CCC GLOBAL CONSENT TO DISCHARGE STORMWATER - CRC 160056/CRC 190445

BEFORE THE 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, into water and into coastal environments

TABLED AT HEARING
Application: CRC190445
.....
Date: 12 Nov 2018

INTRODUCTION

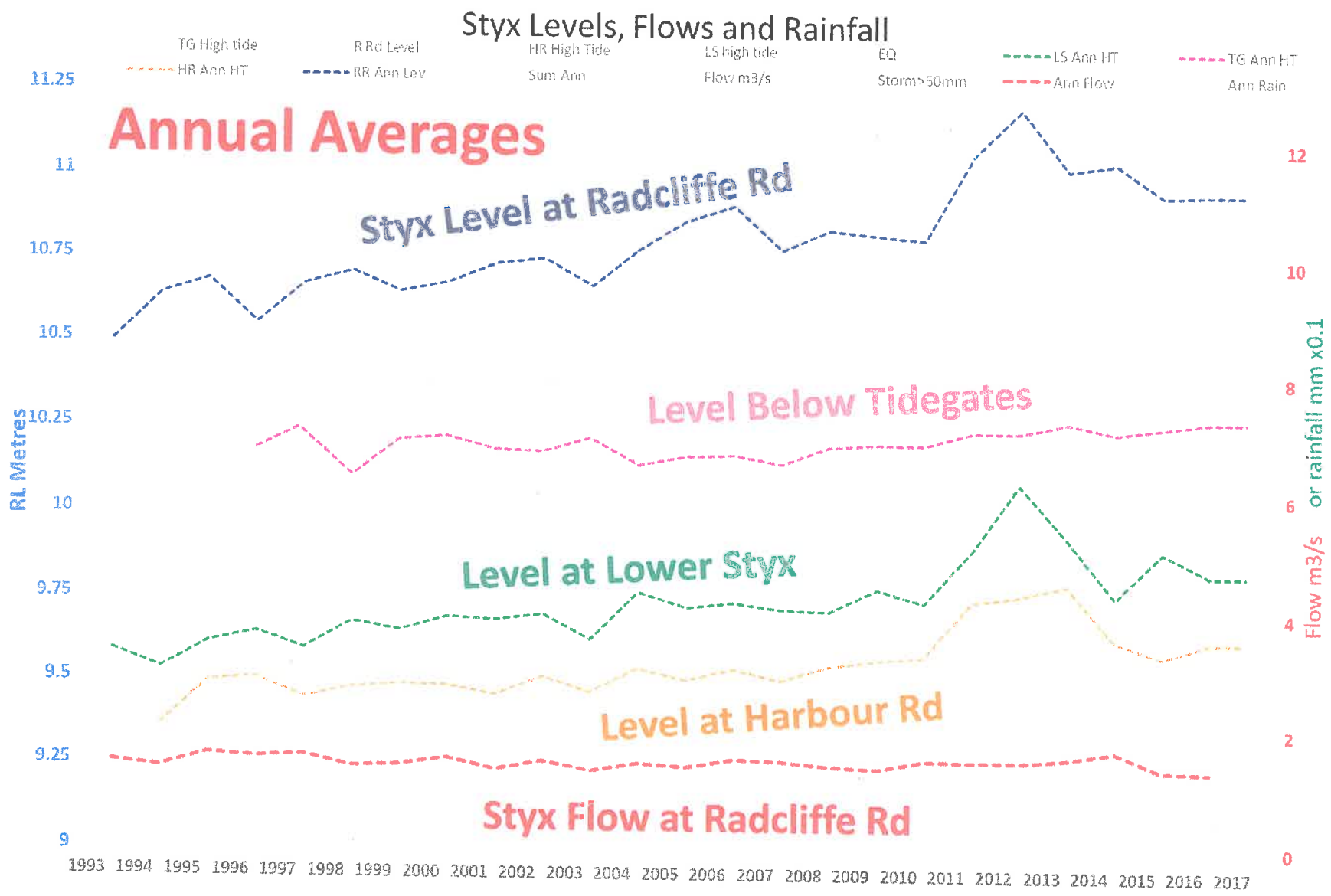
1. We appreciate the opportunity to present before the panel the concerns we have with this application for a consent to discharge additional storm water into the Styx River from proposed developments identified in the reports.
2. Our full names are Raymond John McGuigan and Pauline Fay McGuigan. We presently own a lifestyle property, zoned Rural Urban Fringe, at No. 26 Lower Styx Road. We have lived at this address since 1992 and have maintained farming activities of cropping and beef fattening since 1992.
3. Our property's northern boundary runs parallel to Lower Styx Road and overlooks the Styx River.
4. Our family grew up on the property and the Janet Stewart Reserve was used regularly by us, our extended family and friends for recreational activities. We also formed a close friendship with our neighbour abutting our eastern boundary and wandered over his farmland on many occasions.
5. This farmland abutting our eastern boundary was rezoned in 2011, and is now referred to in many reports as 'Prestons Development'. Our property was not included or accepted by CCC as being part of this rezoning application.
6. 'Prestons' residential development runs along our 400M with the developments storm water ponds (wetlands) abutting the north east corner of our property.
7. Our knowledge of the area for pre-and post-development of Prestons has enabled us to gain a good understanding of the effects to individual properties and the community with developments..
8. Our understanding of these 'effects' have been supported by expert advice which was required by us and involved the services of a drainage engineer and Queens Counsel who is familiar in the RMA Act.
9. I personally have read many of the documents which have formed part of the application before the panel which include the applications for CRC160056 & CRC190445. The content contained in these documents is complex and even more so when reference to supporting documents is required in an effort to understand the future planning and strategy for the Styx Catchment, an area that has been identified for high growth..
10. **COMMUNITY INVOLVEMENT**
11. Many residents living beside the river in the Lower Styx communities held concerns for their properties with the higher water levels being observed by them, particularly post-earthquake and after 'minor' rain events.
12. Following a public meeting, where 80+ residents attended, CCC appointed a facilitator, Dr Phil Driver, to assist the community with their concerns.
13. The Styx Working Party was subsequently formed and I became a member of this working party.
14. I appreciated the opportunity to listen to CCC staff who tabled various reports but for the most part discussions centred on 'operational activities ie: maintenance programme for dredging/weed harvesting.

