Appendix 9

URS Peer Review Report

FINAL PEER REVIEW

Integrated Catchment Management Plan

South West Christchurch

Prepared for

Christchurch City Council

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Christchurch

5 February 2008

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Date: 5 February 2008
Reference: R002.doc
Status: Final

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Section 1 Introduction

1.1 Purpose

URS New Zealand Limited (URS) was commissioned by Christchurch City Council (CCC) to undertake a peer review of the Integrated Catchment Management Plan (ICMP) for South West Christchurch (December 2007) and the associated Water Quantity and Water Quality Assessment.

The ICMP and supporting documents will form the technical basis for a catchment wide discharge consent application. CCC has invested considerable effort into these studies and is seeking assurance that the work undertaken is "fit for purpose". The review assessed the adequacy of the technical information provided in the ICMP and supporting Water Quantity and Water Quality Assessments.

The review also comments on the planning response to the technical information collated. CCC and Environment Canterbury (ECan) jointly issued the "Planning and Consents Protocol for Surface Water Management" in March 2006. The Protocol outlines an agreed process for development of ICMP's and associated discharge consent applications. The South-West Christchurch ICMP and associated discharge consent application is identified as the pilot for implementation of these processes.

1.2 Peer Review Objectives

The brief for the review identified key areas as follows:

1. *Assess the adequacy of the technical investigations in terms of water quantity and quality.*
2. *Assess the appropriateness of the planning response to the information generated by the technical investigations. In particular assess the appropriateness of the waterway classifications, the objectives and whether the plans represent the "best practice" in terms of urban surface water management.*
3. *Assess the draft plans for the implementation and make any recommendations on implementations strategies which may be incorporated into the final ICMP.*
4. *Assess the adequacy of the documentation.*

1.3 Review Structure

The review is presented as follows:

- Section 2.0 Technical Review. The review provides a generic discussion on the methodologies used to generate water quality and quantity information and itemises more detailed technical comments.
- Section 3.0 Planning Approach. This section discusses the interpretation of the technical data - and how recommendations have been translated into objectives and planning rules.
- Section 4.0 Implementation Strategy. Comment is made on the next steps in process i.e. how the ICMP and associated discharge consent application will be implemented in practise.

Section 2 Technical Studies

2.1 Overview

Comments are divided in to “general” and “specific”. The former provides a general comment on whether the overall methodology and approach is in line with best practice. Under the specific section queries/notes are provided in relation to some of the detail within the section.

The review was limited to analysis outputs presented in the documents and did not include review of the background calculations and models.

2.2 Water Quantity

2.2.1 Surface water

General

Comments relate to the Water Quantity Assessment Report, in particular Appendix 3 and 4 of this report which were prepared by the National Institute of Water & Atmospheric Research Ltd (NIWA). Appendix 3 includes the Hydraulic Model Calibration report and Appendix 4 includes the Hydraulic Model Study report. The outcome of our review is detailed below.

The original hydraulic model was supplied to NIWA by CCC. The model has evolved through updates by a number of modellers since pre-1990. The model provided to NIWA for consideration was that associated with *Williams, K. 2005. Heathcote River and Henderson’s Basin hydraulic and hydrological modelling. Technical report on modelling and model results. Christchurch City Council Report, August 2005.* The DHI software package, Mike 11 was used in previous modelling of the watercourse and its use was continued into this work. Mike 11 is considered a suitable package for this type of exercise.

Notwithstanding the specific comments made under ‘specifics’, in general the approach taken to the calibration and validation of the model is considered appropriate as is the subsequent use of the model in determining the required project outcomes.

Regarding the suitability of the model (Appendix 3), the number of events for which data exists provides a reasonably good opportunity to both calibrate and validate the model. At the outset NIWA indicated that the calibration of the model would benefit from a number of revisions, each of these were considered appropriate and were considered to bring greater accuracy to the modelling work.

Within the modelling study itself (Appendix 4) the approach taken is again considered in line with general good practise. The use of the Flood Frequency Analysis at Ferniehurst Street gauge to determine the peak flows within the watercourse, over the use of peak flows estimated by standard rainfall / runoff methodology, is considered reasonable given the disparity of results between the two methods. The scenarios used to represent development to date are also supported, as are the scenarios considered.

The presentation of the results is appropriate, however, the accuracy of the water levels provided in the appendix to the modelling study (3 decimal places) cannot be supported by methodology utilised.

We note that freeboard requirements are detailed in the Waterway and Wetlands Guidelines and will be covered in the Heathcote Floodplain Strategy document. We recommend that freeboard allowances be noted within the report.

Section 2 Technical Studies

Specific

Document Reference/Topic	Methodology/Approach	Comments	Recommendations
Water Quantity Assessment – Report No. 4 (Appendix 3)	Amendments made to model by NIWA prior to calibration / verification (s4.3)	Amendments undertaken are considered appropriate. Consideration should be given to the point below.	-
	Revision of Cashmere Stream Floodplain (s4.3.2)	Weir crest levels which link revised channels in Cashmere Stream Floodplain are considered critical in the assessment of the area. There is concern over using LIDAR data for part of this floodplain as the original surveys vertical resolution is not stated.	Confirmation of vertical resolution of survey required. Independent verification of any key crest levels to verify accuracy of model data based on LIDAR.
	Heathcote River Calibration (s5.2.2)	Regarding the difference in peak flow observed at Buxton Terrace during the validation event it is agreed that the hydrology requires revisiting to resolve the deficiency.	Despite the acknowledged deficiency in the hydrology the results for the area under consideration in this work are considered to be fit for purpose. As recommended by NIWA this issue should be considered in the future.
	Cashmere Stream / Henderson's Basin Calibration (s5.3.2)	Mannings 'n' values chosen to represent Reach 3 and Reach 4 are very high. High 'n' values will result in higher water levels upstream of the reach and lower water levels downstream. Specifying a lower 'n' value would have the opposite effect. A sensitivity analysis has be carried out but it is not stated what decision has been made as a result of	In the reporting of flood level we would recommend plotting two water level series for each scenario (high & low 'n' value) and selecting the highest water level at each data point, as a conservative estimate for the entire watercourse. This will ensure appropriate water levels are used along the

		the analysis.	watercourse in future decision making. The lower values would represent the reach after maintenance has been carried out.
Water Quantity Assessment – Report No. 4 (Appendix 4)	Flood Frequency Analysis (FFA) (s4.7)	The work has acknowledged that 13 years of additional data exists at both gauging sites but this has not been used as it is considered to be 'benign' in terms of occurrences of flood events.	The additional data represents an increase in record length of 93% for Buxton Terrace and 46% at Ferniehurst Street. Such data should not be omitted, unless justified by statistical analysis, and as such this data should be included in a revised FFA. This is important as the FFA relationship is heavily relied upon in the report.
	Sensitivity (s8)	No consideration of the sensitivity of hydraulic structure within, and immediately downstream of, the proposed development area has been given.	It would be prudent to investigate at a high level whether blockage of any structures local to the proposed development area would be likely to impact on the predicted water levels.

Section 2 Technical Studies

2.2.2 Groundwater

General

The effects of land use change on rainfall recharge of the aquifer system within the study area are presented in Report No 4 (December 2007). The report contains two technical documents that address the effects of stormwater discharge on groundwater quantity (PDP Stage 2 Report, September 2004; PDP, February 2007).

Report No 4 provides a summary of the information provided in the technical reports. However, the report does contain discussion on the development of an approach for determining objectives (pp 33). This section contains a reference to groundwater recharge zones 1 and 2 as defined by the NRRP. However, the proposed Variation 6 of Chapter 4 has redefined the recharge boundaries. It would be prudent to update this section to reference the proposed variation, particularly the reference to zone 2 providing protection to the groundwater system.

The earlier PDP Stage 2 report (September 2004) details field investigations that were undertaken to determine groundwater – springs interaction, groundwater levels, and infiltration testing within the ICMP study area. This report provides the basis for the work undertaken in the later report (February 2007). The field work that has been undertaken by PDP, and reported in PDP (September 2004), is not addressed in detail as part of this review. However, the investigations relating to infiltration rates suggests that prior to the commissioning of any infiltration basin as part of the ICMP, further field testing should be undertaken to confirm the capacity of the underlying sediments to accommodate sustained levels of infiltration.

The later report (PDP, February 2007) presents a basic water balance approach to assess the effects of land use change on the groundwater budget. The water balance approach indicates an increase in the volume of water entering the groundwater system as a result of the infiltration basins. While the water balance attempts to quantify the relative changes in groundwater recharge in the confined and unconfined parts of the study area under a status quo and a developed scenario, URS considers that the allocation of groundwater recharge in the confined area under the status quo scenario is unlikely to be representative of actual recharge. URS considers that the proportion of rainfall that is estimated to recharge groundwater in the confined area of the catchment is likely to over-estimate recharge. Therefore, URS considers that the water balance for the SWAP catchment is unlikely to provide a reasonable assessment of changes in groundwater recharge patterns as a result of future land use change.

The potential for the infiltration basins to result in localised mounding of groundwater levels is assessed in the PDP Report (February, 2007). The report indicated that mounding would not pose any significant effect to the operation of the infiltration basins, or the overall functioning of the groundwater system. As the infiltration basins will not be subject to continuous discharges of stormwater, the effects of groundwater mounding are considered to be periodic and limited in terms of aerial extent. URS considers that the modelling of groundwater mounding is appropriate, although some degree of uncertainty exists around the numbers presented by PDP. Therefore, URS recommends that monitoring and maintenance plans for the infiltration basins be implemented to ensure that adverse effects associated with groundwater mounding are avoided.

Specific comments regarding the work undertaken by PDP to assess the effects on groundwater quantity is provided in the table below.

Overall, URS considers that the modelling undertaken in PDP Report (February 2007) is appropriate, albeit the concerns discussed above regarding the water balance. URS considers that the heterogeneity of the aquifer system could have been addressed through a sensitivity assessment of the modelling parameters. However, URS considers that an extensive monitoring and maintenance plan will address the modelling uncertainty to a reasonable degree.

Section 2 Technical Studies

Specific

	Methodology/Approach	Comments	Recommendations
PDP Report (September 2004)	The report provides information on groundwater-spring interaction, groundwater levels, and infiltration testing at various sites in the study area.	The physical investigations indicate general areas that are suitable for infiltration basin design. These areas should be confirmed via further field testing prior to design of the infiltration basins.	
PDP Report (September 2007)	Water Balance Model for South-West Christchurch from the proposed land use change	The model contains a number of assumptions regarding the existing rainfall recharge, the proportion of pervious and impervious surfaces, and the proportion of runoff that is directed to the infiltration basins. Apart from the rainfall recharge contribution there is no references provided as to why the various proportions have been used. The contribution of rainfall recharge to the groundwater system where surface confining layers exists is likely to be over-estimated, which affects the overall comparisons between existing and future water balances. Therefore, the water balance can only be considered to be a general view, and actual changes to the water balance are unlikely to be known until the full extent of the land use changes has been in operation for some time.	The water balance model should recognise that there is likely to be little recharge to the groundwater system when surface confining layers exist.

		However, URS generally agrees that the rainfall recharge to the groundwater system in the study area will increase as a result of the land use changes and infiltration basins.	
	Groundwater Mounding Calculations – Boulton Model	The model that was used to determine the level of groundwater mounding is acknowledged as an accepted approach. The aquifer parameters used in the model are considered to be representative of the permeable aquifer system that is known to be present in the study area. However, as the modelling does indicate a large increase in groundwater levels under the Awatea Road Basin, it would be common practice to undertake a sensitivity assessment to determine to potential extent of the mounding if the sediments under the infiltration basin were less permeable.	Undertake a sensitivity assessment of the mounding calculations.

Section 2 Technical Studies

2.3 Quality

2.3.1 Surface water

General

Water quality within the study area has been established using monitoring data collected by CCC at a number of locations through the study area. The water quality has been compared to typical concentrations experienced in other urban areas within New Zealand and overseas.

The analysis establishes that the Heathcote and Halswell River and tributaries have degraded water quality, characterised by elevated nutrients and bacterial indicators and to a lesser degree metals. It is noted that the monitoring data is limited for residential areas. Generalised urban water quality data is often used as the default to represent contaminant contributions from different landuses within a catchment and we have no concerns with this approach.

Receiving water definitions

The approach taken in the ICMP is to expand on the broad NRRP waterway classifications. This is appropriate given the level of data collated on the waterways in the study area, and also needed if management approaches are to be developed for each stream.

Four Classes are identified (Class 1 to 4) with Class 1 representing the waterways of highest value.

The objectives listed relate to protection of ecology, metals concentrations (copper, lead and zinc), improvement of sediment quality and protection of specific ecological values, flood protection and protection of baseflow conditions/springs. It is understood that the classifications and associated objectives were developed through a series of workshops.

It is noted that the objectives do not include reduction of nutrients, although nutrient levels were identified as a water quality concern. It is understood that this was on the basis that control of nutrient discharges would be outside of the controls that can be applied by CCC. Prevention of channel erosion is also not identified as an objective.

The classifications provide a good basis for developing a management approach. As noted in later sections it would be useful to provide more definition around what types of management practise are needed to meet the objectives – there is limited linkage between these stated objectives and the proposed catchment management approach.

Contaminant Load assessment

Contaminant loads have been estimated for a range of development scenarios and the levels of reduction have been calculated for a range of mitigation options. This type of approach is in-line with common practise elsewhere e.g. Auckland Regional Council (ARC) contaminant load analysis model.

A key difference with the ARC model is that no consideration is given to the control of roofing products as a means of reducing zinc loads. It is accepted however that such controls are still the subject of considerable debate in Auckland and will generate significant opposition from roofing suppliers.

It is understood that the Area Plan CCC is currently preparing will promote voluntary non-use of zinc or copper roofs. On this basis it would not be appropriate to include control of roofing products in contaminant load analysis since the approach cannot be relied upon.

The options involving construction in existing urban areas have taken into account the physical limitations of a retrofit situation i.e. land availability for putting in devices. This is important since finding locations for devices can be very difficult.

NPV values have then been developed for each options and a “cost-compliance analysis” undertaken. The preferred option has then been derived through a process understood to be as follows:

- The assumption is made that copper and zinc are the contaminants of concern for stormwater. This is on the basis that these metals are characteristic of urban stormwater and elevated levels are indicated by monitoring.
- Treatment efficiencies required to meet the USEPA criteria for zinc and copper are derived based on potential low to high concentrations in each catchment

The ICMP states that NRRP water quality standards are too difficult to meet. Instead the design basis for contaminant management approaches is to maintain zinc and copper levels at less than 30/26 % (zinc/copper) of USEPA for the Heathcote River and 15/14% for the Halswell River.

It is understood that Golder has had an International peer review of this approach.

The ICMP would be enhanced by a clearer explanation of how USEPA criteria are applied for future options. This approach is a key component of the ICMP. It is understood that ECan has been made aware of the approach through various workshops. A formal confirmation that ECan agree with the approach prior to the consent application being lodged would be prudent.

