AKAROA WASTEWATER – IRRIGATION OF TREATED WASTEWATER TO LAND

JOINT STATEMENT OF TECHNICAL EXPERTS # 2

ISSUED ON 16/2/17

1.1. This is the second joint statement of technical experts in response to terms of reference set for the Akaroa Wastewater Scheme by Christchurch City Council (CCC) and agreed with Ngai Tahu on 6th of December 2016 (Terms of Reference document TOR Akaroa lex15247 2016-12-06). Several meetings have been held to discuss matters and to formulate this response. The technical expert group is composed of: Greg Offer (Notes) and Richard Young from Beca Limited, Andrew Brough from Pattle Delamore Partners Limited (PDP), Andrew Dakers from ecoEng, and David Painter from David Painter Consulting.

2. INSPECTION OF WAINUI WASTEWATER IRRIGATION SITE

2.1. A site visit to the Wainui land irrigation scheme was conducted on 8th of December 2016 by the technical experts. Assistance on site was provided by Kris Kaser from CityCare. The purpose of the visit was to allow the technical experts to review the scheme operation and performance.

2.2. The Wainui irrigation scheme has been constructed within an area of maturing Pinus radiata forest. It consists of four 1 ha forestry blocks with only one of the four blocks in use. The irrigation system is well built with the dripper lines pegged down and flush valves fitted at the end of each line. Some minor damage to dripper lines was observed including a line breakage caused by tree fall.

2.3. The Wainui scheme is operating at about 13% of design loads at present. Current connected population is 107 and the 2014 design population is 820. Flows and loads will increase when the Wainui Sewerage Scheme is expanded by Christchurch City Council in 2018-19.

2.4. Pine litter falling from the trees has covered the dripper lines up to 100mm thick in places. This is considered beneficial in terms of supporting biological processes in the wetted surface zone and in distributing the wastewater by surface wicking.

2.5. No adverse operational effects were observed on the day of the visit, from the application of wastewater to land. This includes no evidence of enhanced erosion in gullies, nor any recent ground movement, nor evidence of any surface runoff resulting from wastewater application even at the open end of the broken dripper line.

3. WATER BALANCE MODEL

3.1. The water balance model described in the PDP report including the methodology used and the outputs provided, are considered appropriate and provide a reasonable estimate of the soil moisture balance at this stage, given limitations in the current level of information. The Akaroa water balance model, unlike other similar models, does not allow for any water holding capacity in the soil moisture range between field capacity and saturation. As a result the model is considered to be conservative in terms of soil drainage. The model will be revised once physical data for a specific site has been obtained and should also be rerun for any specific scenarios based on irrigation to trees.

3.2. A particular aspect that requires checking is the Long Term Acceptance Rate (LTAR) of wastewater within the soil. LTAR is the terminal rate at which treated wastewater moves vertically downwards through sub-soils after a period of time (which could be months, or even years) once a stable soil ecology (usually referred to as biozone) has established in the soil due to residual wastewater components. It is usually expressed as mm/day, which is the same as L/m^2.day. The LTAR is used to inform the recommended rate at which treated

wastewater should be applied to land. Typically higher quality wastewater means that we can adopt a slightly higher value for the LTAR than for lower quality effluent. Data from field measurement of the rate at which clean water infiltrates through the local soil can be used as an indicator of the recommended value for LTAR. As an example, Van Cuyk et al. (2005)[1] recommends that the LTAR is in the range of no more than 3% to 5% of the saturated infiltration rate for clean water. The greater the LTAR value, the less land area required. A simplified explanation is that if the rate at which wastewater is applied to the land is greater than the LTAR and the evapotranspiration rate, then there is a high risk of the upper soils becoming saturated and possibly resulting in surface ponding and runoff. Clearly rainfall events will also have an impact on these risks. In summary, LTAR values depend not only on the quality of the treated effluent but also on soil texture, structure and soil profile anomalies such as less permeable soil layers (or "pans"). Rainfall patterns vary thoughout the year and for different locations, and evapotranspiration varies according to types of plants grown, and wind, sunlight, air temperature and humidity at the site. All these factors must be taken into consideration to assess the risks and performance of a wastewater land application field.

3.3. The wastewater flows used for the water balance model are considered appropriate and are likely to be conservative for winter dry weather flow as the assumed annual average daily flow is about 5 % higher than the design horizon flow estimated by Beca. Winter time is considered to be the constraining case. During peak summer wet weather events excess flows will go to the buffer storage.

3.4. It was agreed under Joint Statement # 1 item 3.4 that a soil scientist should review the soil infiltration assumptions in the model. If and when a preferred site has been selected, then a soil scientist should review assumptions about soil behaviour that affect the water balance model. Further soil testing may also be required at this stage.

