Folder [110 Kiwi Road flooding - problem and solutions]

Interim Review of 110 Kiwi Rd Flooding

Ian Holyoake. 23 November 2023

Not reviewed

Due to the nature of this inquiry I have not had this document peer reviewed.

I have prepared it for discussion at the stakeholders meeting

Background:

The Kiwi Rd improvements were in response to community pressure.

What I have discovered is Opus 2003 questionnaire included several owners on Kiwi Rd reporting flood issues. Kiwi Rd was at that time formed without borders like most of Whangamata in early road sealing - Some like Tui, Mary and Sylvia remain undefined.

Opus included recommendations for a 375mm stormwater pipe connected to Williamson pipe and overland flow paths into Williamson Golf course. Initially I was in agreement with this but in retrospect after reviewing the overall issues I am not convinced this is the optimum use of money or has the greatest benefit. What pipes do is shift the flood water to somewhere else that then needs to be dealt with. That means big pipes that are used very rarely to capacity like once every year. It is noted that the 10%AEP is the limitation needed for pipe sizes BUT we know we get much larger rainfall events than this that the pipes won't then drain water away. The time of flooding may reduce but the properties will still get flooded.

LGOIMA responses have as yet not been provided to determine how the Pinnacle design failed to follow Opus recommendations or whether any alternative options were considered that would provide an equal or better delivery.

LGOIMA response included a statement that the roading work did not include stormwater improvements.

The Kiwi Rd project was to lay approximately 1200 lm of nib kerbing draining into 10 catchpits, to cesspits and into 5 soakage devices. This is stormwater work which makes the LGOIMA response false.

Awaiting LGOIMA request as to costs of the 2020 roading work.

SmartMaps have not been updated so I do not have LVL or as built capacity

The soakage design was changed from rocks to Cirtex (I believe)

The design does not include soakage tests to determine suitability for soakage devices or sizing

Awaiting LGOIMA request why the soakage devices were installed beside low lying properties

During construction one resident asked why the holes - and was told these are the stormwater soakage devices that drain road water away.

It is noted Kiwi Rd residents signed and presented a petition in 2023 to get things fixed - no response from council to date

One resident has filed a RFS and followed that up with a detailed letter addressed to the Mayor requesting answers - no response to date

I have already prepared a separate file on the 110 Kiwi Rd owners RFS. I don't think this report has value to the stakeholders workshops.

This report is focusing on flooding at 110 Kiwi Rd. Thee problem and some solutions. It is an interim report because I am waiting on LGOIMA responses, responses to the Kiwi Rd petition, response to the letter to the Mayor and our stakeholders workshop debate.

Summary

To be read in conjunction with the letter to the Mayor dated 13 June 2023 by the owner of 110 Kiwi Rd

The soakage device design is completely inadequate.

Repeat flooding is foreseeable. The predicted conditions for repeated flooding are provided in the Opus Groundwater study:

1. Many medium rain duration's - culminating in above 746mm in a 4 month spell
2. Large rain volumes followed by smaller repeated volumes.
3. Very heavy rainfall beyond 10%AEP.

The reasons why 110 Kiwi Rd is flooding is:

- The house is built in a low lying depression with the floor level below the crown of the road.
- The roading improvements located a soakage device in the verge above the low lying land
- The roading catchment area is 50-200 times that of a standard roof catchment area for a soakage device - the sizing of and number of soakage devices would likely require 10 more located along the catchment area
- The roading soakage device is located adjacent to the soakage devices for both 108 and 110 Kiwi Rd. The ground cannot absorb this much water.
- Tui Rd is not developed and has no stormwater management system - it floods which feeds down Achilles and into Kiwi Rd which no-one would have taken into the calculations so cannot cope.
- The 110 Kiwi Rd addition built in 2004 should not have been approved. The then owner responded to the 2003 Opus questionnaire with a circled area where the addition has been built stating this area flooded. Council was required by law to activate a s36 (BA1991 Act). By the time CCC issued this should have been amended to a s73 (BA2004 Act)
- Council failed to maintain the soakage devices and catch-pits so neither worked to capacity in the storms

110 Kiwi Rd has had intermittent surface flooding since 2004 but did not reach sufficient height to enter the floor until the Hale/Gabrielle concurrent floods and subsequent repetitive rains.

110 Kiwi Rd flooding is not the only problem. We must still deal with the surface ponding on neighbours properties and all those properties that lie above Kiwi Rd and feed flood water onto it.

To stop this we need to include all surrounding properties to avoid surface ponding to remain longer than a few hours.

What happens is the soakage device functions for a short time before it becomes overwhelmed from the catchment area.

Then the road water travels along to the next soakage device and overwhelms it as well.

The soakage device absorption rates slow as the sand wets out in a crest down to the water table.

As the water table rises the soakage device cannot function to design and relies on lateral filtration/absorption and hydraulic dispersion which is slower than rainfall rate.

When the sand around the soakage device becomes saturated water breaks ground on the slope of 110 Kiwi Rd depression and floods the low lying surface.

The water level rose to about 500mm deep on 110 Kiwi Rd which corresponds to about the top of the Kiwi Rd soakage device and about 300mm deep inside.

Both 108 and 110 Kiwi Rd roofs discharge into soakage pits in the front of these properties also loading the water table. The ratio of their impact is less than 1/10th to 1/50th of the catchment of the road.

Digging holes around the ground at 110 Kiwi Rd as the water receded to test water table levels is not evidence the whole of Whangamata water table is at this level. It is more likely the water in these holes is the cresting from the soakage devices

It is my view that if the Kiwi Rd soakage devices were built beside properties that were above the crown of the road where they did not have low lying land close by there would be surface flooding but no break outs. In this situation 110 Kiwi Rd (and the 3 neighbors) would only become flooded if/when the surface water then trespassed via verges becoming overrun into their properties.

To correct this:

1. Move the soakage device away from depressions so they cannot influence/breakout the low lying ground.

2. Installing more soakage pits is not a solution as these will get overwhelmed and then the same thing will happen.

3. Change the COP to ensure soakage devices are located away from depressions at a distance they cannot adversely affect nearby properties own soakage calculations.

4. Longer term see DrainMOD proposal to tidy up Tui and surrounding areas feeding the catchment area.

This does not mean flooding will not always be a problem for 110 Kiwi Rd (and other low lying properties) because the floors are located below the flood plane. Taking some actions will reduce the likelihood of at depth surface flooding.

The Opus recommendations need to be reviewed and compared to the current situation - pipes may well be needed as well as overland flow paths. BUT caution as pipes to remove flood water is very expensive and need discharging somewhere.

Conclusion

My conclusion is I do not accept that the rainfall onto any Whangamata property by itself causes ponding or flooding. The sand copes. The causes are run off from impervious surfaces that becomes aggregated by kerb and channels into large catchment areas which overload inadequately designed, unmaintained and poorly located soakage pits. Where there are no overland flow paths surface water becomes a nuisance and will naturally find low lying ground and cause damage.

My opinion (which needs testing at workshops) is soakage devices will perform in heavy rains if they were maintained, the correct size and correctly located.

