Report on Infiltration Tests carried out on the Pinehaven Stream Catchment During July 2019

When rainfall falls on the land the resulting runoff depends on catchment characteristics, on land usage, on the degree of urbanisation etc. These factors also influence the amount of infiltration and ground water yield.

Rain storms vary in duration, and the shorter the storm the greater the intensity of the rainfall. This simple observation is very important.

Infiltration is a significant component of hydrologic processes. Soils have varying capacities to infiltrate water. Influencing factors are soil type , degree of saturation and nature of ground cover. Activities that change the soil surface or alter its properties also have an effect.

When the rainfall intensity is less than the infiltration capacity, all of the water reaching the ground can infiltrate into the ground, such that there is no surface run off. But if the rainfall intensity exceeds the infiltration capacity, infiltration will only occur at the infiltration capacity rate, and water in excess of that capacity will be stored in depressions, become surface run off or evaporate. In general, the initial infiltration capacity of a dry soil is high. As rainfall continues, and as the soil becomes saturated , it diminishes to a relatively constant rate.

The tests undertaken were to establish a reasonable estimate for the infiltration rate on the various land and soil types in the Pinehaven Catchment.

TESTS

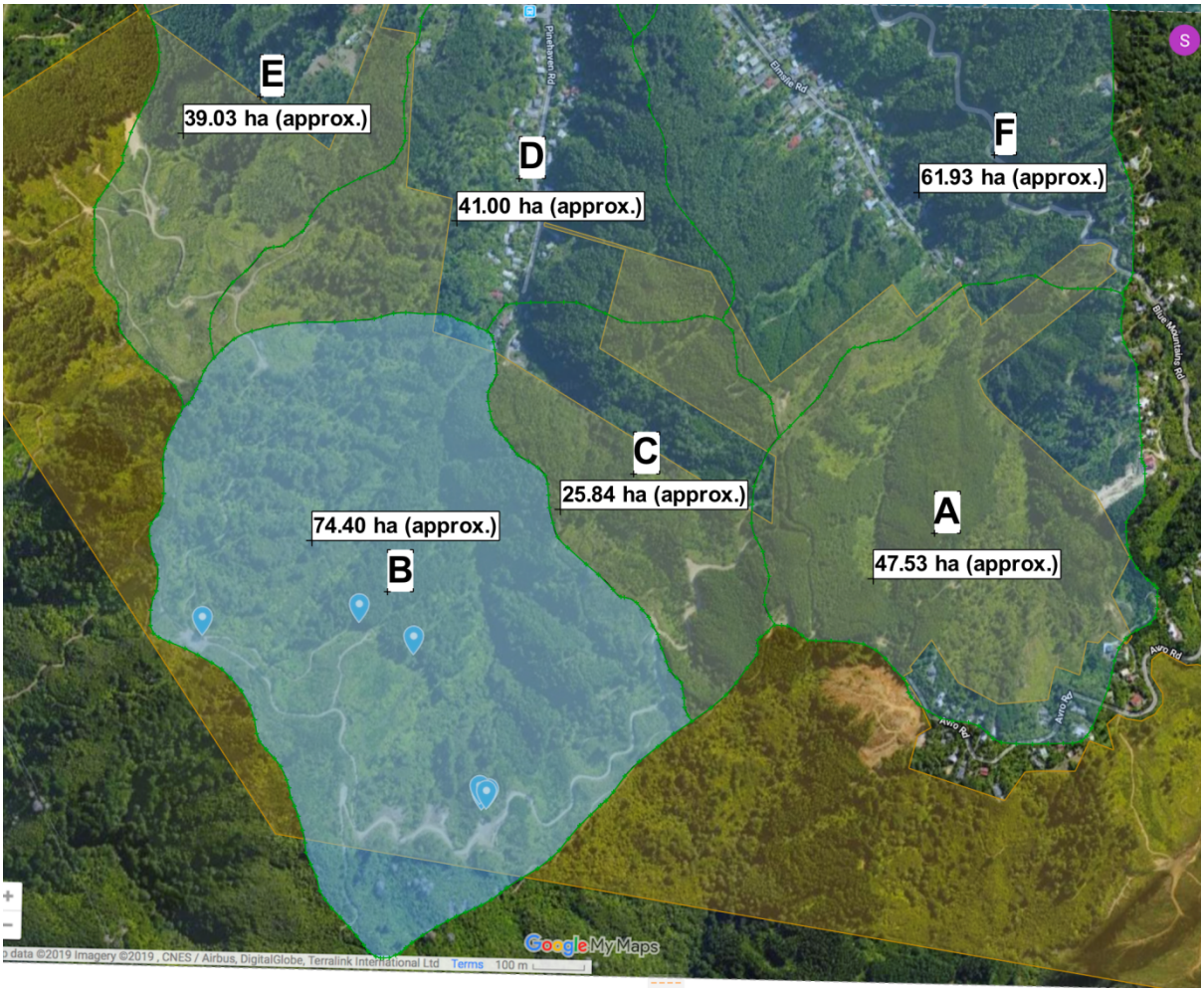
The first tests were carried out using a 100mm diameter uPVC pipe driven into the ground about 70mm and filled with water to a head of 20mm timing how long it took for the water to soak away.