4. EFFECTS OF IRRIGATING TREATED WASTEWATER

4.1. Potential risks to public health depend on the effluent quality, the type of irrigation, the separation distance to receptors, and other mitigations used (eg. boundary tree plantings). The buffer distances proposed for Akaroa are consistent with consented and operational land irrigation schemes while the microbiological quality proposed at Akaroa is significantly better than for most other operational schemes. Spray irrigation poses higher risks than dripper irrigation. This will be taken into account in developing the scheme design.

4.2. Food crops may, in certain situations, uptake contaminants from wastewater that could be potentially harmful to humans. The Akaroa proposal includes buffer separation from areas where people grow food crops. The intention of the design is to provide a sufficient buffer to prevent the risk of any cross-contamination of cropping or other sensitive land uses in proximity to the irrigation area.

4.3. Buffer distances to streams and residential properties, as currently proposed, are based on existing and operational municipal irrigation schemes. The appropriateness of buffers will be assessed for the site specific risks in due course.

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[1] Van Cuyk, S., R. L. Siegrist, K. Lowe, J. Drewes, J. Munakata-Marr, and L. Figueroa. 2005. Performance of Engineered Treatment Units and Their Effects on Biozone Formation in Soil and System Purification Efficiency. Project No. WU-HT-03-36. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by the Colorado School of Mines, Golden, CO.

4.4. Stand down periods for stock have historically related to the cross contamination risk between humans and animals with key organisms (particularly the beef tapeworm, *Taenia saginata*). Stand down periods of up to 30 days have generally been adopted. Specific stand down periods would be developed for stock in any scheme involving irrigation to pasture, such that the risks from key organisms are appropriately managed.

4.5. The risk of wastewater runoff will be mitigated by careful management of the scheme, including monitoring of soil moisture such that irrigation will cease when soil moisture reaches a predetermined level. Irrigation of wastewater has the potential to generate nutrients in excess of the requirements of vegetation that is grown. The proposed scheme will be designed to manage this risk by adjusting the application rate to suit the ability of soils and vegetation to utilise nutrients (for example, more wastewater would be applied in summer and less in winter). Nutrient leaching to groundwater and/or surface water is most likely to occur over the winter when nutrient utilisation is lower. At this stage the movement of groundwater at the sites under consideration has not been fully investigated (although monitoring in some areas is underway). Further work will be required if and when a preferred site or sites are identified. This would include further groundwater level and quality monitoring to confirm the direction and rate of groundwater movement.

4.6. Flood risk will need to be taken into account in the scheme design. This will be assessed at selected sites and appropriate management procedures put in place. Note that for the assessment of the pasture and tree irrigation options to date it has been assumed that wastewater will not be applied to land during high rainfall events, or when soils are saturated, and including a specified period afterwards. These conditions are also times when flooding could occur.

4.7. Climate change has been included in the assessment to date and is detailed in PDP report (October, 2016) "Infiltration Testing Results For Akaroa Treated Wastewater Disposal Via Irrigation – Robinsons Bay And Pompeys Pillar". Climate change impacts on Banks Peninsula are difficult to predict accurately. For seasonal totals of precipitation, for Christchurch and Hanmer Springs [but not necessarily Banks Peninsula], forecast changes to year 2040 are not statistically significant[2]. But the forecast to year 2090 is for increased rainfall seasonal totals in Summer and decreased rainfall seasonal totals in Winter[2]. The forecast pattern of frequency of extreme daily rainfalls "is quite robust" and "shows a systematic increase in much of the South Island, with both time and increasing greenhouse gas concentration." [2] The design horizon for the Akaroa wastewater scheme is to year 2041. Within this time period forecast changes to seasonal totals are not statistically significant, based on best available information. If extreme rainfall events become more frequent in the long term this may result in more frequent use of the wastewater storage pond, or potentially require a larger storage pond. However this is somewhat speculative and a range of factors will influence long term future storage requirements including the impact of remediation to the Akaroa wastewater network to reduce inflow and infiltration. This remedial work is planned to be implemented over the next 5 years.

5. OPERATION AND MAINTENANCE OF IRRIGATION SYSTEM

5.1. Operation and maintenance issues are site specific. The following are general statements about operational and maintenance factors for irrigation schemes.

5.2. Drip irrigation systems can either be placed on the ground surface (surface drip irrigation) or placed below the ground surface (sub-surface drip irrigation). Generally for wastewater

[2] Climate Change Projections for New Zealand. Ministry for the Environment, 2016.

irrigation surface drip irrigation occurs in trees or on specially constructed mounds. For the Akaroa scheme surface irrigation would only occur as irrigation to trees. Surface irrigation to trees is common where there is an existing tree plantation that can be irrigated (e.g. Wainui, