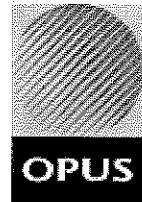


Appendix 5 – Stormwater Management Review
(Opus International Consultants)

27 April 2010

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3AG303.00

Pakinui Structure Plan Stormwater Management Review

The purpose of this report is to review the Catchment Analysis and Stormwater Management Report prepared by Applied Geographics Ltd, December 2000 (Applied Geographics Report) and review the relevance of the catchment management approach in this report against the Kumeu/Kaipara Catchment Management Plan (CMP).

Boffa Miskell has commissioned this report on behalf of the private plan change applicants.

Background

The Pakinui Structure Plan (structure plan) area is an area of land around 180 hectares that lies within the upper catchment of the Kumeu/Kaipara River system. The structure plan area lies within the Waitakere City Council boundary with the northern boundary of the structure plan area being the Rodney District Council territorial boundary. Current land use of the structure plan area is rural and lifestyle including intensive poultry farming, horticulture and pasture with varying densities of development from small land holdings of 3,000m² up to 30 hectares in area.

The Kumeu/Kaipara River catchment (two names describing the upper and lower reaches of the same river) covers a total area of approximately 28,000 hectares (280km²), extending from the upstream reaches of the Kumeu River in the Waitakere Ranges in the south to the Kaipara Harbour at Helensville in the north. It is one of the larger catchments within the Auckland Region. The Kumeu/Kaipara River Catchment Management Plan reviews stormwater values and issues, with reference to Resource Management Act (RMA), local and regional policies and planning documents, to assist in the identification of current stormwater-related problems and flood hazard areas and then proposes methods/options for addressing these issues. The latest version of this report that is referenced in this letter is Final Release 3, dated 8 March 2010.

Pakinui Catchment Analysis and Stormwater Management

The Pakinui Structure Plan – Catchment Analysis and Stormwater Management Report was prepared by Applied Geographics in December 2000. This report includes an assessment of the structure plan area hydrology and makes recommendations for the management of stormwater generated by additional development in the catchment. The Applied Geographics report was then summarised in a structure plan application document by Cato Bolam dated November 2002 which has also been referenced in this letter.

The hydraulic analysis that has been made in the Applied Geographics report is based on the Auckland Regional Council method TP108 with analysis undertaken for the 50%, 10%

and 1% AEP events. A hydrologic model was used to model future scenarios taking into account various stormwater mitigation methods. The overall objective was to ensure hydrological neutrality was maintained within the catchment; that is, there should be no significant change to the timing of runoff or the magnitude of flood peak and flood volume as a result of development.

The primary method of mitigation presented in the report is planting of bush. The report recommends that in order to maintain hydrologic neutrality in the structure plan area the following procedures and practices should be adopted:

- All channels are to be left in their existing state,
- For every 1m² of impervious surface created there must be 5.5m² of compensatory (i.e. new) bush planting,
- All runoff must discharge to the channel as dispersed flows. This can be achieved by using either natural flow paths or by engineered flow spreaders, and
- A pond of 3,271m³ volume and 0.25m average depth must be provided at the catchment outlets to provide water quality treatment.

Kumeu/Kaipara River Catchment Management Plan

The structure plan area is at the top of the Kumeu/Kaipara Catchment. Two headwater streams, the Pakanui and Copedo, both originate within the structure plan area. These streams discharge into the Kumeu River north of Kumeu. The lower Kumeu River has a low gradient and broad floodplain, and frequent flooding occurs.

A hydrological and hydraulic model was developed for the Kumeu/Kaipara Catchment Management Plan and used to assess the impact of landuse changes in the catchment as well as the viability of a range of flood management options. Several growth scenarios were modelled and the results generally indicate that increasing development of the catchment upstream of Kumeu does have adverse impacts on water levels downstream. The CMP states that *"it is appropriate that new development upstream of the SH16 bridge at Kumeu should provide for flow attenuation to maintain the 2 year, 10 year and 100 year ARI storm events at their pre-development (i.e. current) levels."* (Kumeu/Kaipara CMP)

The Pakinui Structure Plan is discussed in the CMP: *"Existing flooding problems in the Kumeu River catchment are well known and documented. For this reason it is critical that any new development within the Pakanui structure plan area does not exacerbate these existing problems."* (Kumeu/Kaipara CMP).