Specifics

- There is no specific linkage between the proposed options and objectives set for Streams – contaminant loads are provided for the whole basins – what are relative values for Class I streams ? -it would be useful to show proposed treatment device catchment areas in relation to receiving waters – to illustrate how they will benefit specific streams – particularly Class 1 streams;
- Leading on from this it is noted that there is no indication of priority for construction of the various devices – growth (and associated developer contribution) may be the main driver- however in some cases devices may also provide greater protection to Class 1 reaches than others. Some discussion on “triggers” for device construction would be helpful. Leading on from this should be an indication of priority for device construction.
- Options selection seems to be primarily based on meeting zinc and copper targets. BPO/QBL discussion relating to a broader range of selection criteria that were probably considered but have not been identified e.g. social and amenity values and/or compliance with Greenprint objectives would provide better justification.

2.4 Groundwater

General

The effects on groundwater quality of disposing stormwater to ground via infiltration basins are presented in Report No 5 (December 2007). The report contains two technical documents that specifically address this issue (PDP, December 2006; PDP, July 2007). The technical approaches set out in the two documents are summarised in the following table. The effects of land use change on groundwater quality from the disposal of stormwater via infiltration trenches are considered to be manageable, given the recommendation of the reports. Of particular concern to groundwater quality is the potential for increases in heavy metals and micro-organisms. While the modelling indicates that the risk is minor, it is important to implement a monitoring and maintenance plan to ensure that the infiltration basins are effective in the removal of contaminants. URS consider this to be an essential component of the ICMP, as the technical modelling that has been undertaken is based on a number of assumptions which may not accurately reflect the dynamic nature of the groundwater system.

The reports contain no assessment of model error/sensitivity to the various inputs. URS believes that the model parameters are likely to be appropriate, however, there is limited reference made to site specific values. Therefore, URS considers that a sensitivity assessment should be undertaken to determine the envelope of effects. Alternatively, URS believes that the predictive uncertainty could be offset by agreeing to undertake more rigorous monitoring and maintenance of the infiltration basins.

Section 2 Technical Studies

Specifics

Document Reference/Topic	Methodology/Approach	Comments	Recommendations
PDP (Dec 2006) Section 4.8 – Water Quality Modelling	Line Source Modelling of Contamination of the aquifer. A line source model was used to determine the potential change in contamination levels a heterogeneous isotropic aquifer. The aquifer behaviour was characterised using values of pore velocity (i.e. average linear velocity), dispersivity, and effective porosity. Contaminant input concentration at the source were provided to PDP by KMA. Modelling was undertaken for nitrates, faecal coliforms, and heavy metals (i.e. lead and zinc).	PDP used a line source model to calculate the effect of adding contaminants into the aquifer system from the infiltration basins. The modelling incorporated a number of assumptions with regard to linear velocity of the aquifer (referred to as pore velocity), dispersivity values, and porosity. No references for where pore velocity values, dispersivity values or porosity were provided. Pore velocities for the microbiological modelling were increased to replicate clean gravels associated with preferential flows paths. This was done to estimate the potential travel distances of faecal coliforms down gradient. URS considers that the pore velocity value used is reasonable, however, it is possible that in preferential flow paths the pore velocity could be higher. Dispersivity ratios are in generally agreement with those provided in Fetter (1999) and Freeze and Cherry (1979). However, URS notes that it is generally recognised that dispersivity ratios are variable in heterogeneous systems. URS agrees generally with the porosity value used, although the aquifer system could support a porosity value of 0.3. Input concentrations are based on values provided by KMA. The heavy metal concentration is based on a 90% removal of metals through the treatment system. URS considers that the sensitivity of the modelling to the input concentration requires further	A sensitivity assessment should be undertaken to determine the potential impacts of varying hydraulic properties of the aquifer system on contaminant transport. This is particularly relevant to the modelling of metals and faecal coliforms. Alternatively, mitigation and maintenance plans could equally address the modelling uncertainty.

		investigation. URS agree with the general findings for nitrate contaminant risk. URS considers that faecal coliform and metal contamination modelling outcomes require further sensitivity assessment to be undertaken.	
PDP (Dec 2006) Section 5.2, 5.3, and 6.0 – Rules for Development	PDP provide a number of recommended rules for development to manage the stormwater quality that reaches the infiltration basins. PDP also recommend regular inspection and maintenance of the infiltration basins.	URS believes that the recommended rules would reduce the level of contaminants in stormwater that are directed to the infiltration basins, and ultimately reduce the level of contamination of the groundwater system. However, the PDP modelling indicates that the contamination of the groundwater system will be small and localised. Therefore, URS considers that it may be difficult to enact some of the recommended rules if the effects are considered to be small and localised (i.e. minor). URS considers that design, regular inspection, and maintenance of the infiltration basins are essential to treating the contaminants.	Propose an inspection and maintenance plan to be part of the mitigation and monitoring plan for the ICMP.
PDP Report (July 2007) Section 2.0	Review of existing groundwater quality information for Christchurch and the study area using bacterial indicators, nitrate concentrations, and TDS concentrations was undertaken, focusing on water quality information from wells less than 60m deep.	Varying levels of nitrate in the study area from the monitoring wells has been attributed to the potential variance in the recharge sources of shallow aquifer water. However, URS believes that the variance is likely to be attributed localised sources of contaminants rather the varying recharge sources. Overall, URS considers that the discussion on groundwater quality in the study area is appropriate.	None