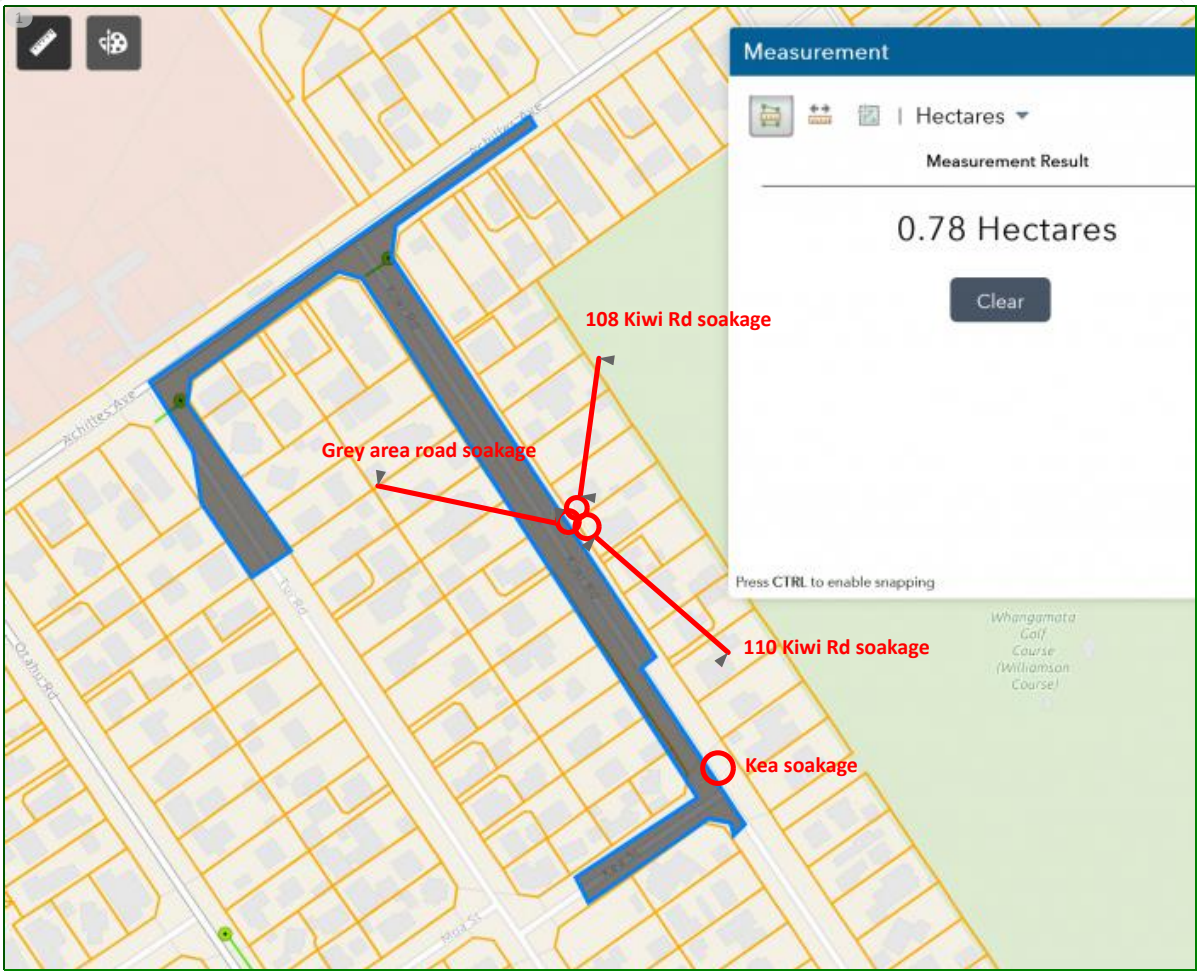
I have been studying DrainMOD which could have value for maintaining our water table levels without over draining it. See separate report.

To correct Kiwi Rd soakage design would be to install many more soakage devices located along the road side outside properties that are above the Crown. More soakpits that are wider and longer, not deeper. Fill in soakage devices that are above and nearby low lying land.

Caveat: if sea levels do rise so will the water table which means the soakpits will slowly become liabilities and fail more regularly even in light rains. DrainMOD can be turned into a pump removal system.

If we get more ongoing events like Hale/Gabrielle and continued repetitive rain fall we will get more of the same.

Kiwi Rd Kerb & Channel Final R1.pdf »



100 Catchment area and soakage device locations..jpg

The problem:

What was witnessed on 19 November 2023 in the light rains was rainwater from all the grey catchment area was flowing to Kiwi Rd to be dealt with by the 108 Kiwi Rd soakage device and as it became overwhelmed down to Kea Street soakage device.

This could equate to 7800sqm catchment. I accept verges get calculated at lower rates. The catchment area does not include driveway run off to the roads. The catchment area does not take into account greater flooding or the Achilles pedestrian crossings getting blocked by the swimming pool.

The calculations for domestic dwellings soakage devices requires 1 at 750dia by 900mm deep ring per 50sqm impervious area.

The evidence is clear that this ratio is working. If not hundreds of properties would have breakouts from their soakage devices.

The 7800sqm catchment is possible because the road has been formed almost level with little fall. Kea Street appears to be slightly lower than 108 Kiwi Rd. Tui is higher than Achilles and Kiwi. Water feeds in from higher ground which is difficult to test until 100-200mm of water is ponding and running to the lowest point.

What has gone wrong:

1. The location of the Kiwi Rd soakage device, right between 108 and 110 Kiwi Rd is overloading the ability of the surrounding sand to absorb rainfall - in normal circumstances the 2 dwellings would not by themselves overwhelm soakage - but when the road is delivered to the same area the sand absorption cannot cope.

2. The Kiwi Rd soakage device cannot be located outside 108 and 110 Kiwi Rd because these properties lie in a depression and 110 kiwi Rd has a dwelling with floor level below the crown of the road. If the low lying land filled with water to a level to flow into the Golf Course more houses would be flooded.

3. The Kiwi Rd soakage device is too shallow in respect to the surrounding properties surface ground levels - when full it will breach through the side and onto the low lying land.

4. The catchment area delivered to the Kiwi Rd soakage device is probably 50-200 times the combined roof catchment areas that the soakage devices for 108 and 110 Kiwi Rd are designed for.

5. No overland flow paths were formed

6. No pipes to remove surface ponding - ie any surplus rainwater the soakage devices could not store or transfer into the sand must be removed - not stored as ponding water on the surfaces of the land.

The Temporary Solution:

A temporary solution is to add at least 6 more soakage devices enroute from Tui to the Kiwi Rd soakage devices between 108 and 110 Kiwi Rd and from Tui back to Kea Street to break up the catchment area into smaller areas that soakage devices can managee. Note: This only assists when the water table remains low and the rainfall is below 746mm over a 4 month period.

To reduce the likelihood of floors flooding an above ground stormwater pipe could be installed from the Kiwi RD road cesspit outside 108 Kiwi Rd to discharge onto the Golf Course land. This would act as a temporary overland flow path at peak load.

The Permanent Solutions:

1. Overland flow paths to be formed - problem is where and how

2. Pipes to remove rainwater that overwhelms the soakage devices - problem is these must not drain all water away as this will adversely lower and prevent water table levels being recharged naturally in lighter rain.

3. Road verges be lifted to 100-150mm above the crown of the roads to form channels to prevent trespass water entering properties

4. Where this cannot be achieved provide financial incentives to owners to lift homes and fill sections to 150mm above the crown of the road.

SmartMaps requires updating.

