

EASTERN BEACH STORMWATER CATCHMENT STUDY

A1. CATCHMENT PLAN WITH MAJOR SUB-CATCHMENTS

There are 3 major sub-catchments. These are shown in the attached map with pipe capacity, 1 % AEP and 20% AEP peak flows at the outfall.

PIPE CAPACITY OF THE SYSTEM

An IIsax model has been used to calculate the pipe capacity. It uses Colebrook - White Equation and Manning's Formula. While the former is recognised as being more accurate the latter has been used in this study with roughness coefficient "n" equal to 0.012, giving results close to Manukau City Council standards.

The available data on the existing stormwater network was limited. The pipe gradients were determined from invert depths read from service sheets kept by Manukau City Council and manhole lid levels obtained from digital terrain modelling of aerial photographical data. Survey of a limited number of manhole lids at critical points was carried out to verify these data. Where manholes were close together or had similar characteristics they were all put together in one reach. An average grade for the reach was used.

Pipe gradients derived by this means are not as reliable as those from as built records. However the overall performance of the catchment is nevertheless reasonably modelled and is considered adequate for this study. Flow results for individual pipes or locations will be approximate if the actual pipe gradients are different from those used. It is to be noted that surcharge that may actually occur in manholes will go some way to "smoothing" out any anomalies in input pipe gradients.

TIDAL INFLUENCE AT OUTFALL

The engineering high water for design is taken as R.L 1.75M.

1500mm diameter outfall

The pipe invert at the outfall is at R.L 0.65m. At full pipe capacity, the hydraulic head is at R.L 2.15m which is used to calculate the nominal capacity of the pipe. Since this is higher than the engineering design high water the influence of tide on the nominal capacity becomes insignificant

900mm diameter outfall

The invert of this outfall is at R.L -0.7m. Approximately 50% of the time this outfall is likely to be influenced by the tide level. For outfall to maintain its nominal capacity the downstream end of the hydraulic grade line will have to rise to the level of the tide and remain parallel to the gradient of the pipeline, about 1.0m above the top of the pipe. Since the pipes are laid at about 2.0m below the ground surface this hydraulic grade line will be just below the surface of the ground. Hence the outfall achieves its nominal capacity as calculated using the pipe gradient. The only tidal effect that is of concern is that it will surcharge the outfall pipeline to near point of overflowing.

525 diameter outfall

The invert of this outfall is at R.L 0.33m. The tide levels higher than about R.L 0.85m are likely to influence the outfall. Similar to the explanation as given above the outfall maintains its nominal capacity as calculated using pipe gradient.

RUNOFF COEFFICIENT

The runoff coefficient has not been used in this study. Instead effective rainfall, after subtracting rainfall losses, is used to generate runoff hydrographs. For each sub-catchment the surface, pipe and/or stream, and overland inflow hydrographs are routed and combined to produce the total flow hydrograph. Full hydrographs are produced, not just peak flow rates.

The time and catchment make-up dependent losses are also taken into account.

Losses from paved areas are treated as depression storages which are considered as initial losses and are subtracted from rainfall hyetographs. Values used are 1.0mm for paved areas and 5.0mm for grassed areas. The infiltration losses are based on the general equation developed by Horton in the 1930s:

$$f = f_c + (f_o - f_c) \times e^{-kt}$$

where f is infiltration capacity

f_o and f_c are initial and final rates on the infiltration curve k

is a shape factor equal to $2h^{-1}$

t is the time from the start of rainfall

The $f_o = 100.0\text{mm/hr}$ and $f_c = 4.5\text{mm/hr}$. are used as an average representative value of the catchment to get an average representation of the infiltration curve of the catchment.

The antecedent moisture conditions (AMC) fix the point on the above equation at which calculation commences. These are taken as dry that is, starting at 87.0mm/hr for summer and 4.5mm/hr as saturated for winter.

In an investigation carried out for Manukau City Council by Fraser Thomas (Draft Report 1995) it was found that design permeability of $7.7 \times 10^{-5}\text{m/s}$ may be considered appropriate and the soakage capacity is relatively low. For example a soak hole 1.5m deep and 1.5m in diameter has a soakage capacity of about 0.8 litres per second. This low soakage capacity is primarily a function of the high ground water level and the consequent

small head differentials. In the lower areas the groundwater rises to within approximately 0.5m of the ground surface during 'the wet winter conditions. The soil type with initial (f_0) and final (f_c) and the antecedent moisture conditions as selected above to represent the overall infiltration rate of the catchment is consistent with this investigation.