PDP Report (July 2007) Section 3.0	The effects of groundwater contamination from the infiltration basins on wells are presented in this section. The modelling of contaminant transport undertaken in PDP Report (Dec 2006) was used to determine risks to potable supply. PDP apply separation zones around the infiltration basins to demark contamination risk to wells. Wells more than 60m deep have a lower separation zone than wells less than 60m deep. PDP state that with the exception of Dunbars Road public supply, there are no other CCC public supply wells within the separation zones proposed for the infiltration basins.	The separation zone for wells less than 60m deep appears to be based on the outcome of the microbiological contaminant transport modelling. This needs to be clearly stated in the report if it is the case. The report does not reference the proposed separation distances to public supply wells provided in Chapter 4 NRRP. Overall, URS agrees with the conclusion that the infiltration basins are unlikely to pose a contamination risk to the existing CCC public supply wells.	Cross reference the zones of separation proposed by PDP with the Well Protection Zone in the NRRP.
PDP Report (July 2007) Section 4.0	PDP present a water balance approach to determine the larger scale impacts of the infiltration basins on groundwater quality. The report indicates a 2.4% increase in recharge from status quo from using infiltration basins. The increase in flow is primarily directed to springs, with a smaller component attributed to aquifer	The water balance approach generally provides a conservative assessment of changes in groundwater volume and potential spring flow changes as a consequence of land use change. However, URS notes that the water balance is only indicative and based on a number of raw assumptions. URS considers that the increase in rainfall recharge is expected given the concentration of runoff (stormwater) in infiltration basins will result in more water entering the groundwater system. URS agrees with the conclusions presented regarding the effects	Reconcile the difference in the efficiency of the infiltration basins to remove heavy metals between the mass mixing model and the line source model. A sensitivity assessment should be undertaken of effectiveness of the infiltration basins in removing

	through flow. Contaminant loadings of the groundwater from the land use change are derived using a mass mixing model. Increases in PAHs, TPH, and TP are expected. However, given the treatment offered by the infiltration basins and the nature of the constituents, the risk of contamination of the aquifer is not expected. Small increases in concentration of Copper and Zinc are anticipated, but at very low levels.	of PAHs, TPH, and TP are considered to be appropriate. Table 3 provides removal factors arising from basin infiltration treatment. For the metals a removal factor of 95% is applied. This differs from the 90% applied in the line source modelling. URS suggests that these differences be reconciled. In addition URS considers that while the infiltration basins are very good at filtering metals, a degree of error should be applied to the calculations.	contaminants. Alternatively, mitigation and maintenance plans could equally address the modelling uncertainty.
PDP Report (July 2007) Section 4.4	Groundwater impacts on Springs There is the potential for increases in metals discharging from groundwater into the spring fed streams as a result of the infiltration basins. PDP report this effect as being minor.	The spring fed streams are of high aesthetic, recreational, and cultural value. URS considers that while the level of nutrients and microbiological contamination may not increase in spring discharges as a result of the infiltration basins, the potential for increases in metals in the streams should be included in the monitoring plan.	Implement a monitoring programme for metal discharges in springs of the Heathcote and Halswell Rivers.

Section 3 Planning Approach

3.1 Overview

The following sections provide some discussion in relation to the planning response to the information provided in the ICMP. The ICMP presents a large volume of technical information and ideally this is distilled down into an approach to stormwater management that can be easily interpreted and implemented by a range of stakeholders.

The following sections outline areas where it is considered the ICMP would benefit from greater definition.

3.2 Design Objectives

What seems to be omitted from the document is a statement relating to the general design objectives CCC will apply to the catchment. For example there are standard “Levels of Service” that CCC has committed to meet in relation to flood control that are not explicitly stated (although they have been taken into account in the water quantity analysis).

It is also noted that the document focuses on mitigation on a catchment wide scale. However it is important to also provide guidance on other activities within the catchment that relate to management of stormwater at a smaller scale. This is to clearly set the rules that will guide future developments.

In discussion with CCC/Golder it was explained that the intention is to issue more detailed plans for sectors of the catchment and these will provide a greater level of detail. In particular these will outline the “general rules” for stormwater management applicable to each sector.

We suggest that within the main ICMP references is made to these Sector Plans and what they will contain.

An example of general rules taken from a Waitakere City Council ICMP is provided below:

The Waitakere City Council, Code of Practice for City Infrastructure and Land Development, Engineering Standards Manual, (WCC 1999c) describes the target standards set by WCC for stormwater drainage systems. These target levels apply to all new land development projects and also represent a target level of service for the existing drainage system.

Table 11-1 summarises the design criteria applicable to drainage networks.