15. Personally I felt disappointed with what was tabled and discussed through this process and what was actually achieved for the community. The working party was dispersed with 11 questions that had been tabled by the facilitator and these questions related to drainage. Subsequent efforts to get these 11 questions answered have failed and these questions remain unanswered.
16. Documents identify a Storm Water Management Team (SWAT) as the mechanism for issues to be addressed but there is no opportunity for community representation within this process.
17. We feel the residents who live on or near the Styx River have a wealth of knowledge which could be beneficial to any Storm Water Management Team.
18. Other than the 'complaint' process that presently exists could a condition be included within the approved consent that allows elected community representative(s) an opportunity to participate in the reporting processes adopted as part of this global consent.
19. **RIVER WATER LEVELS – HISTORIC/PRESENT DAY**
20. Many documents refer to the 'base flow' and 'peak flows' when addressing river levels however reference to these are of minor consideration to the residents. It is the height of the water levels within the Styx River which concern the residents within the catchment.
21. I accept the earthquakes have had an impact on the river with 'bed heave', slumping of banks and land dropping and a report completed by G. Harrington and T. Parsons "Styx River Earthquake Effects" details very clearly the effects on the environment in this regard.
22. However a 'cumlative' effect on the water levels within the Styx River has been identified by CCC and formed part of a presentation to the 'Styx Working Party' by Graham Harrington. I wish to draw the panels attention to water levels as recorded at the Radcliffe Road site and presented by G. Harrington.(ATTMT 1)
23. I feel the data recorded at the Radcliffe Road site gives a good example of how the water levels have continued to rise within the rivers channel since 1993.. This site I believe gives the most accurate information on river levels - No inundation of private properties has occurred upstream and the site is not affected by the tides. .
24. Over recent months we have noticed a significant drop in the river levels and we see this as a 'positive' with this application.
25. However we need to understand if this significant drop is a 'temporary fix' or a 'permanent fix' and will past community concerns be revisited once this application is approved.
26. I have attached 'before' and 'after' photos showing the significant drop in water levels for the panels reference and consideration. These photos can also be viewed on the screen.
27. **RADCLIFFE ROAD MONITORING SITE**
28. **BEFORE** - ATTMT **2** – TAKEN APRIL 2018 - 11.7RL - NO RAINFALL DATA
29. **AFTER** - ATTMT **3** - TAKEN NOVEMBER 2018 – BELOW 11.0RL – NO RAIN EVENT
30. **JANET STEWART RESERVE**
31. **BEFORE – ATTMT 4**- APRIL 2013: **ATTMT 5** – APRIL 2014: **ATTMT 6** – APRIL 2016 ; **ATTMT 7** – APRIL 2018 **ATTMT 10 – PHOTO MANAGEMENT PLAN OCT 2012**
32. **AFTER – ATTMT 8** – NOVEMBER 2018
33. I have corresponded rain events as measured by NIWA on the paper attachments.
34. I do accept this inundation does not pose an acceptable adverse effect to the community however the photos confirm the lower bench seat on the jetty in the Janet Stewart Reserve has been under water on many occasions and in 'minor' rain events.
35. The flooding does give a visual perception to the community of high river levels in minor rain events.
36. **MODELLING DATA/MONITORING SITES**
37. Documents suggest more frequent monitoring of river water levels is required to ensure the conditions of this application are met.

38. The Harbour Road site has been suggested but I feel data recorded from this site gives a false indication of the effects on the community and does not record the reality of the flooding that may be happening in the lower catchment.
39. Kaputone Stream provides about 12% of the total flow into the Styx River. With new developments this % could increase.
40. We suggest a new monitoring site needs to be installed as part of this application which is better positioned to reflect river water levels prior to inundation of private properties occurring downstream and include discharges from Kaputone Stream and Prestons Development.
41. Historically the river has breached its banks and inundated private land, albeit 'Rural', however there is a danger that the Spencerville community could be inundated if the river exceeds the 'modelled' data.
42. **The GHD report ' INVESTIGATION INTO THE RIVER AND TIDAL FLOOD PROTECTION NEEDS FOR CHCH – STYX RIVER STAGE 1 REPORT *Dated 18 February 2014***
43. This report refers to flooding 1/100 yr event in the lower reaches of the Styx River and suggests there are 12 houses which require 'raising' in the green zone between Spencerville and Brooklands. If this application is approved can we expect more homes to be identified for 'raising' in future reports. ATTMT 9
44. Will homes which currently meet the Building Code fail to meet the 1/50 year building code as required by the Act, a direct consequence of this application.
45. Will the ability to insure and secure lending on these properties become unavailable.
46. How is the applicant proposing to mitigate this effect?
47. Is this an accepted consequence of this application being approved.
48. Cranford Basin is mentioned throughout the reports and states storm water is directed primarily to the Avon Catchment and a map provided to the panel suggests Cranford Basin has not been modelled in the Styx River Management Plan.
49. Graham Harrington's evidence states '*Upgrades to Horners Drain were modelled. The upgrade allows transfers from Cranford Basin north to the Styx River.*'
50. It remains unclear if the upgrades to Horners Drain includes the discharge from Cranford Basin.
51. We respectfully request the panel to consider if storm water discharging from the Cranford Basin to the Styx River has been included in the modelling for this application.
52. **MAINTENANCE - RIVER**
53. I understand addressing the earthquake effects have become part of the 'Operational & Maintenance Programme with an allocated budget for the Styx River catchment. To date I feel the funds allocated within the budget has not allowed for a maintenance programme which reflects the cost of works that are required now within the Styx Catchment. It appears the Styx Catchment receives a reduced dollar value based on population/land is predominantly zoned 'Rural'/Variation 48 for ponding/Brooklands is 'red zoned'.
54. The Styx Catchment has been recognised as one of the largest growing areas for development and growth and any 'Operational' budget needs to reflect this and be apportioned to the catchment in which the development is sited.
55. Further to this it remained unclear to the Styx Working Party 'how' and 'where' the funds received from the Land Drainage Recovery Programme (LDRP) for earthquake damage sustained to the rivers has or has been apportioned to each catchment.
56. I appreciate 'Operational Budgets' is beyond the scope of this application but if the maintenance programme is lacking there are flow on effects with the river.
57. It is encouraging to read consideration is being given by CCC operational staff to reactivate the 'dredging programme for the lower reaches of the Styx River.
58. **MAINTENANCE – WETLANDS WITHIN DEVELOPMENTS**
59. The question of maintaining 'wetlands' within developments requires some discussion.
60. The storm water system for Prestons Development has been designed for a 1/50year rain event with house floor levels being set at 1/200 year.