In summary the Kumeu/Kaipara catchment has significant existing flooding issues and additional development, if uncontrolled, will result in an increase of impermeable surfaces, and therefore increased peak stormwater runoff.

Please note that Opus has not been involved in the latest (March 2010) revision of the Kumeu/Kaipara Catchment Management Plan. While the latest version appears substantially the same as the earlier version prepared by Opus, it has not been possible within the constraints of this current commission to conduct a comprehensive review of the comparison between the versions.

Kumeu/Kaipara Catchment Management Plan Recommendation vs Pakanui Structure Plan

The following table sets out the relevant recommendations from the Kumeu/Kaipara Catchment Management Plan the extent to which the Pakinui Structure Plan Stormwater Study will meet these recommendations and objectives:

Kumeu/Kaipara CMP Recommendation	Pakanui Stormwater Management
<p><i>7. New subdivision and development in the upper catchment, upstream of the SH16 bridge at Kumeu, the upper Awaroa River, and the upper Waimauku Stream should provide hydraulic neutrality via attenuation of 2, 10 and 100 year peak flows to pre-development levels to avoid exacerbating downstream flood levels.</i></p>	<p>The Applied Geographics report included the development of a hydrologic model and this model was used to determine mitigation measures to ensure the 2 and 10 and 100 year peak flows are mitigated to predevelopment levels.</p>
<p><i>9. Additionally, stormwater from new development and rural land use should be managed to minimise flow increases that might cause stream erosion. This can be achieved by providing extended detention in accordance with ARC TP10 guidelines. However due to low stream gradients in the lower reaches of the main Kumeu/Kaipara River and the hydraulic regime, there is some justification for reducing the extended detention volume below guideline values for development downstream of the SH16 bridge at Kumeu (for discharges to the main stream – most tributaries will still require the full extended detention volume).</i></p>	<p>The structure plan area being in the upper reaches of the Kumeu River will require management to minimise stream erosion. The Applied Geographics report does not specifically model the 34.5mm rainfall event. To confirm the overall objective of hydraulic neutrality, this scenario may also need to be modelled to ensure the mitigation methods achieve this requirement. The re-vegetation of bush which is proposed in the structure plan area can provide a reduction in total runoff volume and minimise extended detention requirements.</p>
<p><i>10. Stormwater discharge outlets should be designed so that stream erosion is minimised. Specific outlet design is to be encouraged. Drilled outlets, stilling/bubble up manholes and/or large pipes may be required to reduce velocities. The performance standard is for outlets to discharge in line with the direction of flow, outside the stream channel and at low velocity.</i></p> <p><i>13. Erosion protection shall be provided for piped discharge of stormwater into catchment watercourses.</i></p>	<p>The Applied Geographics report proposes runoff from impervious areas dispersed through vegetation areas and the use of level spreaders and vegetated filter strips where appropriate. This should satisfy this recommendation.</p>
<p><i>11. No piping of permanent watercourses (except access culverts) should be allowed.</i></p>	<p>The structure plan states that channels and valleys are left in their existing state.</p>
<p><i>14. Farmers should be encouraged to retire riparian strips along permanent watercourses. No watercourses should be used for stock watering.</i></p>	<p>The structure plan includes a 10m riparian margin to the Pakanui and Copedo Streams and re vegetation of these riparian margins where required.</p>