None of Kiwi Rd soakage devices or cesspits are recorded on the system

The Pinnacle designs did not include soakage tests (Hydrant or other)

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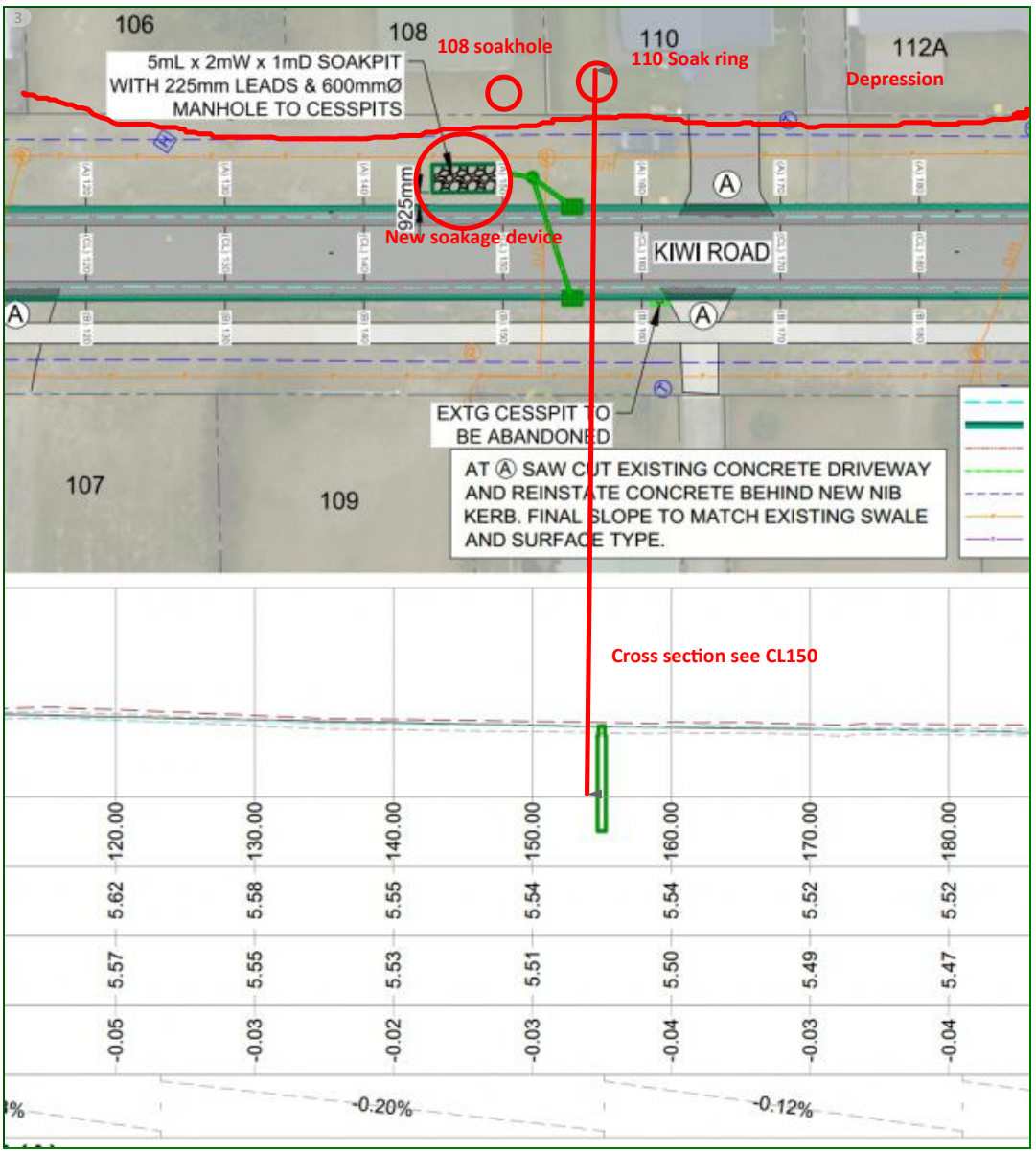
105 20231119.jpg

Cesspit opposite 108 and 110 Kiwi Rd overwhelmed on 19 November 2023 then flows to the Kea Street cesspit. Some of the water originates from Tui Rd. The Kea Street soakage devices were immediately overwhelmed which causes stormwater to back up, rise and trespass.

Noted the other side of the road kerb and channel was not as full with water as the crown at this stage is preventing water breaching across.

The cesspit outside 108 Kiwi Rd was full - this will be because of the pipe connection from the flooded cesspit.

No solution will be found for Kiwi without dealing with Tui and repositioning the soakage device away from low lying land.



200 Plan at 110 Kiwi Rd.jpg

Pinnacle Plan detail at 110 Kiwi Rd between CL140 and CL150

Soakpit is in front of 108 Kiwi Rd

Plan does not have LIDAR contours - freehand line is approx edge of depression - noted 110 Kiwi RD is below 108 Kiwi Rd.

There was an existing cesspit on opposite side of road which was abandoned. This will be the original low ground.

Looking at levels it seems the ground is pretty level making drainage to single points means water becomes deep and can breach the nib kerb and flood properties enroute to the soakage device.

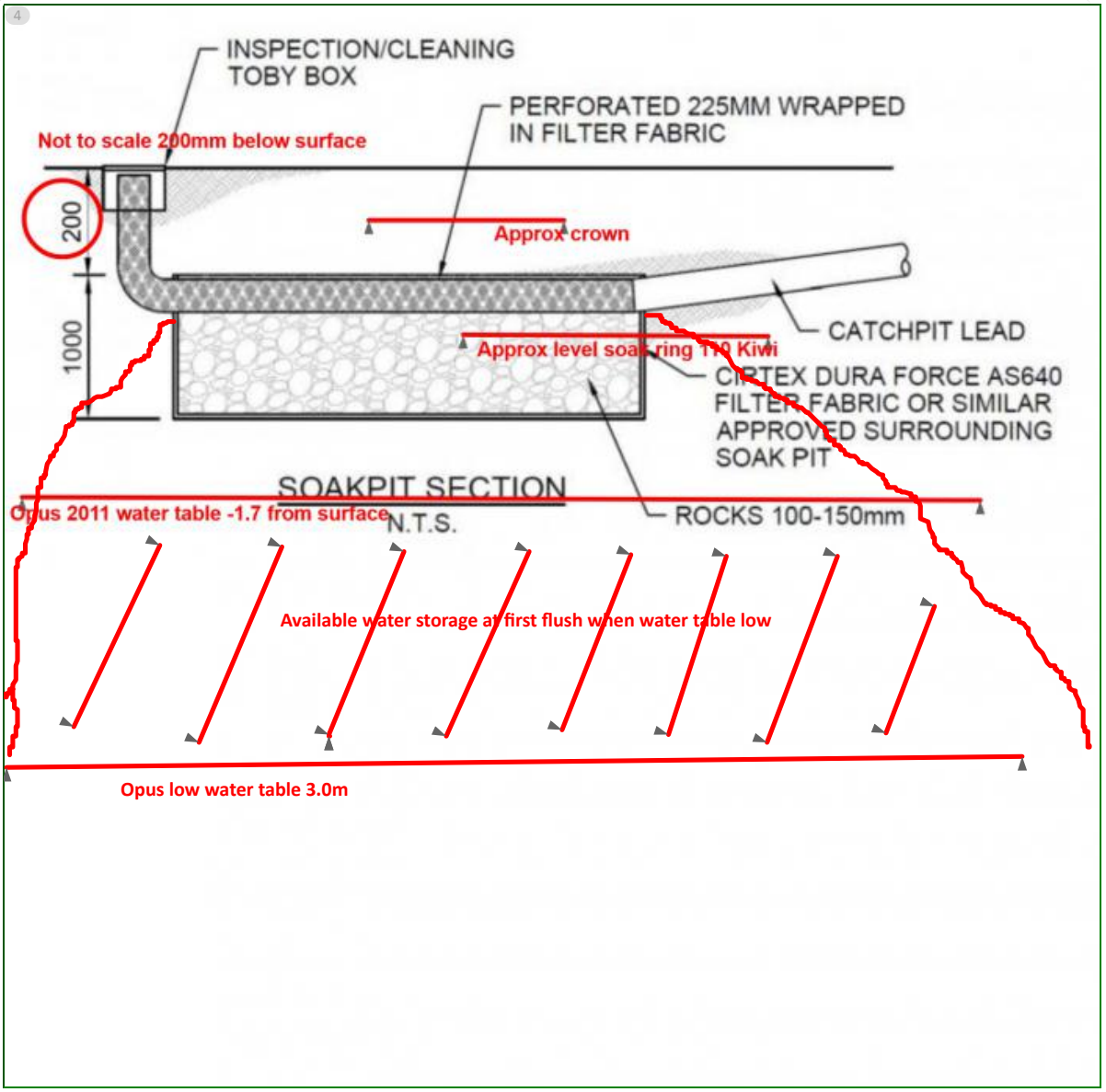
Rings denote soakage devices at 108 Kiwi Rd and 110 Kiwi Rd

Cirtex circled and green box denotes new road soakage device outside 108 Kiwi Rd

Red line see CL150 for cross section

No inspection hatch for maintenance found

No reason why Kiwi Rd soakage device was constructed at this particular location.