61. The wetlands have a permanent water level of 11.60RL and will hold back an additional 500mm when the river is high to a level of 12.10RL. This level has been modelled as being a 1/50 year rain event.
62. I have used approved Subdivision Resource Consents for Prestons development as an example.
63. The RMA consent numbers referred to are: **RMA 92022389/RMA 92022389(A)/RMA92027739.**
64. **STORM WATER CONDITIONS NO. 8**
65. Clause 8(G) states:
66. *"The constructed wetland shall be designed with two parallel treatment cells, both of which are able to be individually taken 'offline' from the storm water system for maintenance works".*
67. This subdivision consent was subsequently varied (RMA92022389A) with consent condition 8.(G), stated above, being deleted in its entirety.
68. The Assessment of Environmental Effects (AEE) were not addressed with this clause being deleted.
69. Waterways & Wetland Guide (WWDG) Part B Design/Chapter 6 – Storm water Treatment Systems Impacts of Development Dated February 2003 states; – 6.9.4 Operations and Maintenance for Constructed Wetlands
70. *The primary maintenance consideration is the loss of hydraulic performance due to either sediment accumulation or excessive vegetation growth.*
71. How will wetlands within a development be maintained to ensure the capacity of the storm water facilities are not reduced over time?
72. Will storm water discharge from wetlands to the Styx River in a rain event which is less than that modelled ie:1/50year
73. We respectfully suggest any consents approved for storm water facilities and/or discharge needs to include a maintenance programme for both the river and storm water infrastructure associated with developments.
74. To summarise we respectfully request the panels consideration with:
75. **1/** Request a formal response from the applicant detailing 'how' river levels have dropped so significantly over recent months.
76. **2/** Install a new monitoring site downstream of Kaputone Stream and Prestons Development but upstream of the Spencerville community.
77. **3/**Applicant needs confirm Cranford Basin has been included in the modelling data for this application.
78. **4/** Consent conditions must include substantive clauses to address maintenance programmes for the Styx River and all existing and new storm water 'wetlands' constructed
79. **5/** Reinstate a 'dredging' programme for the lower reaches of the Styx River.
80. We feel the Styx catchment has been and continues to be a low priority for any maintenance programme and/or mitigation options due to the rural environment and red zoning of Brooklands.
81. Approval of this application will allow an increase to the 'cumlative' effect with river levels and we implore Environment Canterbury to ensure conditions of the consent are substantive to address the issues within the Styx Catchment.
82. We thank the panel in giving us the opportunity to bring our concerns to the table which have been and continue to concern us and we believe the wider community.
83. We are happy to answer any questions the panel may have.
84. **ATTACHMENT 10** – Photo of Janet Stewart Reserve 2010 (Canterbury's earthquakes 4 September 2010 & 22 February 2011)

Att 1. P


Styx Levels, Flows and Rainfall
TG High tide
HR Ann HT
R Rd Level
RR Ann Lev
HR High Tide
Sum Ann
LS high tide
Flow m3/s
EQ
Storm>50mm
LS Ann HT
Ann Flow
TG Ann HT
Ann Rain
Annual Averages
Styx Level at Radcliffe Rd
Level Below Tidegates
Level at Lower Styx
Level at Harbour Rd
Styx Flow at Radcliffe Rd
RL Metres
Flow m3/s or rainfall mm x0.1
11.25
11
10.75
10.5
10.25
10
9.75
9.5
9.25
9
12
10
8
6
4
2
0
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

11 APRIL 2018

ATT. 2.