A nominal 100mm Ø PVC pipe x 140mm long was set 70mm into the soil (after clearing the pine needles and leaf litter away). A line had been marked at 70mm from the top inside the pipe (soil level), and another line 20mm above it. 3 or 4 soakings were applied to the soil before timing how long it took for 20mm of water to soak away.

These tests were carried out in several locations in forest, and in regenerating bush. These tests were limited due to the availability of water which had to be carried to the various sites on foot for several kilometres.

The locations of the tests were plotted by GPS app on a cell phone. Then the sites were located on google maps. This map was then overlaid on a map of the catchment showing other features.

This map is reproduced below.



Soil and rock were observed in road cuttings as transport of the water for the tests proceeded.

Photographs showing tests using single ring infiltrometer.

DOUBLE RING INFILTROMETER

Following the first series of tests a double ring infiltrometer (DRI) was used for the remaining tests . The double ring infiltrometer had a 100mm diameter inner ring, and a 300mm diameter outer ring. The purpose of the outer ring is to keep the water in the inner ring infiltrating vertically into the soil. The rings were inserted into the ground to a depth of 130mm. (which is within the suggested range of 50 - 150 mm described by most methods). The outer ring was filled with water to 100mm above the soil and the inner ring was also filled to the same depth. The timer was started and the depth of water in the inner ring noted at regular intervals whilst keeping the water in the outer ring at the same level as the inner ring by the addition of water. When the water in the inner ring infiltrated the soil it was replenished to the 10 cm mark and the water in the outer ring was also replenished, the depth of water was then measured at the next time interval. The test repeated until the infiltration depths remained constant for the same time interval. The locations of the tests were plotted by GPS app on a cell phone.

In all eight tests were performed on different areas of the catchment and on different ground conditions from forest areas to grassed lawns and reserves.

The photographs below show the various test sites at 27 Elmslie Road, Pinehaven and in the Pinehaven Reserve.

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DRI Test 1 Edge of Pines

DRI Test2 Middle of Pines

DRI Test #3 Regenerating Bush

DRI Test # 4 Back Lawn

DRI Test #5 Mid Lawn

27 Elmslie Road

DRI Test #6 Front Lawn

DRI Test #7 Pinehaven Reserve

DRI Test #8 Pinehaven Reserve

RESULTS OF TESTS

The test results were graphed for tests 1 - 3 of the double Ring Infiltrometer (as shown below), and gave base infiltration rates between 512 - 900 mm/hr for the Bush and forest areas at 27 Elmslie Road.