Kumeu/Kaipara CMP Recommendation	Pakanui Stormwater Management
<p>15. <i>That streams and tributaries in the Kumeu-Kaipara River catchment be targeted for the ultimate creation of vegetated riparian zones, with the following widths:</i></p> <ul style="list-style-type: none"> • <i>20m wide along each side of the Kumeu and Kaipara Rivers downstream of Taupaki,</i> • <i>15m along principal, named tributaries</i> • <i>5-10m along each side of any other intermittent tributaries.</i> 	<p>The riparian planting plans within the CMP include the Pakanui Stream as a first order tributary and therefore requiring a 15m riparian zone.</p> <p>The Structure Plan includes a 10m riparian margin to the Pakanui and Copedo Streams and re vegetation of these riparian margins where required. This riparian margin will need to be increased to 15m in order to follow recommendations from the CMP.</p>
<p>19. <i>New buildings (residential and commercial) should be located outside the 100-year ARI flood plain.</i></p>	<p>While the Applied Geographics report does not define the 100 year flood plain, the structure plan area is at the top of the Kumeu/Kaipara catchment and includes headwater streams. The CMP has not modelled the Pakanui Stream and identifies this area will not have any significant flood plains. All development in the structure plan area is proposed away from riparian margins and all channels and valleys are to be left in their existing state.</p>
<p>24. <i>New developments shall provide stormwater treatment in accordance with the requirements of the Proposed Auckland Regional Plan: Air, Land and Water (ARC 2001a) and its variations. In general new developments greater than 1000m² shall provide stormwater treatment of at least 75% sediment removal on an annual basis.</i></p>	<p>The Applied Geographics report states water quality will be enhanced by the filtration effects of vegetation and through a specifically designed pond in the largest catchment. Effectiveness of treatment through bush and riparian filtration is difficult to quantify. There are two smaller catchments that do not discharge to the proposed pond, although with the large lot residential development proposal stormwater contamination will not be a major issue and is likely to be managed effectively with the filtration methods proposed. The CMP includes complementary ways of providing water quality mitigation of Low Impact Design as per ARC TP124 and the “toolbox” approach in accordance with the Code of Practice – Management of Stormwater in Countryside Living Zones (2005). Both of these methods have been incorporated into the structure plan proposal. (see additional discussion on mitigation methods below).</p> <p>The Applied Geographics report states the proposed stormwater quality pond has been designed in accordance with TP10 which will ensure compliance with the Air, Land</p>

Kumeu/Kaipara CMP Recommendation	Pakanui Stormwater Management
	and Water Plan. We do note that the proposed pond is illustrated on the structure plan map as an on-line pond. ARC does discourage the construction of on-line ponds on a perennial watercourse and prefer ponds constructed off-line of the main stream channel.
<p>26. <i>Wherever practicable new development should utilise low impact design principles. ARC's TP124, Low Impact Design Manual for the Auckland Region provides guidelines for these design principles.</i></p>	<p>The Applied Geographics report states that the stormwater management requirements of hydraulic neutrality are formulated on the principles outlined in TP124. This is also evident in the proposed development plan including existing bush areas remaining largely undisturbed, channels and valleys left in their existing state, and all development located away from riparian margins.</p>
<p>28. <i>Stormwater management for rural, countryside living and low density development should be provided onsite and provide hydraulic neutrality for 2 and 10 year ARI flows, or as shown in figure 9-3. The Countryside Living Zones Toolbox of Methods is considered an acceptable methodology for rural residential development.</i></p>	<p>In Figure 9-3 of the CMP the structure plan area requirement is for 2, 10 & 100 year ARI attenuation.</p> <p>The Applied Geographics report included the development of a hydrologic model and this model was used to determine mitigation measures to ensure the 2 and 10 and 100 year peak flows are mitigated to predevelopment levels. The mitigation method proposed in the structure plan is bush planting based on the Countryside and Living toolbox. An additional discussion regarding recent changes to the toolbox document is below.</p>
<p>33. <i>Property accessways must not cause blockage to flow.</i></p>	<p>The Structure Plan illustrates several driveway crossings over existing streams. The design of these crossings must ensure this criteria is met.</p>

Stormwater Mitigation Method

To ensure that new development will maintain hydraulic neutrality with respect to pre- and post-development flows the Applied Geographics report has used the method of bush planting. On properties that have significant areas of pasture, the establishment of native bush is able to offset increases in impermeable areas.