ATT. 3

NOVEMBER 2018

22 APRIL 2013

ATT. 4

18 APRIL 2014

ATT. 5

76 mm fell over 2 days

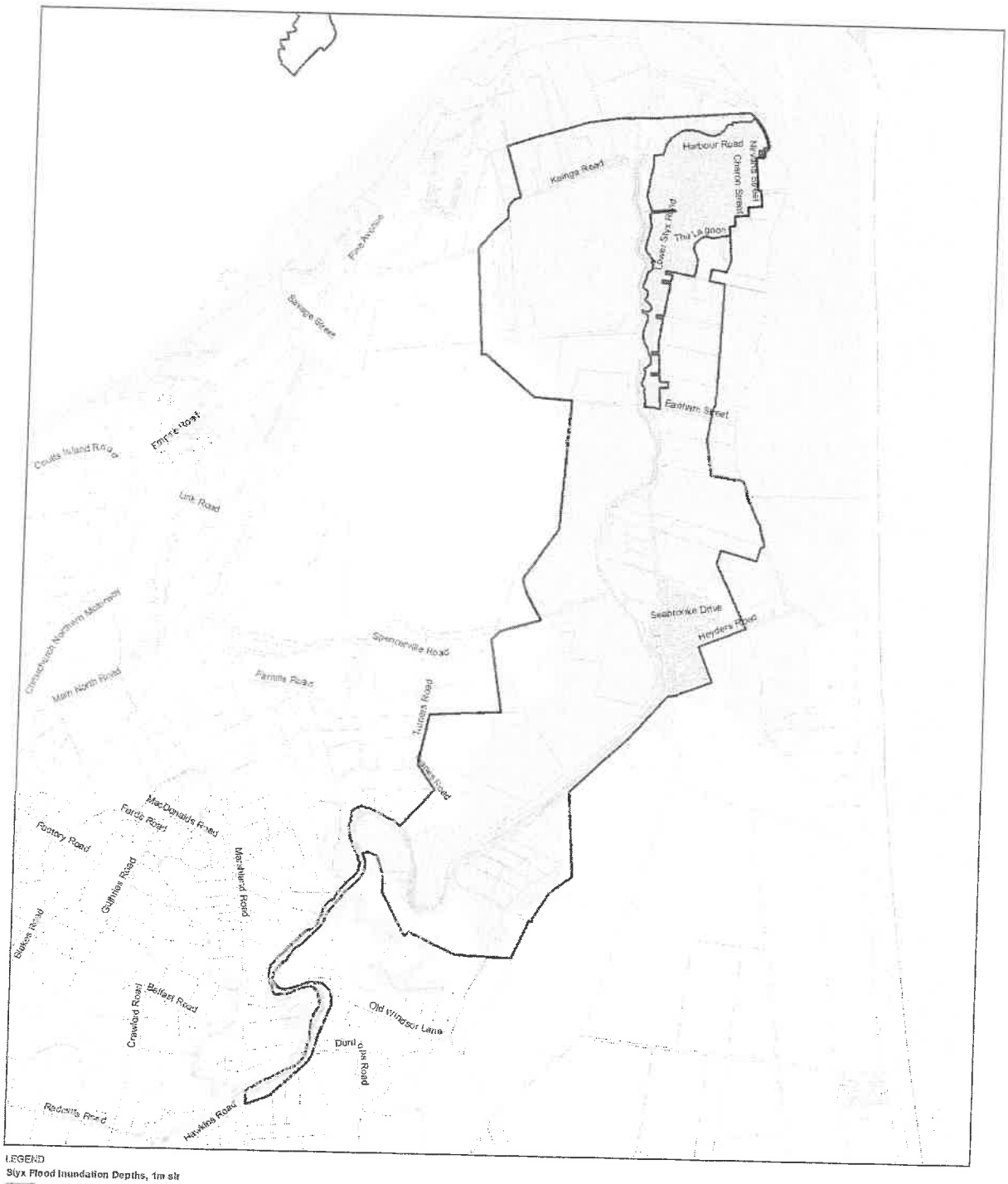
2 APRIL 2016 ATT. 6

No record provided

11 APRIL 2018

ATT. 7

Figure 20 Styx flood management area



LEGEND

Styx Flood Inundation Depths, 1m slr

- Max Flood Extent
- Red Zone
- City Flood Management Plan
- Parcels
- Project Rivers

Flood Event: Maximum Probable Development, 1m slr, 16% increase in rain intensity and no flood protection measures

1:25,000 (At A3)

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

CHRISTCHURCH

Christchurch City Council
River and Tidal Flood Protection

Styx River Options
CCC FMA, Redzone and Flood Inundation Extents

Job Number	51-31046
Revision	B
Date	27 Nov 2012

GHD House, 226 Antigua Street, Christchurch 8011, PO Box 13468, Christchurch 8141 New Zealand T 64 3 378 0900 F 64 3 377 8676 E chcmail@ghd.co.nz W www.ghd.com

ATT. 9

Table 19 Identification of local options for Spencerville (Reach 3)

Options	Description	Discussion
3B – 3C, 3O – 3P	Spencerville ring bank	Stopbank and floodwall around Spencerville
3I – 3K	Brooklands ring bank	Stopbank and floodwall protecting Brooklands Green Zone properties
3a – 3J, 3L – 3N, 3P	Combined ring bank	Stopbank and floodwall protecting Spencerville, Brooklands and the land in between
3R	Brooklands house raising	Raising of 3 houses
3S	Between Spencerville and Brooklands house raising	Raising of 10 houses
3Q	True left bank house raising	Raising of 2 houses
n/a	Do nothing	

The options are:

- **Spencerville ring bank:** It is proposed that a stopbank be built, starting from the southern end of this reach and following around the edge of the Spencerville residential area before ending at 89 Heyders Road where it connects to high ground. The ring bank continues from the other size of the high ground, travelling through 396 Lower Styx Road, turning south after crossing Lower Styx Road then west around the back of the proposed stormwater pond. The bank then borders the river to the end of the reach. This option requires a stormwater pond (#1) which is located on both sides of Spencerville Road. The ponds would be connected by a culvert under the road.
- **Brooklands Green Zone ring bank:** A stopbank around the Brooklands Green Zone is proposed which would commence from 898 Lower Styx Road, travelling parallel to Earlham Street before crossing at 21 Earlham Street and bordering the properties and crossing the road at 930 Lower Styx Road and connecting to the main stopbank. This option requires a stormwater pond (#3) which is located on Brooklands Red Zone land.
- **Combined Spencerville and Brooklands ring bank:** A stopbank is proposed combining the Spencerville and Brooklands ring banks. The stopbank would commence from 21 Earlham Street and travel south before connecting with the stopbank in Spencerville. This option requires a stormwater pond (#2) which is located within private property at 373, 395 and 427 Lower Styx Road
- **Brooklands house raising:** Three houses in the Brooklands Green Zone are to be raised. Should the raising of houses not be possible due to foundation or cladding type, the houses could be ring banked.
- **Between Spencerville and Brooklands house raising:** Ten houses on the true right bank of the river between Spencerville and Brooklands are to be raised. Should the raising of houses not be possible due to foundation or cladding type, the houses could be ring banked.
- **True left bank house raising:** Two houses on the left bank of the river within this reach are to be raised. Should the raising of houses not be possible due to foundation or cladding type, the houses could be ring banked.
- **Do nothing:** Construct no flood mitigation measures in this reach.

vegetation types including open wetland, ephemerally flooded podocarp forest, coastal forest and dry shrubland. Additional thought should be given as to how wildlife-vehicle conflicts can be avoided where waterfowl cross Lower Styx Road between Prestons facility and the wetlands of Janet Stewart Reserve (Figure 10). This may be mitigated by establishing a dense band of native forest vegetation immediately adjacent and parallel with the Lower Styx Road to discourage waterfowl.