20231120_213743 _SC_.jpg

On the lead up to Hale we had a dry end of year so the water table could have been 3.0M below the surface (Opus Bore 3).

At Cyclone Hale first flush the area below the soakage device was capable of storing surface water entering the system. Denoted by area below the soakage device.

As the rain persisted the water table would rise - eg to Opus 1.7M below the surface.

At cyclone Gabrielle the next first flush only has the area above the 1.7M line available for storing surface water.

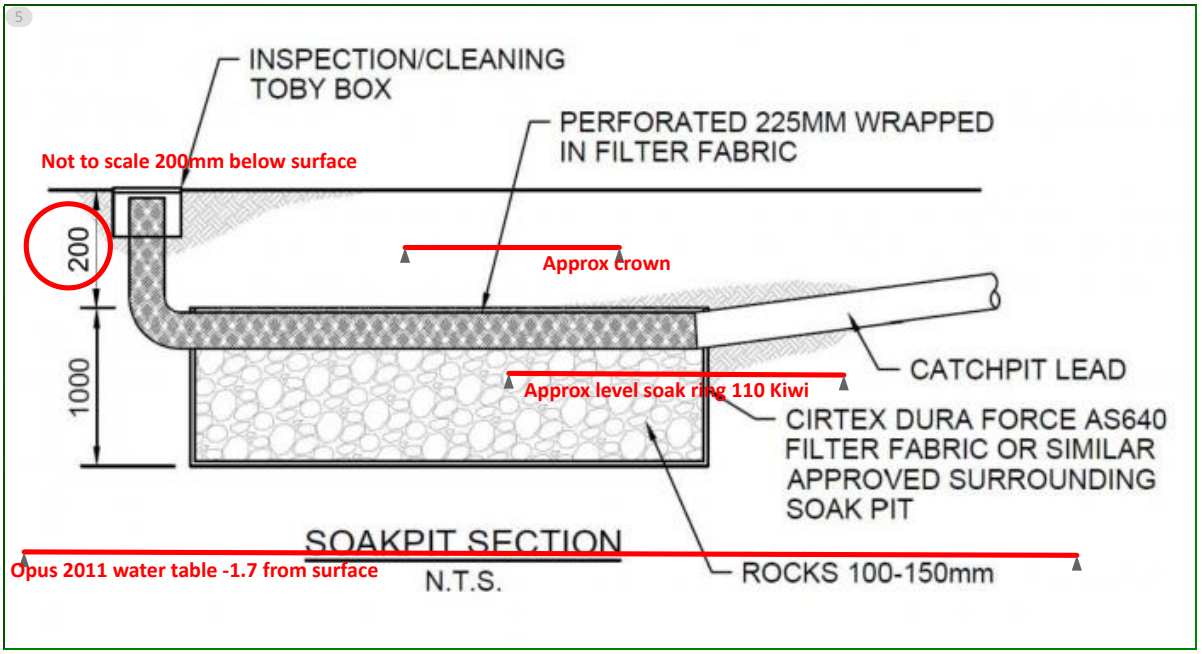
Whilst lateral filtration/absorption will be occurring, together with hydraulic pressure from the weight of the saturated sand, the water table will crest up below the soakage device.

The top of the Kiwi Rd soakage device is about 300mm above the ground level of 110 Kiwi Rd.

'Breakout' will then occur through the sloping ground onto the surface of the depression within 110 Kiwi Rd.

What compounds the issue is as the soakage devices becomes overwhelmed the stormwater collects as surface water which then drain backs into the cesspit and feeds the breakout onto 110

Kiwi Rd depression.



220 Soakage pit Kiwi Rd at CL 150.jpg

Cross section of soakpit design

Note shows top of soakpit to be 200mm below ground level - states not to scale as 1000mm deep is out of proportion to the 200mm

Note shows rocks 100-150mm. We believe this is incorrect and substituted to Cirtex plastic crates.

We found a second cesspit along the catchpit lead but not yet found the inspection/cleaning toby box.

The horizontal line is presumably the grass verge line which is higher than the curb and channel.

The top red line is about the line (to scale of the 200mm) which is above the grate height of the catchpit

The lower red line is the approximate ground level of 110 Kiwi Rd which means the soakage device stores water to above the level of the depression on 110 Kiwi Rd.

I do not have LVL for the site as the new stormwater assets are not loaded into SmartMaps. For the discussion I am using Opus BH03 Groundwater data and taking it for now that BH03 in relation to Achilles crown is the same level as the Kiwi Rd to crown.

The Opus report 2011 the minimum ground water clearance (ie height of water table) was 1.7m - note the maximum length and volume of rains during the study is less than half Hale/Gabrielle and subsequent repeated events. It is conjecture but if the road soakage device base is 1.2M down it would be 500mm above the 2011 water table. It is not.

That leaves 500mm of sand to store flood water below the soakage device. This is not enough.

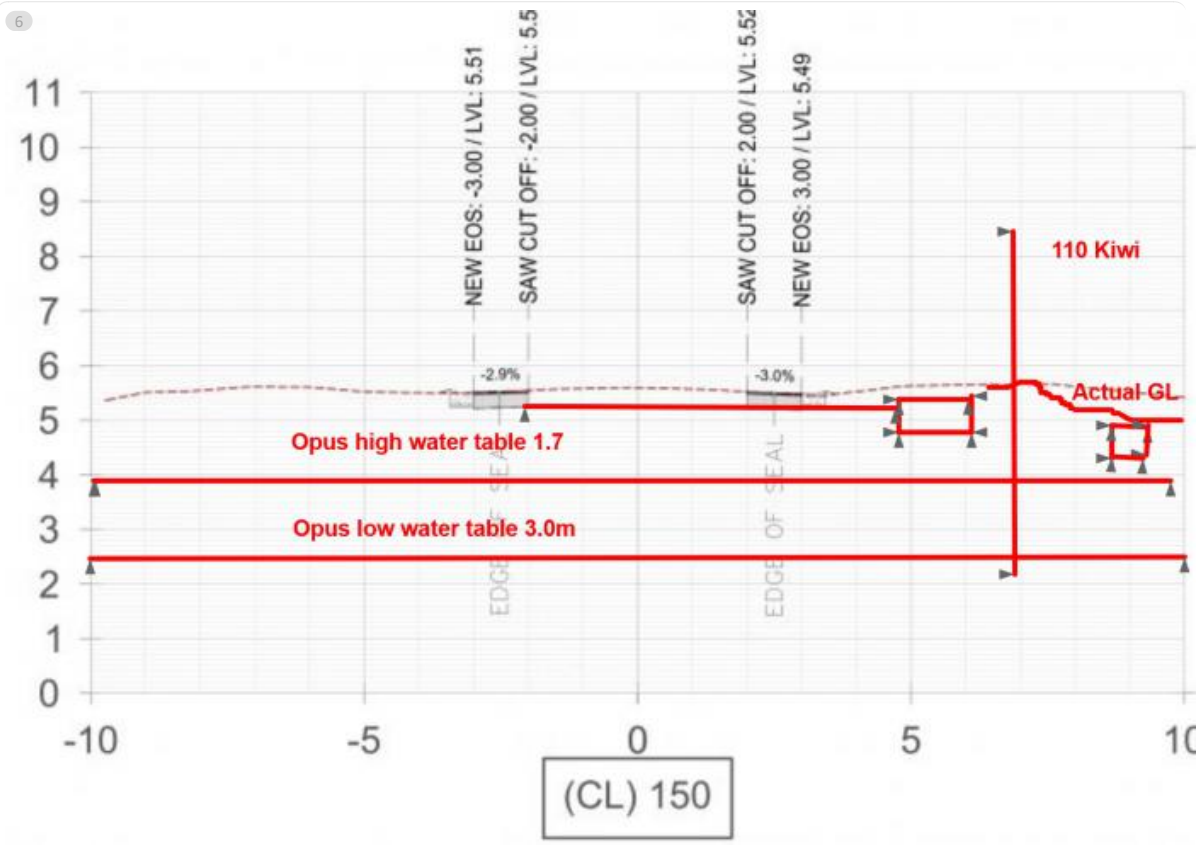
110 Kiwi Rd depression is about 500mm below the verge so it would have only 200mm storage. This is not enough for roof discharge.