Table 3-1: Design storm requirements for residential stormwater systems

Type of Development	Return Period (years)	Annual Exceedance Probability (AEP)
Primary Piped Networks	5	20
Open Channels	100	1
[1]Secondary Flow Paths	100	1

[1]Overland flow paths and secondary flow paths for piped networks are to be designed to accommodate the 1% AEP rainfall event as follows:

- *20% AEP not greater than 0.5 m^3/s-pipe condition fully blocked;*
- *20 % AEP between 0.5 m^3/s and 1 m^3/s-piped condition 50 % blocked; and*
- *20 % AEP over 1 m^3/s-piped condition 25 % blocked.*

If there is no overland flow path, piped systems are required to have capacity for the 1:100 year flood event with an allowance for 50% blockage of the opening.

Section 3 Planning Approach

WCC also require that habitable dwellings and other freestanding buildings including garages, are a minimum of 0.5 m above the 100 year flood plain level.

It is recommended that a statement on target levels of Service is included in the ICMP. It is also recommended that the ICMP lists the standard management approaches that CCC would want implemented within the catchment. Some examples are listed below:

Stormwater Drainage

- *The location of secondary overland flow paths must be defined on sub-division plans and incorporated into the design of new stormwater drainage systems. No new building, structure or other impediment to flow is permitted in designated overland flowpaths.*
- *That all new buildings must be constructed at least 500 mm above the 1% AEP flood plain or the level of any downstream hydraulic control (e.g. 500 mm above the crest of any road embankment), whichever is the higher).*
- *The limits of overland flowpaths must be recorded on Christchurch City Council's Flood Hazard Register and be recorded on the affected property files and be recorded on CCC's GIS system.*
- *….etc*

Protection of watercourses

- *That the existing surface water flow directions be generally maintained.*
- *That fish passage in all existing natural watercourses is maintained and existing barriers to fish passage are removed, where practicable.*

Protection of groundwater

- *That all existing groundwater bores are marked on plan and including in building consent applications.*
- *That CCC be provided with a detailed plan for either decommissioning or continuing use of bores. Where bores are to be kept, overland flowpaths must be directed away from the bore and the bore entry points are to be sealed to prevent ingress of stormwater*

Inclusion of the above ensures a standardised approach across the entire catchment.

We note that in relation to groundwater there appears to be some uncertainty as to the division of responsibilities between ECan and CCC in relation to groundwater bore protection and this needs to be covered in the MOU under preparation.

3.3 Flood Protection

The Quantity Assessment indicates that the management approaches adopted are based on maintaining existing flood levels for the 2% AEP event. It is further understood that flood protection on a catchment wide scale will be covered by the Floodplain Management Strategy that ECan is preparing. This will include restrictions on development in areas that currently flood etc

We suggest an explanation at the front of the ICMP summarising briefly how the ICMP relates to and assists with implementing the Floodplain Management Strategy.

Section 3 Planning Approach

We also note that the ICMP covers flooding associated with whole catchments and there is little coverage of localised flooding (e.g. from overland flows, localised network capacity problems). As noted earlier it is assumed this type of detail will be covered in the sector plans.– is this a non issue.

3.4 Stream protection and enhancement

The ICMP provides a comprehensive description of stream values and sets objectives based on the four classifications. An omission in the document is an explanation of how the proposed management approach will meet objectives described earlier in the document for streams, Greenprint etc. The justification for the approach seems to be primarily based on the contaminant/cost analysis described in the Water Quality report.

There is also little discussion around other mechanisms for stream protection – e.g. establishment of riparian margins, fish passage. The Waterways and Wetlands and Drainage Manual describes the CCC approach to stream protection and enhancement, and drawing or referencing some of this material would enhance the ICMP.

It is also noted that no specific works or priorities associated with the individual streams are identified in the ICMP.

An example is provided below of how management approaches can be summarised for different streams.