Figure 10: Well established ponds, restoration plantings and sculptures at Janet Steward Reserve, Lower Styx Road (Photograph A. Shadbolt 2010).

Low depressions further east along Lower Styx Road provide ephemeral wetlands that are used by a wide range of native waterfowl and wading birds (Figure 11).

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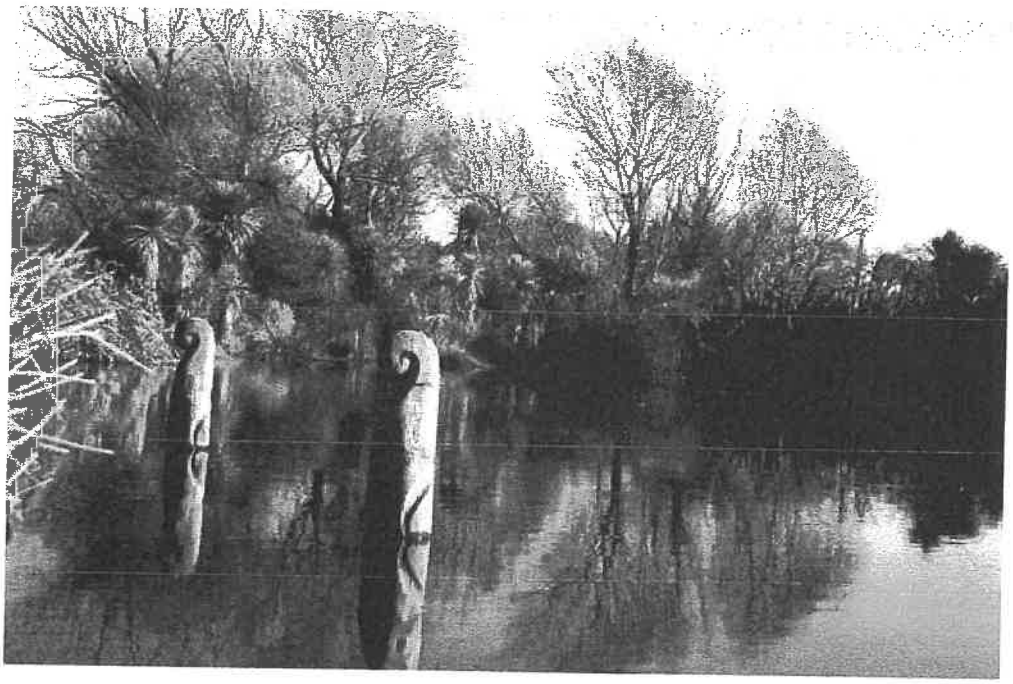

Figure 10: Well established ponds, restoration plantings and sculptures at Janet Steward Reserve, Lower Styx Road (Photograph A. Shadbolt 2010).

Low depressions further east along Lower Styx Road provide ephemeral wetlands that are used by a wide range of native waterfowl and wading birds (Figure 11).

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Phil Driver's summary of observations and comments from the tour of the Styx River catchment on Monday 27th November 2017

(1st draft provided 4th December 2017, updated at CCC request on 12th January 2018)

"The purpose of the bus tour is to enable members of the Styx River Working Party, other members of the Papanui-Innes and Coastal-Burwood Community Boards, as well as staff, to visit the key locations that have a bearing on the Styx River" (from the brochure provided to participants).

This report was prepared by Phil Driver, a member of the Working Party. The first part of the report summarises observations and comments and the second part summarises the questions that arose from the tour.

1. Preston's retention ponds

a. The total area of Preston's about 200Ha of which about 100Ha is developed with about 50Ha feeding into the Styx catchment and the balance feeding into the Avon catchment
b. The ponds hold almost 5 days of rain from a 1 in 50 year event and in doing so will remove sedimentation (in the 1st flush ponds) and contaminants (in the wetlands). Sediment will need to be excavated about once every 20 years.
c. The worst storms are considered to be intense 48 hour rainfall events @ 3mm/hour (144 mm over 2 days = about 70,000 cu metres)
    i. For comparison the normal flow of the Styx is about 1 cumec, so 70,000 cu metres = about 20 hours of normal flow in the Styx or 2 hours of flood flow of 10 cumecs.
    ii. If the 70,000 cu metres of water is released over the 5 day design period of the ponds then that equates to an average flow from the ponds of 166 litres/second for 5 days (roughly 17% of normal flows and 1.7% of flood flows)
d. The wetlands hold ½ metre of flood water over and above their normal level, resulting in 20,000 cu metres of 'live' storage (although see below re the cut in the walls of the wetland)
e. There have been groundwater level changes as a result of the earthquakes and the wet 2017
f. The size of the final outlet from the ponds would permit up to 2 cumecs to flow *but only if such an amount of water were available – which should never happen if the ponds are operating correctly*
g. The final outlet is discharging into an *effectively* non-tidal stretch of the Styx
h. One resident questioned whether or not Preston's houses were supposed to have installed rain water collection tanks to slow down run-off but council staff advised that such tanks were never an expectation
i. Run-off from about 1000 houses drains into the Styx

j. The CCC has installed flow and level sensors into the final outlet from the ponds and these can measure flow in both directions. This is important because when the Styx is running high, water from the Styx enters the ponds and that reduces the level of the Styx downstream but also reduces the capacity of the ponds to hold run-off from the Preston's development. The CCC believes that overall this is beneficial for minimising water levels during flood events. However, as noted below, the existence of a cut in the wall of the wetland *may* mean that water from Preston's bypasses the new sensors.

k. The last 12 months have been very wet throughout Canterbury and this has meant that ground water levels have been very high and that in turn has impacted in river levels. 2017 was in the top 8% of rainfall years.