BUT the Hale/Gabrielle and subsequent rain on rain is over twice that of the 760mm peak period Opus study covered during 2010 that Opus reported caused 4 months of surface flooding.

Quote from Opus 2012

3) The main driver for sustained high ground water levels is lots of rainfall events, whether small or large, day after day as opposed to single intense rainfall events on their own as shown in Figure 12, the Bore 2 summary chart.

For all bores, the June to September 2010 rainfall events created the largest positive increase in groundwater level. For Bore 2 such groundwater levels were consistently maintained within a 25 cm range for approximately 4 months (highlighted by Circle 1 in Figure 12). The greatest single one-day rainfall during this period was 94mm, which was only a small part of the 760mm total rainfall over the period. The regularity, not intensity, of the rainfall resulted in the large and sustained increase



240 Cross section showing water tables and soakage devices.jpg

Note:

The road soakage pit design does not meet the TCDC soakage pit design requirements of 500mm above winter water table levels.

Neither does 108 or 110 Kiwi Rd meet this criteria.

There are no soakage test results for any of these 3 soakage devices.

This cross section along CL 150 shows it more clearly.

The dotted grey line is NOT correct. The dotted grey line does not follow the actual ground contour of the low lying land along Kiwi Rd starting at 100 Kiwi Rd (and back to Achilles) right down to about 118 Kiwi Rd.

What was viewed on 19 November 2023 is rainwater is marshaled along the nib/channel and into the cesspits as shown. The rainwater almost immediately overwhelmed the soakage device at 108 Kiwi Rd, the rainwater level rises until it banks up back to Achilles and along to the cesspit at Kea St. It took about 10 mins to then overwhelm the Kea St soakage devices. Then water banks up and overflows into the low lying properties along Kiwi Rd.

At the same time Tui Rd is being overwhelmed. Road water begins flooding along 100-113 properties and banks up and starts running down Achilles Rd. This runs to Kiwi and totally overwhelms everything.

Tui Rd verges and properties are semi impervious leaving rainwater ponding with the only release a gradual flow into Achilles, into Kiwi, which keeps the 108 Kiwi Rd and Kea Street soakage devices overwhelmed.

This map is a rough estimate of what appeared to be the catchment area of the surface ponding water that could be feeding Kiwi Rd. It is noted the rains on 19 November 2023 were minor compared to Hale and Gabrielle.

More could be learned by visiting during first flush. LIDAR cannot help here.

It is noted that the water table has dropped steadily since Gabrielle so the surface ponding water will to a large extent be absorbed into the sand in a few hours.

What is clear from Opus is 760mm of rain over 4 months caused breakouts of the water table and took about 4 months to 'out drain the ongoing rains' to lower the water table so surface ponding disappeared.

Cyclones Hale and Gabrielle plus the ongoing rains since measured over twice that of the periods Opus were monitoring the water table.

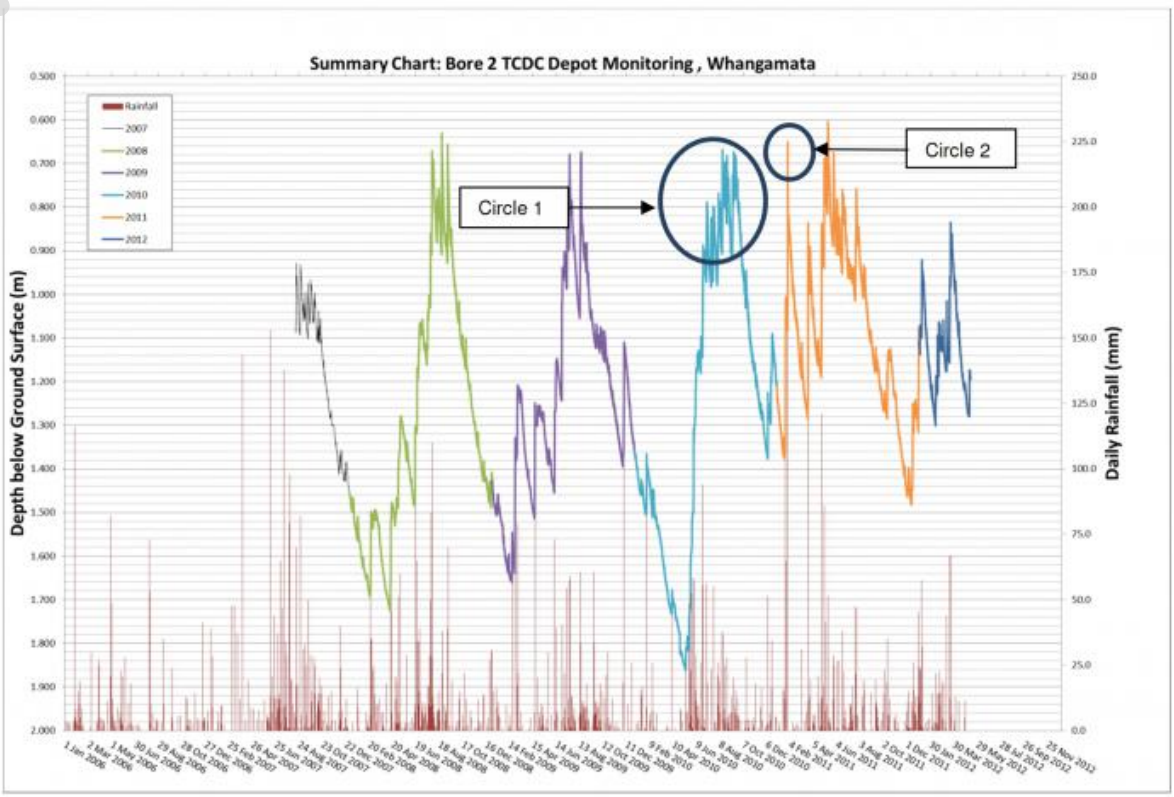


Figure 12: An example of a large increase in groundwater level, sustained over 4 months.

300 Opus charting of rainfall vs water table monitoring 2008-2012.jpg

Opus 2012

The peak groundwater level highlighted by Circle 2 was influenced by two events occurring in a short period of time with measurements approximately 100 mm and 170mm respectively. While the increase in groundwater level is significant, the corresponding time sustained does not compare with the Circle 1 period which contained significantly smaller, but more, daily rainfall events.

Year*	2007	2008	2009	2010	2011	Maximum variation between years.	Average of yearly min/max/variation	Clearance from soakage tank**
Bore 3								
Min depth to GW (m)	-	1.9	2.2	1.8	1.7	0.5	1.9	0.4
Max depth to GW (m)	-	3.6	3.4	3.8	3.0	0.8	3.4	1.9
Year Variation	-	1.7	1.2	2.0	1.3		1.5	

** Clearance is from the bottom of an assumed typical soakage device, 1.5m below ground surface, down to the groundwater level.

1) The maximum effect an individual rain event had on the depth to groundwater at each bore varied. No single rainfall event changed the depth to ground water by more than 0.68m in any bore.

