the causes of flooding, and roles and responsibilities regarding different aspects of flooding, residents of flood prone properties experience flooding as a combination of all factors. Flood risk management relies on joint use of capital infrastructure and operational measures. As both can be controlled, they should both be accommodated within the water level targets.

Absence of design flood levels;

33 Schedule 7 lists the proposed allowable increases in design flood level, but does not provide the reference design flood level that will be used to test future performance.

34 As I expected, CCC would prefer not to include absolute design flood levels in the conditions (Schedule 7) due to changes in modelled flood levels as a result of upgrades in the flood models (as opposed to modelled changes in urbanisation or waterway).

35 I accept that the modelled design flood level may change as a result of refinements and enhancements in flood modelling during the period of the consent. As such I accept the difficulties that this could present to CCC.

Re-assessment interval

36 CCC propose (Section 4.3, Environmental Monitoring Programme. July 2018) to assess and report stormwater performance every five years in four modelled catchments by updating the catchment land use and development, re-running the models and comparing the resulting maximum water levels at the performance reporting locations against those for the baseline conditions (Schedule 7).

37 I agree that a five-year interval is appropriate. In my evidence, I had suggested that additional reporting should occur following a 20-year ARI or greater flood and re-calibration of the flood models. Given the proposed rolling programme of reporting, I appreciate that additional reporting may be disruptive to that programme.

Non-modelled catchments

38 The approach taken to ensuring no unacceptable stormwater-induced increase in flood risk in the unmodelled Otukaikino, and Banks Peninsula catchments relies on managing flood risk at the development scale, with the expectation that this will provide the required performance at the catchment scale.

39 In the absence of catchment-wide modelling, managing runoff peaks and volume at the development scale is a pragmatic approach that I accept. However, there are two things to consider:

(a) While managing peak flows will help control **stream erosion**, the length of time that flows are above 'normal' can also affect the amount of erosion. Attenuating peak flows to pre-development rates, but keeping them at that rate for extended periods may exacerbate erosion risk, particularly with the loess soils of banks Peninsula. This risk would need to be managed at the development consent scale.

(b) The proposed lifespan of the CSNDC consent is 25 years. Given advances in modelling capability and efficiency, **stormwater models** of parts, or all, of the currently un-modelled catchments will be developed over that time. In which case, the proposed conditions should reflect future opportunity to measure stormwater performance in a comparable manner to that proposed for the four modelled catchments?

General comment

40 I note that Tom Parsons' revised version of Schedule 7 presents the targets more clearly, with the format similar to the layout that I proposed in Appendix B of my Section 42A evidence. I welcome that change in format.

The updated Environmental Monitoring Programme, dated October 2018

41 Surface water levels and flows are addressed in Section 4 of the Environmental Monitoring Programme (EMP). Section 4.1 refers to Schedule 7[2], but the table is not included in the EMP.

42 Section 4.3 sets the five-yearly reporting interval for performance against the targets in Schedule 7. As discussed above, I consider five years to be a reasonable interval for performance reporting. I note that this reporting will include "A discussion of progress toward meeting the flood mitigation targets set in Schedule 7 of the consent". This is a vague response to targets not being met.

KEY AREAS OF AGREEMENT

43 Based on the above I agree with CCC that:

(a) Testing increases in urbanisation and mitigation measures should be done through modelling, as it allows these effects to be isolated out from other effects such as sea level rise and climate variability.

(b) Five years is an acceptable interval for performance reporting. The rolling programme probably precludes additional reporting after events as it would put the reporting out of sync.

(c) Including design water levels in Schedule 7 could be problematic if model updates result in changes to baseline flood levels.

(d) The approach to stormwater management in currently un-modelled catchments is appropriate.

KEY AREAS OF DISAGREEMENT

44 Remaining areas disagreement are:

(a) The need and benefit of additional reporting locations

(b) Reporting on performance in the 5-year ARI event, as well as the 50-year ARI event

[2] The table in the proposed consent conditions listing the target water levels and baseline years for the modelled catchments .

45 In both cases, CCC have acknowledged there may be a need for the additional reporting, but we disagree as to whether they can be identified and included in Schedule 7 without waiting for the next SMP process.

RESPONSE TO SUBMITTERS

46 In my S42 evidence, I responded to issues raised in the 39 submissions on the 2018 CSNDC application. Below, I make a few comments on the Evidence in Chief provide by Rob Potts, and the address some questions arising during the hearing.

Evidence in Chief from Rob Potts

47 Mr Potts provided evidence on behalf of submitters A and K Rodrigues, and relating to the lower Styx catchment. He provides a clear and comprehensive explanation of the issues relating to flooding. I wish to draw attention to some points that he raises.

48 In paragraph 25, Mr Potts considers that the Styx SMP should be reviewed if the five-year performance review indicates increased flood risk to his client's property or inaccuracies in information presented to this hearing. This is a stronger response to a breach of the targets than expressed in Section 4.3 of the EMP

49 Paragraph 32 highlights concern over additional water entering the Styx catchment from Cranford Basin. One of the reasons that I recommended additional reporting locations is to determine such changes in flow regime, and allow the effect to be quantified.