l. A resident pointed out the grates installed at the end of the ponds in the middle near to Styx Mill road. The resident asked what the grates achieve in the system.
    i. Question for the CCC: Please provide information on the what the grates do and achieve

m. A resident raised the issue of the cut in the wall of the wetland. It was clear that the CCC staff on the tour were unaware of this cut (although it is visible in the photo on page 5 of the brochure that tour participants received). Subsequently several staff had a look at the cut and their initial judgement was that it merely increased the size of the ponding area and that that was a good thing. *My own thoughts on this are*:
    i. There *appear* to be *at least* 3 possible scenarios in relation to the impacts of this cut and all of them would *appear* to impact on the design effectiveness of the Preston's ponds and wetlands:
        1. Scenario #1: It could be that the land outside the ponds is at a lower level than the ponds and is not connected to the river. *If* this is the case then this lower area would appear to be simply providing additional ponding area. I would be surprised if the owners of the adjacent land were to be happy if this were the situation
        2. Scenario #2: It could be that the land outside the ponds is at a lower level than the ponds and it discharges directly into the Styx River, thereby by-passing the pond's infrastructure that has been designed to slow down the discharge of water from the Preston's development. *If* this is the case then it would appear to be a serious issue.
        3. Scenario #3: It could be that the land outside the ponds is at a high level than the ponds, in which case run-off from this other land would enter the ponds and therefore increase the flood-loading on the ponds. *If* this is the case then it would appear to be a serious issue.
    ii. Irrespective of which of the above scenarios (or any other scenarios) is correct, it would appear that the cut is unauthorised and not known-about by all relevant CCC staff. Residents reasonably request an explanation of which scenario is unfolding, the impact of the scenario on Styx river flows under normal and flood situations, whether or not the cut was authorised, who authorised it, and on what grounds was it authorised.
        1. Question for the CCC. Please provide residents with explanations for the existence and effects of the cut in the detention pond bund wall.

2. **Kaputone**
    a. The CCC advised that according to their measurements, the Kaputone provides about 12% of the total flow into the Styx River. There was considerable discussion about whether or not the CCC's flow and level data is accurate given the location and types of level and flow monitoring equipment that is installed. Recently install monitoring devices may provide more accurate information.
    b. Almost all residents stated that the Kaputone used to be much smaller and that they could easily jump over it. Explanations for the apparent increased flows include:
        i. New springs in the Kaputone catchment
        ii. Less water abstraction by industry
        iii. Changes in irrigation
        iv. Impacts of industrial and housing developments
        v. Other?
    c. Residents are keen to know whether or not the current flows and levels are considered by the CCC to be 'the new normal' and hence will be maintained at these flows/levels
        i. Question for the CCC: Are the current flows and levels in the Kaputone considered by the CCCX to be "the new normal" and hence the CCC intends to take no steps to change them
    d. Participants observed a number of significant pinch points and near-blockages in the Kaputone and asked when they would be cleared and whether or not such clearances would make a significant difference to levels under normal and flood flow conditions
        i. Question for the CCC: Will the CCC clear the observed pinch points and near blockages in the Kaputone and if so, what impacts will such clearances have on both normal and flood flow conditions?

3. **Conversation with the weed eater operators.**
    a. The stretch of the Styx from Spencerville to the flood gates is the narrowest and shallowest, so much so that they can't get the weedeater into the shallowest parts at low tide
    b. The operators of the weed-harvester were surprised to see the diggers removing sediment where they are currently operating and would have thought it would be more effective to remove it further downstream
    c. They report that sandbanks throughout the river are getting bigger and making the river shallower
    d. The rivers were high for this time of year with more water than usual coming in from the side streams and this appears to be impacted by the wet 2017 and the consequent higher ground water levels
    e. Salt water appears to kill the curly pond weed (is there an opportunity here?) This is interesting since there is salt water right up the river to marshlands road according to some councils staff) also related to point 'r' below
    f. The rivers are not dropping as expected as a result of the current harvest

g. Curly pond weed grows rampantly (3-6 inches/day?) after cutting at certain times of year when the water is warm but it grows very slowly in winter (but doesn't die off as the roots stay alive)
h. Shading reduced weed growth.
    i. Question for the CCC: Is there an opportunity over time to replace willows, which have roots that encroach into the river, with other shade trees with less rampant root?
i. The weed-harvester can cut down to a maximum of 1.5 metres depth
j. The encroachment of willows and other foliage along the river banks impedes the weed cleaning operations so although the operators can remove some foliage and logs, they can't easily remove larger foliage and embedded roots/tree trunks.
k. They report that in the Drainage Board days there were 4 staff permanently working on the Styx river catchment to minimise flooding
l. There is a slime that appears on the weeds at times and this smothers the weeds but is easily washed away in the next flood event
    i. Question for the CCC: Is there an opportunity to encourage this slime from time to time as an alternative to weed harvesting?
m. 3 cuts per year of the weed currently appears to be 'about right' but it's important to get the timing right. However it wasn't clear whether the objective of the weed eating is to lower normal river levels or to have an impact on flood levels (which would seem to be the most important) or both
    i. Question for the CCC: Will weed harvesting have a significant impact on water levels in a 1 in 20 and 1 in 50 year flood event?
n. Wherever there has been a significant build-up of silt it has smothered the weed and it takes a couple of years for the weed to re-establish, but when it does re-establish it is often worse than before
o. Deepening the bed of the river appears to encourage the weed to grow taller as it attempts to reach the surface
p. The weed appears to trap sediment and reduce the depth of the river
q. Clearly there are a lot of poorly understood weed-growth and harvesting dynamics, with considerable speculation by everyone on possible causes-and-effects. More in-depth study is required
r. Salt water appears to kill curly pond weed. This raises the interesting possibility of deliberately allowing seawater into the river during very high tide events when the river is at a low level and/or tipping salt into the river, although both such actions would impact on river ecology. This is interesting since there is salt water right up the river to marshlands road according to some council's staff. Is this worth investigating?
    i. Question for the CCC: Will the CCC investigate the option of controlling weed growth by either allowing more seawater to enter the river and/or tipping salt into the river?
s. There is a general sense that more flow and level sensing is required in order to understand, rather than speculate on, the hydrodynamics of the catchment. In particular it's important to understand exactly which natural events cause exactly which types of flooding and which types of flooding are most in need of mitigating. In this respect, is

there a 'new normal' that everyone needs to accept so that only those situations that are beyond the 'new normal' can be focused on?