BORE	Maximum rise from an individual event	Daily Rainfall mm	ARI (Based on daily rainfall)	Date
Bore 1	0.68 m	165	<1.58	28 Jan 2011
Bore 2*	0.44 m	175	<1.58	22 Mar 2011
Bore 3	0.50 m	165	<1.58	28 Jan 2011
Bore 4	0.41 m	165	<1.58	28 Jan 2011
Bore 5	0.50 m	165	<1.58	28 Jan 2011

310 Opus groundwater monitoring high and low water table levels.jpg

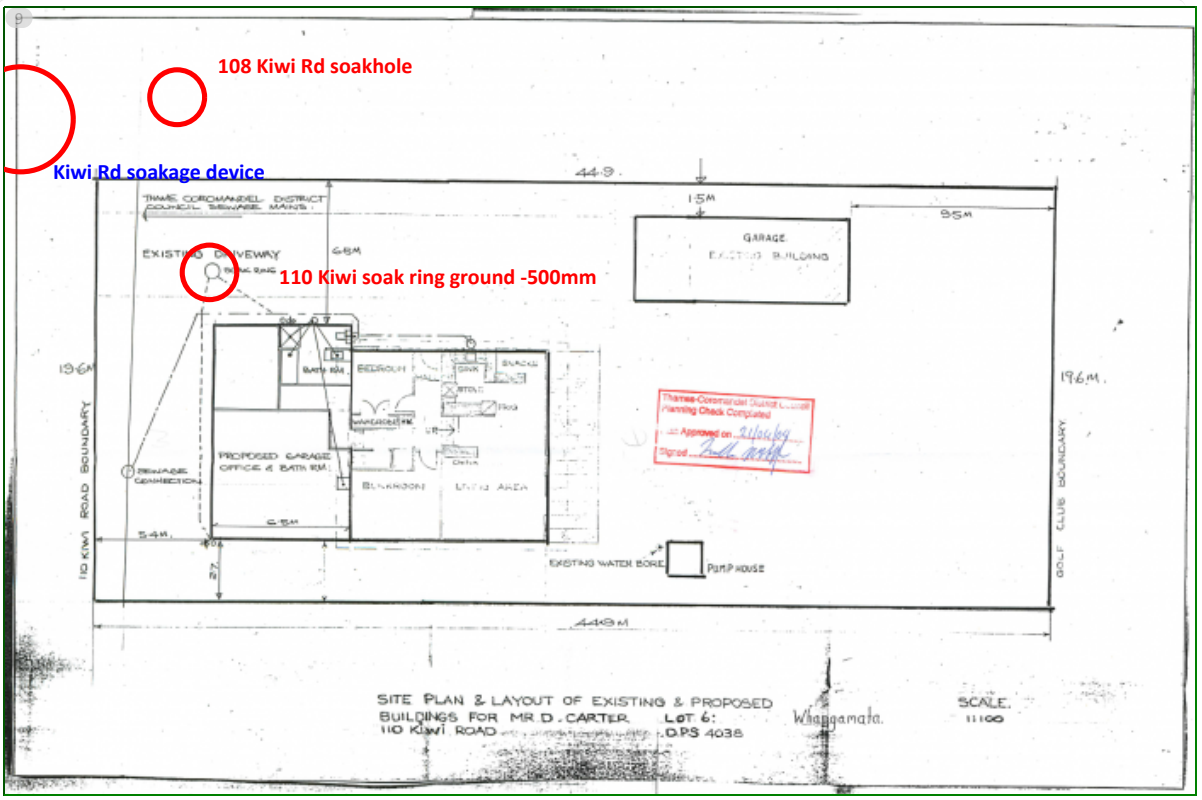
Opus 2012

7 Implications for Whangamata Generally

There is no doubt that much of Whangamata is underlain by sandy soils that can in general provide excellent stormwater soakage. However the findings of this study indicate that winter groundwater levels can rise to a level where the function of a conventional soakage device could be impaired. Careful design and detailing of soakage devices will be required, including measures to keep the device shallow and maximise storage volume.

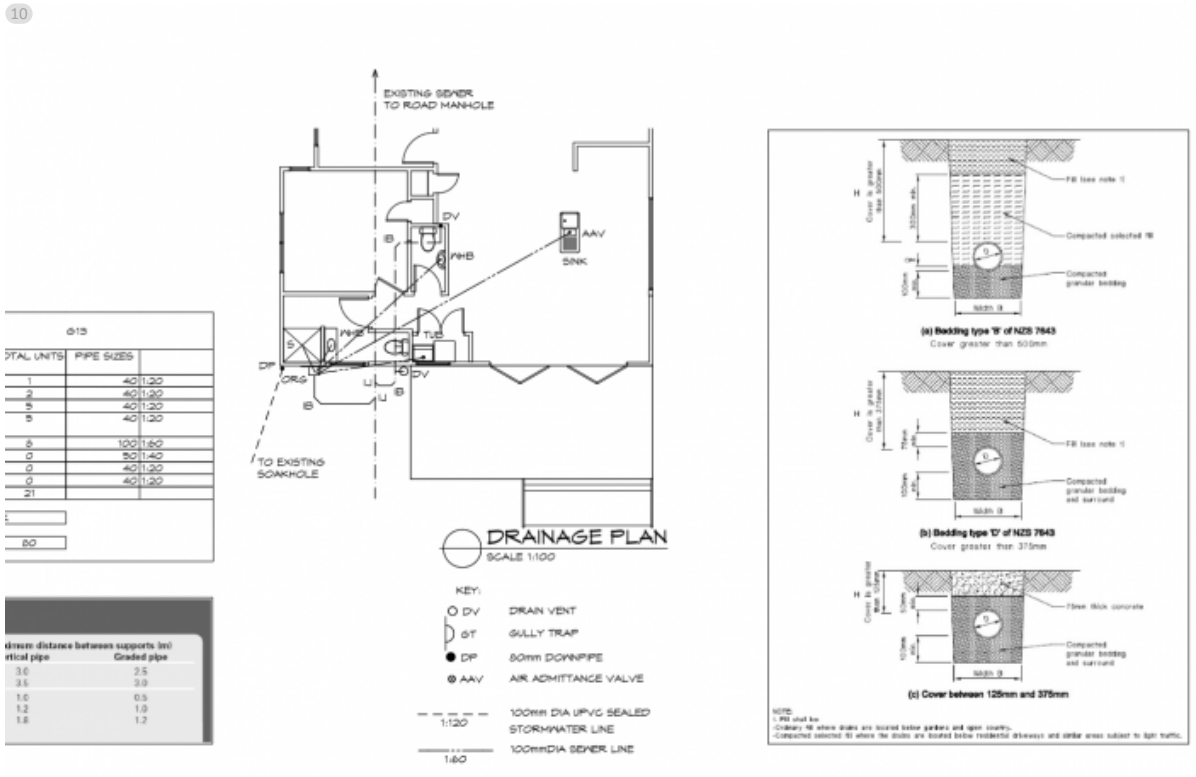
For much of Whangamata domestic soak-holes designed in accordance with standard procedures (e.g NZ Building Code, E1/VM1) are likely to be satisfactory most of the time, however due consideration should be given to the fact that the winter groundwater table is too high for successful soakage in some areas, and will cause reduced performance in many others. We recommend that TCDC commissions a specific study to develop suitable soakhole design standards for general application at single dwelling sites.

With respect to higher-intensity land-uses, such as commercial, industrial and apartments, and for communal/roading applications, we recommend that specific design is undertaken in all cases. This should include consideration of winter GWLs – as a minimum using the observations contained in this report, but preferably involving winter GWL measurements at the site itself.



400 showing soakage device location 110 Kiwi Rd domestic dwelling.png

110 Kiwi Rd plans 2004 showing soak ring in front left of property. This is in the 'low' point of the section.



410 Showing 108 Kiwi Rd drainage plan and soakhole.png

108 Kiwi Rd last drawing on property file shows 'existing' soakhole.

It is understood that the owners undertook maintenance about when Kiwi Rd was being upgraded and installed a larger soakage device toward the front right corner of the property.