Section 3 Planning Approach

Mangement Options	Primary Regulation Tool	Applicable to Stream/Reach ?								Notes
		Sakaria Stream (Type 4)	Sinton and Pikau Steams (Type 2)	Slaughterhouse Stream (Category 2)	Totara Creek- Stream Mouth (Type 1)	Totara Creek- main channel (Type 4)	Upper Sakaria Stream (Type 5)	Un-named Totara Creek tributaries (Type2)	SH 16/18 Culverts (Type 6)	
Develop parks and reserves adjacent to streams	District Plan	✓	✓	✓	✓	✓	✓	✓	NA	Proposed in Plan Change 15 for Sakaria Stream
Maintain existing impervious cover in the catchment	District Plan	NA	✓	✓	NA	NA	NA	✓	NA	
Maintain impervious cover in the catchment at below 10%	District Plan	NA	✓	✓	NA	NA	NA	✓	NA	Not practicable for Sakaria Stream and Totara Creek if Plan Change 15 proceeds
Maintain impervious cover in the catchment at below 25%	District Plan	NA	✓	✓	NA	NA	NA	✓	NA	
Prohibit piping of first and all higher order streams	District Plan	✓	✓	✓	NA	NA	✓	✓	NA	
Prohibit piping of second and all higher order streams	District Plan	✓	✓	✓	NA	NA	✓	✓	NA	Excludes culverts already consented for SH16/18
Prohibit piping of third and all higher order streams	District Plan	NA	NA	NA	✓	✓	✓	✓	NA	
Locate all stormwater treatment devices off-line	District Plan	✓	✓	✓	✓	✓	✓	✓	✓	Excludes devices already consented for SH16/18
Facilitate community-led stream restoration projects	?	✓	✓	✓	✓	✓	✓	✓	NA	
Facilitate community-led stream monitoring projects	?	✓	✓	✓	✓	✓	✓	✓	NA	
Restrict public access to protect ecological functions	District Plan	✓	✓	✓	✓	✓	✓	✓	NA	
Develop parks and walkways adjacent to streams	District Plan	✓	✓	✓	✓	✓	✓	✓	NA	Proposed in Plan Change 15 for Sakaria Stream
Refer Section 9.4 and 9.5	-	-	-	-	-	-	-	-	-	
		-	-	-	-	-	-	-	-	
Fence streams to keep out stock	Annual Plan	✓	✓	✓	✓	✓	✓	✓	NA	Fencing is less important in urbanised area- remains high priotiy in rural
Stabilise eroding banks with vegetation	Annual Plan	✓	✓	✓	✓	✓	✓	✓	NA	
Provide erosion protection where a change in hydrology is predicted	Building Consents	✓	NA	NA	✓	✓	✓	✓	NA	It is important to prevent erosion associated with development in channels downstream.
Maintain current time of concentration, discharge volumes and peak flows for the 50 % AEP rainfall event	Building Consents	✓	NA	NA	✓	✓	✓	✓	NA	Requires attenuation of runoff in areas identified for development in Plan Change 15
Maintain current time of concentration, discharge volumes and peak flows for all events up to the 1 % AEP rainfall event	Building Consents	✓	NA	NA	✓	✓	✓	✓	NA	Flood inundation can be managed in rirparian margins - less priority than erosion prevention
Detain and discharge over 24hrs the first 34.5 mm of rainfall	Building Consents	✓	NA	NA	✓	✓	✓	✓	✓	
Designate riparian margins in the District Plan	District Plan	✓	✓	✓	✓	✓	✓	✓	NA	
Fund riparian planting programs	Annual Plan	✓	✓	✓	✓	✓	✓	✓	NA	
Remove invasive weeds through a weed reduction/elimination program	Annual Plan	✓	✓	✓	✓	✓	✓	✓	NA	
Identify, map and protect spawning areas	Annual Plan	NA	NA	NA	✓	NA	NA	NA	NA	
Remove existing fish barriers	Annual Plan	✓	✓	✓	✓	✓	✓	✓	✓	Few existing-removal benefits entire stream network
Design new motorway culverts to provide for fish passage	Transit Resource Consents	-	-	-	-	-	-	-	✓	Required by consent conditions
Refer Section 9.2	-	-	-	-	-	-	-	-	-	
Refer Section 6	-	-	-	-	-	-	-	-	-	
Action weight :	H-red									
	M-blue									
	L-green									

Sourced from Totara Creek Integrated Catchment Management Plan, URS, November 2006

Section 3 Planning Approach

3.5 Implementation

The implementation section outlines the processes that will apply to the ICMP.

As noted earlier it would be useful to identify the “triggers” and potential timeframes associated with implementation works. This is to provide some certainty to works being carried out.

Figure 8.1 suggests a timeframe for construction has already been established.

It is appreciated that their may be issues with raising community expectations about when development will occur. Equally ECan will need some assurance that devices will go in place.

Section 4 Implementation Strategy

4.1 Network Consent Application

4.1.1 General

The ICMP will be the primary document supporting the network discharge consent. It would be useful to clarify within the introductory section of the ICMP the activities that will be covered by the consent application.

For example will the consent cover the discharges only to surface and groundwater- or all activities associated with the ICMP (works in streams ?). It would be helpful to clarify this at the start of the ICMP.

It is noted that an AEE will be provided in support of the consent application. It is noted that practise elsewhere is for the ICMP to incorporate the AEE so all necessary information is contained in a single document.

4.1.2 Consultation

The ICMP makes no reference to community consultation associated with the management approach. Consultation needs to be covered as part of the consent application. It is understood that this will be covered in the separate AEE document.

4.2 Consent Conditions

Ultimately Ecan will need to translate the proposed management approach provided in the ICMP into consent conditions.

CCC can be proactive about how this is structured by presenting management recommendations in a way that can be readily converted to consent conditions. It is recommended that CCC and Ecan invest time in working through draft consent conditions prior to applications being lodged to avoid unnecessary appeals.