4. **Dredging**
    a. The dredging is taking out about 5000 tonnes (same as in 2013) and its impact on river levels is being monitored (for normal and flood flows?) (remembering that any depth greater than 1.5 metres is below the reach of the weed harvesters, so given that weed growth *appears* to have the biggest impact on levels (and flooding?), dredging deeper *may* not be particularly beneficial)
    b. The dredges are also widening the river by about 2 metres
    c. At this stage there is no plan to address the large fissures that have appeared in numerous places along the riverbanks so there continues to be a risk that these fissures will continue to widen and eventually slump into the river

5. **Earlham St/flood gates**
    a. The July 2017 flooding in the July 2017 high tide and storm surge was caused by the Brooklands Lagoon overflowing. Preventing this from happening has been estimated to cost over $400,000. At the moment there are no plans to change the lagoon edge although there are proposals for a walkway/cycleway that could, if implemented, have some impact
    b. This problem will be exacerbated by sea level rise and requires a decision on the long term management of the area.
    c. Rather than viewing sea level rise and increased flooding as purely negative issues, perhaps thought needs to be given to working with nature and finding ways to create benefits from these changes (economic; environmental; social; cultural benefits). This will ideally be considered in the long term strategy for the Styx Catchment as proposed by residents to the Styx Catchment Working Party.

Notes from Graham Harrington prior to and subsequent to the tour

    d. The Working Party is looking forward to receiving notes from Graham Harrington's presentation at the Working Party meeting on the 22nd November (received via Trevor on 4th December 2017)
    e. Subsequent to the tour, Graham sent through the following:

Hi Phil

I have had a look at the low tide levels at Harbour Rd to see if there is an issue of draining the water from the lower reaches out through the tide gates - see attached pdf document. The Harbour Rd low tide level shows the same post-earthquake blip that the other sites above the tide gates show - but otherwise there does not seem to be any significant trend.

Up to now we have looked at the effectiveness of weed harvesting in reducing the water levels however - if you look at the effect of seasonal weed dieback you can see that it can reduce the Lower Styx level by up to 800mm. This is an effect which is independent of sediment, channel width or other physical restrictions in the channel that might be addressed by dredging. The dieback effect is also much greater than produced by mechanical weed harvesting. It does suggest that the single biggest factor restricting flow - and raising water levels - is the growth of weed and that other work to remove physical restrictions and sediment will have a relatively minor benefit.

I have also included (below) the flow record to date from Guthries Rd - as discussed on the field trip.

Cheers

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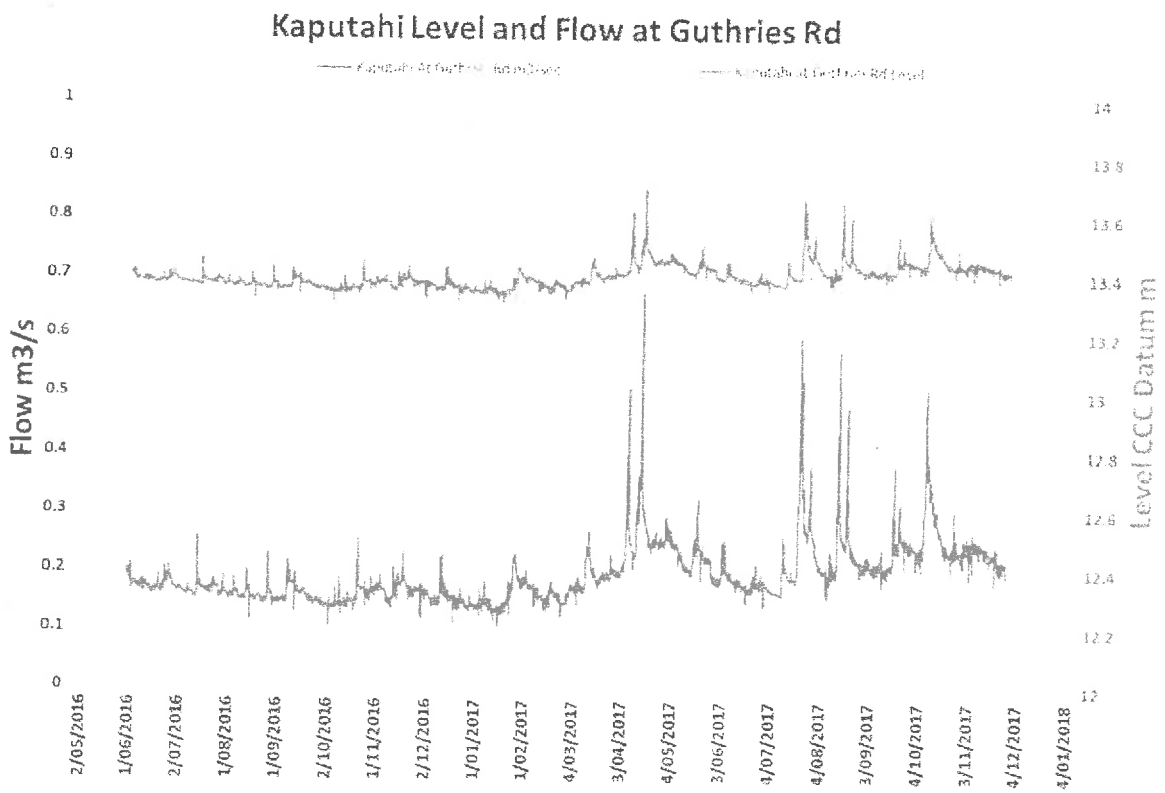