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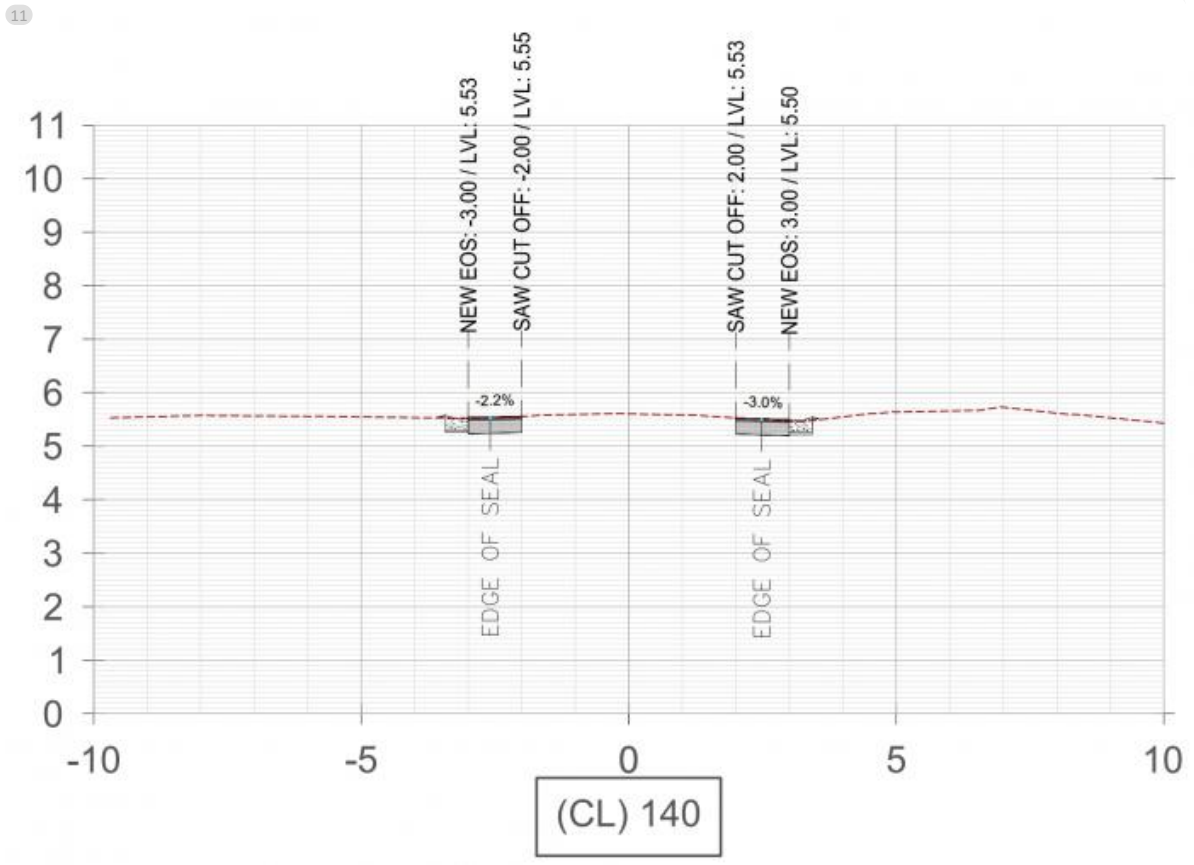


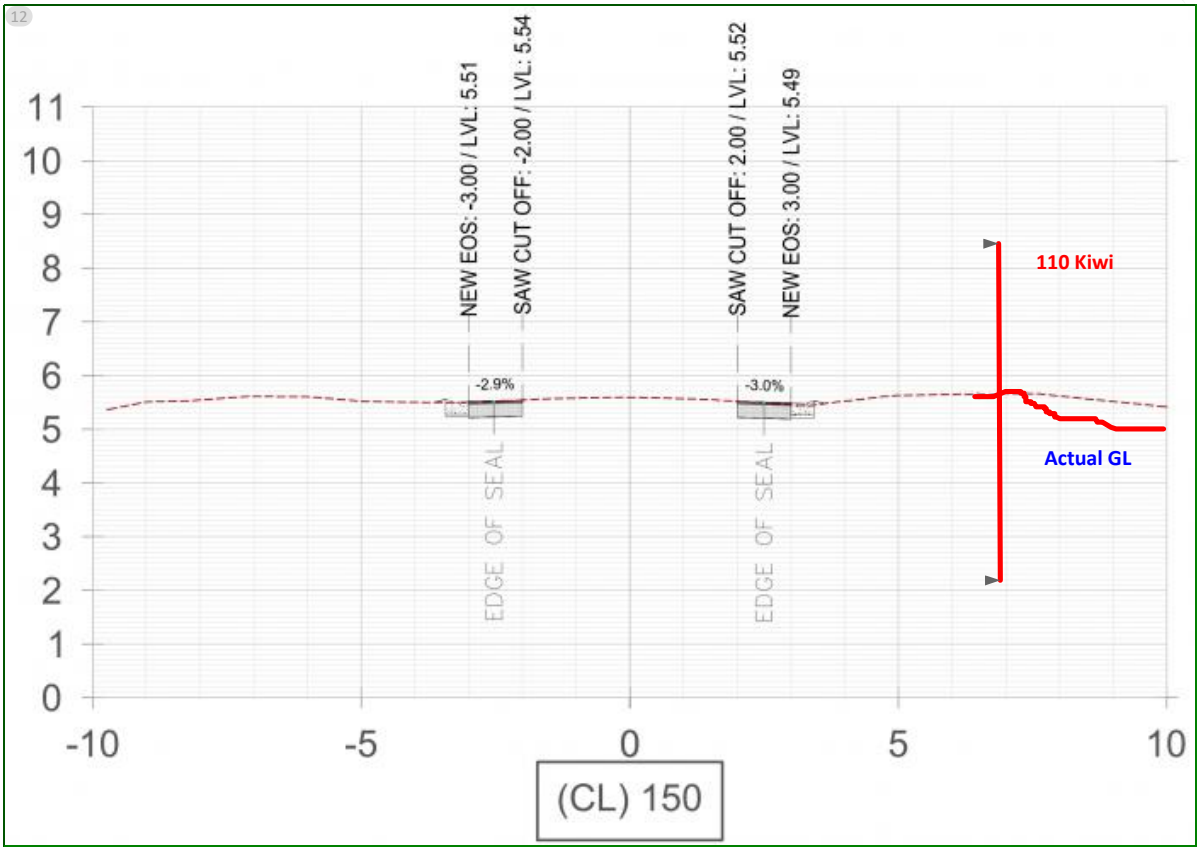
600 CL 140 Kiwi Rd.jpg

Cross section of purported ground line to LVL at CL 140 which is at 108 Kiwi Rd far edge of soakpit.

Note LVL varies 5.53 to 5.55M ie 200mm with the dotted line not falling below the edge of seal and new EOS

Portions of 108 Kiwi Rd property is below the road crown. This cross section is not correct.

12



610 CL 150 Kiwi Rd.jpg

Cross section ground level at CL 150 to right of soakpit and near boundary between 108 and 110 Kiwi Rd.

LVL now 5.51 to 5.54M with low point around 100mm at -10M left and dropping - on both sides.

ie at edge of roadage boundary the top of the soakpit at -200mm below ground - but probably only -100 below the top of the cesspit grate - is still below the road boundary by about 100mm.

The actual ground level in 110 Kiwi Rd is much lower than the cross section shows.

My measurements by eye suggest it is -300mm from the top of the road soakage device

Using BH03 the 2011 water table could be this horizontal line.