The initial single ring tests in Sub Catchment B gave results of :-

Test 1	36 sec
Test 2	56 sec
Test 3	106 sec
Test 4	435 sec

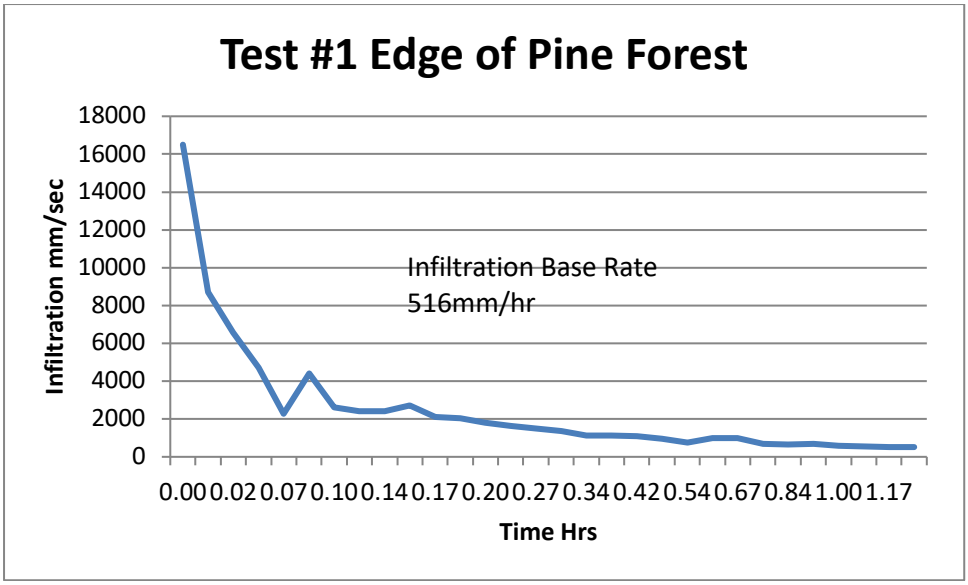
In Regenerating Bush for 20 mm of water to soak into the soil. And

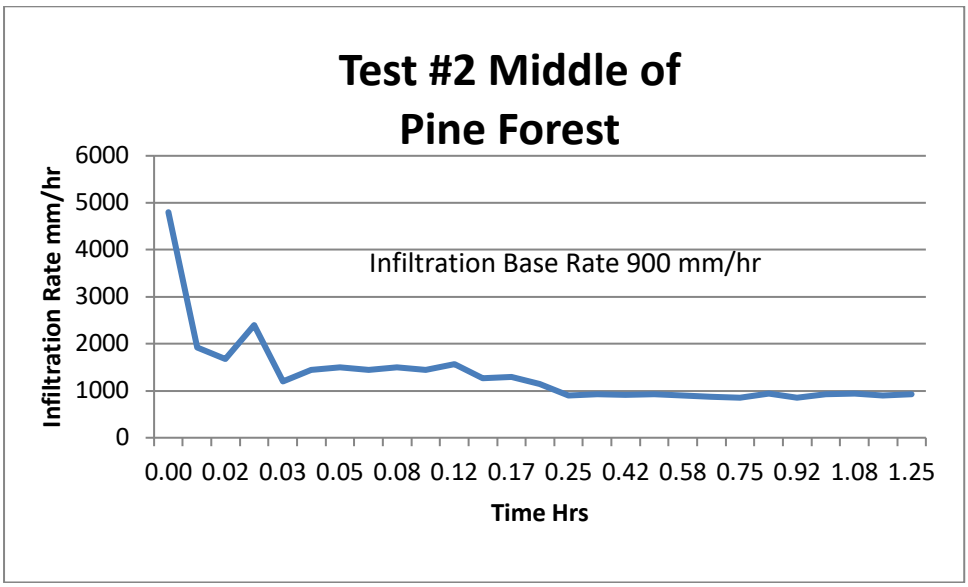
Test 5	60 sec
Test 6	7 sec
Test7	40 sec
Test 8	85 sec