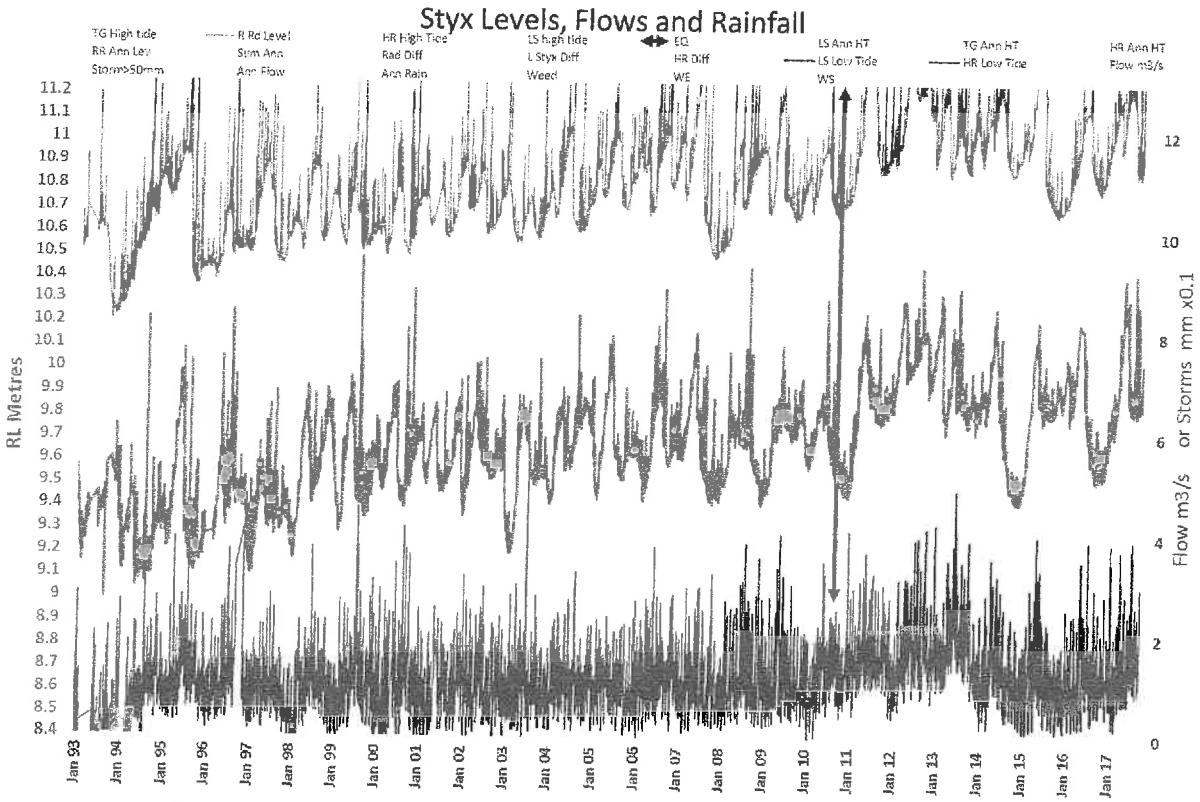

Summary of questions for the CCC

1. Irrespective of which of the above scenarios (or any other scenarios) is correct in relation to the cut in the Preston's wetland bunds, residents reasonably request an explanation of which scenario is unfolding, the impact of the scenario on Styx river flows under normal and flood situations, whether or not the cut was authorised, who authorised it, and on what grounds was it authorised.
2. A resident pointed out the grates installed at the end of the ponds in the middle near to Styx Mill road. Can the CCC please provide information on what the grates do and achieve?
3. What does the CCC consider to be the 'new normal' for the Kaputone River, various stretches of the Styx River and the Brooklands Lagoon?
4. Would the clearance of bottle-necks and obstructions in the Kaputone reduce normal and flood levels in the stream?
5. Is there an opportunity over time to replace willows, which have roots that encroach into the river, with other shade trees with less rampant roots?
6. Is there an opportunity to encourage this slime from time to time as an alternative to weed harvesting?
7. Will weed harvesting have a significant impact on water levels in a 1 in 20 and 1 in 50 year flood event?

8. Are the CCC/ECAN/others interested in investigating the option of using salt water to reduce weed growth, either by letting seawater enter the river on very high tides and low river flows, or adding salt water to the river further upstream, or both?
9. Is there an opportunity to encourage the growth of the slime (mentioned by the weed harvester operators) from time to time as an alternative to weed harvesting?
10. Will the Working Party consider ways of working with nature to respond to the river's changes due to earthquakes, climate change and sea-level rise (eg by looking at options such as aquaculture; creating a thriving wetland; other)? This could fit into the long term vision
11. Further to Graham's most recent email in which he states: *"It does suggest that the single biggest factor restricting flow - and raising water levels - is the growth of weed and that other work to remove physical restrictions and sediment will have a relatively minor benefit".* The question remains whether Graham's comment applies to water flow restrictions for normal flows or for flood flows. Can Graham please clarify this because it is the view of at least some residents that widening the river significantly (back to its width when it was being managed by the Drainage Board) would reduce flooding by providing more capacity during flood events? Also, such widening could be maintained with less frequent work than the three-times-per-year weed harvesting.

Residents also raised issues relating to determining current, viable floor levels (one resident has prepared a letter with many detailed questions and this has been sent to the CCC and will also be tabled at the next Working Party meeting). Getting floor levels right is essential because it has profound implications for residents. At the moment it appears that any floor levels that have been established so far by the CCC must necessarily have been based on out-of-date hydrological models of the Styx catchment because the new model hasn't yet been completed and run for the Styx catchment. It is therefore important to:

1. Finish the catchment model and run it for relevant scenarios
2. Ground-truth the model by comparing actual levels with modelled levels
3. Establish true, viable floor levels based on the ground-truthed model.

So the key questions re floor levels are:

1. Is the above approach the one that the CCC will take for establishing floor levels? (and if not then what approach will the CCC take?)
2. When will residents receive new floor levels that they can have real confidence in?

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4th December 2017