50 In Paragraph 45 Mr Potts states that he considers the Brooklands Lagoon to be part of the Styx river system, as there are flood flows between the lagoon and the lower Styx. In paragraphs 13-16 of his Rebuttal Evidence, Mr Harrington refuted this suggestion; reiterating that the application is for "consent to discharge stormwater from urbanised surfaces and not seeking to manage the effects of sea level rise" (Paragraph 14). In paragraphs 65 and 76, Mr Potts refutes the Mr Harrington's opinion. This issue highlights the gap between the limited scope of the consent application and the wider community perception of what the application should be covering.

Submitter Concerns

Scope of the consent

51 This follows on from the previous paragraph. CCC's view is that the scope of the consent only extends to the effects of urbanisation on flood risk, and not the effects of the earthquakes, operational flood management (weed removal, dredging), downstream flood infrastructure (stopbanks, Dudley Creek diversion), or sea level rise.

52 I am not a planner or a lawyer, but I can see that it is a difficult line to tread; between ensuring that the scope of the consent is defined enough to for CCC to meet (and for CRC to enforce) targets, and yet broad enough that it meets realistic expectations for general flood risk management.

53 I note that there has been discussion about whether the effects of the earthquakes (land lowering, river bank slumping) and sea level rise form part of the existing environment. The Styx catchment has been the focus of the many of the submissions to the hearing, with many focusing on increased flood risk as a combination of effects. The proposed water quantity target for the Styx River at Harbour Road is a comparison against the 2014 baseline; post-quake. As such, CCC are proposing that the earthquakes effects are part of the existing environment in that catchment.

54 As the targets for the other catchments are upstream of the lower reaches where most earthquake damage to land and rivers occurred, it is a moot point as to whether the earthquake effects for part of the existing environment.

The Halswell catchment

55 CCC's main approach to managing stormwater from new urban development is through detention; reducing peak flows to pre-development levels and allowing water to be slowly released to the receiving environment, or allowed to soak to ground. Flood volume as well as peak flows is an issue in the Halswell and Styx catchments, and questions have been raised as to whether the detention results in prolonged ponding

56 Submitters raised concerns regarding the *increase in baseflows in the Halswell River* and *the effect of stormwater on upper reaches of spring-fed streams*. The increase in baseflows in Christchurch's rivers and streams can be positive in maintaining flows during periods of low flow, but can reduce the capacity of watercourses and storage areas to accommodate stormwater, especially if rain falls on catchments that are already saturated.

57 By setting robust performance targets for key locations in the modelled catchments (including the Halswell), an encompassing approach is taken to managing flood risk within acceptable limits irrespective of whether the pressure on flooding is due to increase base flows or changes in runoff as a result of development.

58 However, the flood models must be calibrated and set up to account for changes in baseflow, antecedent conditions, and the effects of multiple storm events in close succession, especially when detention has been designed for water to be released over a 96-hour period.

<u>The Styx catchment</u>

59 As we have heard during the hearing, the lower part of the Styx catchment is flood prone, with many submitters expressing concern over the effects of:

(a) Cumulative effects of *additional runoff from development* in the upper catchment

(b) *Sea level rise* and increased closure of the tidal gates preventing egress of floodwater

(c) *Diversion of water from Cranford and Flockton* into the Styx catchment

(d) *Land levels and channel capacity* around Brooklands and Spencerville following the Christchurch and Kaikoura earthquakes.

(e) Water from *Brooklands Lagoon* increasing flooding in the lower Styx following the earthquakes

60 Submitters assert that these have resulted in an increased flooding in the lower reaches of the catchment and a *transfer of risk from upstream to downstream* within the catchment. One submission also identified a lack of flood mitigation targets and inadequate monitoring.

61 I have proposed that additional performance reporting locations should be included in the Styx (and other) catchment, and that performance should be measured against the more-frequent 5-year ARI event as well as the design 50-year ARI event. Monitoring in the mid- and upper-catchment will have catchment wide benefits.

62 I suggested that the long-standing flow recorder site at Radcliffe Road should be used a reporting location. However, this is upstream of where the new Prestons Road sub-division discharges to the Styx River, and so I recommend that a reporting location is including in Schedule 7 downstream of Prestons Road. This will allow the effects of urbanisation in the upper catchment to be quantified, and isolated from the effects of earthquake damage and sea level rise on the lower catchment.

63 Given that the lower reaches of the Styx catchment are prone to flooding from ponded water, it would also be worth including limits on increases in flood volume entering the lower catchment, as well as peak flow.

Additional reporting locations

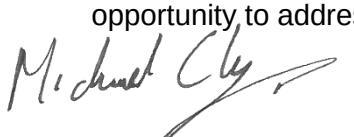
64 Returning to the subject of additional reporting locations.

65 CCC maintain that SMPs are the most appropriate means of setting additional sites, but are not opposed to additional sites where flooding risks persists.

66 Existing flow recorder locations are preferred, as they allow the opportunity for robust model calibration. Yet these are not always located at sites with flood risk, or where there are other benefits to quantifying changes in flood level, flow or volume.

67 Reporting locations can be taken from anywhere in the modelled network, and so the most appropriate locations can be selected. This may mean that CCC need to install additional level/flow recorders; whose value grow with age (like trees) as more data is collected.

68 And finally, I would like to thank to thank the Commissioners for this opportunity to address the Hearing.



MICHAEL CHARLES LAW

14 November 2018