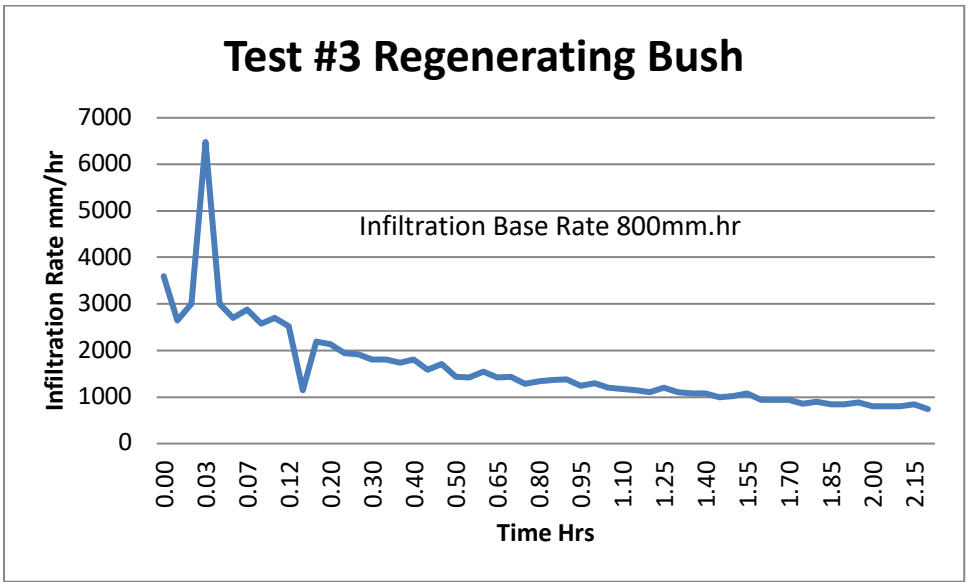
In the forest area for 20 mm water to soak into the soil.

Setting aside the outlier of Test #6 at 7 sec the average time is 119 sec giving an infiltration rate of 603 mm / hr Which is reasonably consistent with the double ring tests.

The tests on the lawn areas and the Pinehaven Reserve gave consistent results of 1 - 2 mm/hr for the infiltration rate on this type of land cover.


Test #1 Edge of Pine Forest
Infiltration mm/sec
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Infiltration Base Rate
516mm/hr
0.00 0.02 0.07 0.10 0.14 0.17 0.20 0.27 0.34 0.42 0.54 0.67 0.84 1.00 1.17
Time Hrs


Test #2 Middle of
Pine Forest
Infiltration Rate mm/hr
6000
5000
4000
3000
2000
1000
0
Infiltration Base Rate 900 mm/hr
0.00 0.02 0.03 0.05 0.08 0.12 0.17 0.25 0.42 0.58 0.75 0.92 1.08 1.25
Time Hrs


Test #3 Regenerating Bush
Infiltration Rate mm/hr
7000
6000
5000
4000
3000
2000
1000
0
Infiltration Base Rate 800mm.hr
0.00 0.03 0.07 0.12 0.20 0.30 0.40 0.50 0.65 0.80 0.95 1.10 1.25 1.40 1.55 1.70 1.85 2.00 2.15
Time Hrs

Conclusion

The results show that the forest and bush areas in the Pinehaven catchment have much higher infiltration rates than what was proposed in the flood model calculations by WRC and as such the peak flood calculations, volumes, and extent of flooding shown on the maps based on the catchment as presented in 2019 are grossly exagerated.

The other conclusion from the tests is that the lawns and grassed reserve areas in the developed urban portion of the catchment along with the impermiable areas of roads, footpaths, driveways, and roofs will provide the majority of the run off due to their negligable infiltration capacity.

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