One of the key areas that needs to be worked through is how much information (i.e. level of detail) ECan are comfortable with receiving in relation to management of the consent. Some examples of consent conditions that might be developed are noted below:

ICMP Recommendation	Proposed Consent Condition
The location of secondary overland flow paths must be defined on sub-division plans and incorporated into the design of new stormwater drainage systems. No new building, structure or other impediment to flow is permitted in designated overland flowpaths.	Existing and future overland flow paths with 100 year ARI flow in excess of *** cumecs shall be marked on the CCC flood maps within three years of the issue of this consent and progressively updated annually as development occurs and thereafter at not less than the review periods of this consent.
• *Detailed design calculations and drawings for all wetlands must be provided to CCC for approval to demonstrate compliance with this ICMP.*	The consent holder shall supply to the Manager within six months of Practical Completion, written certification and As-Built plans of the stormwater management works, required under the Network Discharge Consent and as identified in the table in

Section 4 Implementation Strategy

• *Infiltration devices will be the primary form of stormwater treatment and attenuation and are to comply with design criteria presented in section ** of the ICMP.* • *Wetlands identified as a,b,c,d,e on Figure *** may change in location once detailed topographic information is available. Any changes in location must be approved by CCC.*	Condition ** of this consent,, which are certified as a true record of the stormwater management system by an Chartered Professional Engineer or Registered Surveyor. The As-Built plans shall include, but not be limited to: i. The surveyed location and level of the discharge structure, measured to the nearest 0.1 metre with co-ordinates expressed in terms of the New Zealand Map Grid and LINZ datum. ii. Location, dimensions and levels of the major overland flowpaths including cross sections and long sections. iii. Plans and cross sections of all stormwater management devices, including confirmation of the Water Quality Volume, storage volumes and levels of any outflow control structure.
That a Monitoring Plan be prepared covering groundwater, surface water, stream sediment quality and ecological monitoring in accordance with section 6.0 of the ICMP	That the Consent Holder shall submit a Monitoring Plan in accordance with section 6.0 of the ICMP within 3 months of the grant of this consent for approval by the Manager. The Monitoring Plan will include a proposal for reporting of monitoring data to Ecan.
That a Project Control Group be established with ECan to enable implementation of the network discharge consent	That the Consent Holder shall establish a "Control Group" to meet and review the compliance with the Network Discharge Consent on a minimum of a 6 monthly basis unless waived by the Manager. The group shall be chaired by CCC and shall consist of ECan representatives in addition to any interested parties. The Consent Holder shall circulate an agenda for the meetings to all parties who have expressed an interest in the Network Discharge Consent a minimum of 7 days prior to the meeting to determine who will attend. The group shall review the implementation of catchment network development and mitigation works in accordance with this consent and the ICMP. The group shall not have a decision role but shall be able to make recommendations to the Consent Holder or the consent authority. Minutes and any recommendations from the meeting shall be forwarded to the Manager within a 14 day period following the meeting. Issues for reporting shall include but not be limited to the following: • Presentation of the Annual Report • Summary of Compliance with consent conditions

Section 4 Implementation Strategy

	• Proposed development and upgrade works • Operation and Maintenance provisions; • Any significant policy changes in relation to district or regional plans that may have an impact on the ICMP and Network Discharge Consent; • Any other matters related to ICMP implementation that may arise and documentation of changes associated with implementation options

Section 5 Institutional Capacity

5.1 Institutional Capacity

This section cannot be extended much further until an Implementation Strategy has been agreed – however there are some general points that should be considered:

- Which team will manage and co-ordinate consent applications ?
- Who will co-ordinate and manage monitoring and reporting responsibilities ?
- Is specific training needed within CCC in relation to consent related procedures such as monitoring and reporting
- Which team will provide ongoing updates to the ICMP; and
- Who will ensure that cross- functional projects are scoped, approved, implemented and reviewed by staff from various relevant departments to ensure that issues such as the stormwater aspects of the project are addressed ?

Section 6 Summary

URS has reviewed the Integrated Catchment Management Plan (ICMP) for South West Christchurch (December 2007) and the associated Water Quantity and Water Quality Assessment.

The review included looking at the technical information contained within the documents and a higher level review of how the documents will support a discharge consent application.

The review identified some points of detail associated with the technical work and these have been itemised. While these points should be addressed by CCC, they are considered minor and the work presented is considered “fit for purpose” i.e. as supporting information for the ICMP.

As an overall package the review identified limitations in the linkages between objectives and the final proposed management approaches.

This applied in particular to streams. Extensive work has been carried out on the streams within the catchment and they have all been classified into stream types with associated objectives. The ICMP as written does not “spell out” how proposed mitigation works will assist with meeting these objectives. If these objectives are to be met through other planning mechanisms (e.g. the Greenprint) this should be clarified.

It is also considered that the ICMP should outline clearly the “Levels of Service” that ICMP implementation will achieve.

The management approaches address higher level flood mitigation and contaminant management approaches. It is understood that there will be a further suite of documents that will cover the more detailed “rules” applicable to stormwater management within specific sectors. It would be helpful to explain this in the ICMP so it is clear for future users of the ICMP what other documents they need to reference.

It is understood that CCC and ECan are currently developing an MOU that will clarify responsibilities relating to implementation of the discharge consent and associated conditions. Clearly there are a number of issues to still work through relating to implementation and some of these have been noted in section 5.1.

It is strongly recommended that CCC are pro-active and work with Ecan with regard to consent conditions prior to the application being made, since conditions will drive CCC actions on Institutional Capacity.

Section 7 Limitations

URS New Zealand Limited has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Christchurch City Council and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated December 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared in January 2008 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.