The box is the new road soakage device

The storage below that to the water table is minimal to the 2011 peak water table which was only 746mm of rain compared to this period >1.6M

This would mean the water table rose to above the actual GL of 110 Kiwi Rd

BUT the fact it did will be because of lateral absorption from the road soakage device. As the water table rises the soakage device does not work so water breaks out through into the depression.

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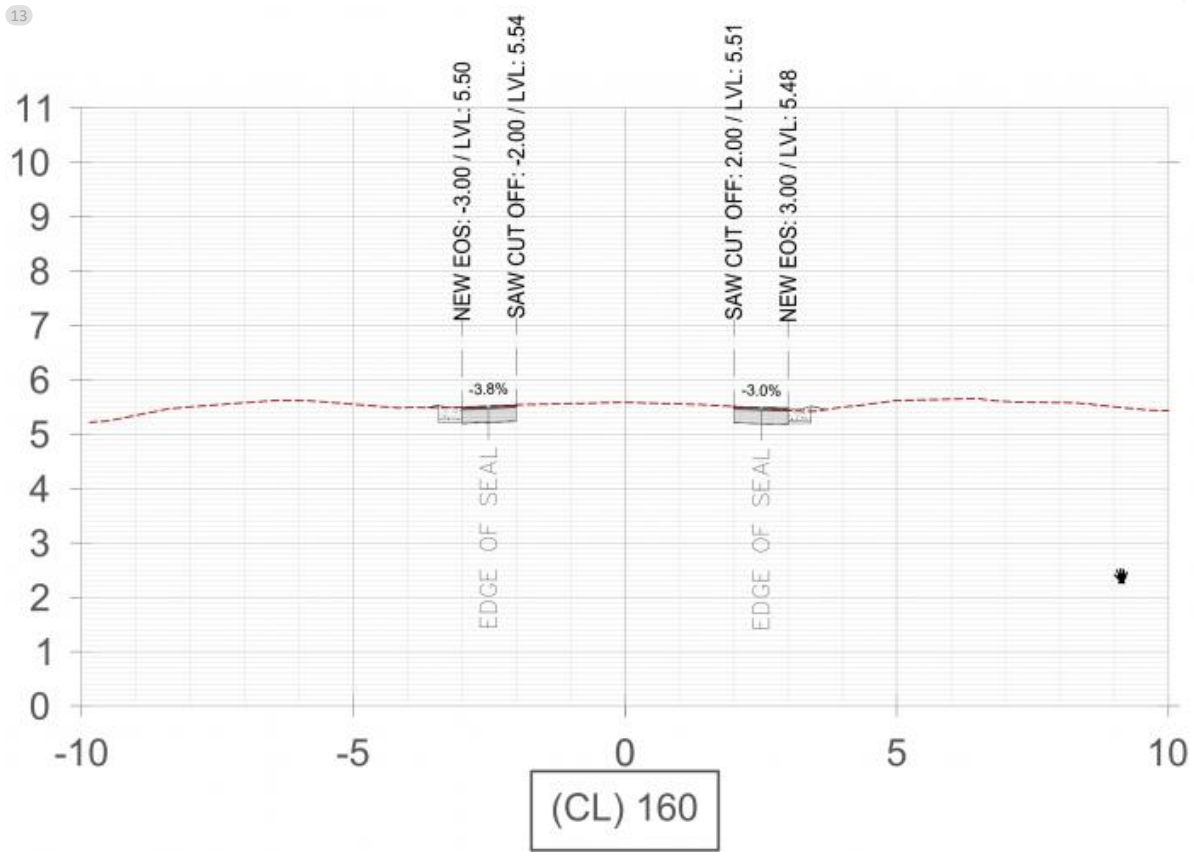


620 CL 160 Kiwi Rd.jpg

Cross section at CL 160 beside driveway into 110 Kiwi Rd.

LVL now 5.48 to 5.54M

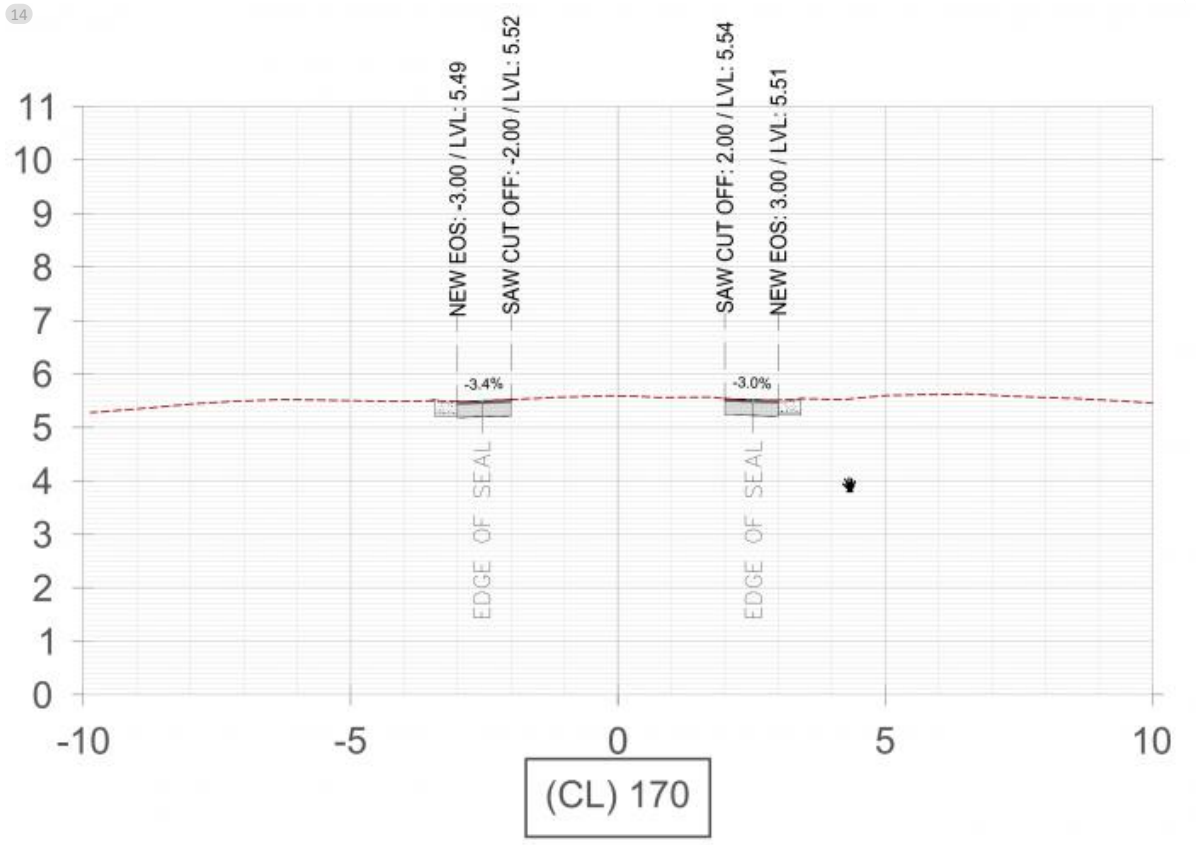
Ground height to left now drops to 5.2M ie now at -100mm below top of soakpits.

Noted 110 Kiwi has a depression basin at about -500 to -600mm below crown of road.

This would mean ground level inside 110 Kiwi Rd is 300-400mm below the top of the soakpit

The road EOS was overloaded which means the soakpit is full (-200mm) so water soakage into the sand is cresting and flowing through the sand verge and draining into the basin 300-400mm below.

This is likely to mean the overall Whangamata water table may not be the influencer of surface water within 110 Kiwi Rd - because the source is the cresting flow coming from the soakpit which is loaded to +400mm above the basin so drains in.



640 CL 170 Kiwi Rd.jpg

Cross section to right of 110 Kiwi Rd driveway shows LVL at 5.49-5.54M

Ground line depicted at LVL 5.3M on left and 5.5M on right.