The CMP recommends low impact design principles for new developments and the Countryside and Foothills Stormwater Management Code of Practice, as an acceptable methodology to achieve hydraulic neutrality. The Countryside and Foothills Stormwater Management Code of Practice was initially prepared as a document to be applied in Waitakere City and Rodney District. This Code of Practice has recently been updated by the ARC and is now titled "Countryside Living Guide Toolbox" dated April 2010.

The Applied Geographics report modelled the effect of bush planting on the post-development flows and came to the conclusion that to maintain hydraulic neutrality, for every 5.5m² of compensatory (new) bush planting is required for every 1m² of new impervious surface.

The Pakinui Structure Plan, Volume One application prepared by Cato Bolam (November 2002) referenced the Countryside and Foothills Stormwater Management Code of Practice (April 2002) and presented in their report that 2,000m² of compensatory bush planting will be provided per lot. This area is based on the Countryside and Foothills Stormwater Management Code of Practice (April 2002) that requires 2,000m² of bush planting per lot for a maximum imperviousness of 600m² per lot. Equated back to a ratio to compare with the Applied Geographics recommendation this is a ratio of 3.3m² of bush planting for every 1m² of impervious surface.

The latest Countryside Living Guide Toolbox dated April 2010 has reviewed the bush planting requirements and there is an increase in the amount of bush planting to offset impermeable area to 3,500m² per lot for a maximum imperviousness of 600m² or a ratio of 5.83m² of bush planting per 1m² of impervious surface¹.

In summary the Applied Geographics report recommends similar areas of bush planting to the latest Countryside and Living Guide Toolbox. The current structure plan application however appears to be based on the lower 2,000m² per lot in which case the increase is substantial – in the order of 75%. The applicability of the new toolbox is also uncertain as it does not appear to have been formally adopted yet, but is clearly an indication of future trends.

Summary

The stormwater management approach recommended by the Pakinui Structure Plan – Catchment Analysis and Stormwater Management (Applied Geographics 2000) is consistent with the Kumeu/Kaipara River Catchment Management Plan in that the proposal is to:

- provide minimal disturbance of the catchment during development;
- ensure new development will maintain hydraulic neutrality with respect to pre-development and post-development flows;
- Channels and valleys are to be left in their existing state; and
- Water quality will be enhanced by filtration effects of vegetation and through a specifically designed pond in the largest catchment.

Further stormwater analysis may be required to show the approach achieves the extended detention requirements of the ARC Air Land and Water Plan, and more details of the proposed stormwater pond may be required, potentially including off-line construction.

The riparian margin for the Pakaunui Stream will need to be 15m each side of the stream in order to comply with recommendations from the CMP.

The primary means of mitigating stormwater in order to achieve the outcomes in the structure plan stormwater proposal will be by re vegetation and additional plantings. This is acceptable in principle. The actual level of planting that is required in order to comply

¹ Note that the ratio of bush planting to impervious area is not constant and the 3,500m² area of bush planting is for the maximum impermeable area of 600m² per lot.

with both Waitakere City Council and Auckland Regional Council requirements is uncertain due to a recent change in the published document Countryside and Living Guide Toolbox requiring greater areas of bush planting compared with the previous edition of the document (i.e. 6% increase on Applied Geographics report and 75% increase on the structure plan report). We recommend that the implications of the increase in bush areas on subdivisional layout should be assessed.

Thank you for the opportunity to carry out this review of stormwater management for the Pakinui Structure Plan area. If there is any further assistance you require or any further clarification regarding the details of this letter please don't hesitate to contact me on 355 9269.

Yours faithfully

A handwritten signature in black ink, appearing to read 'A. Raea'.

Annise Raea
Senior Environmental Engineer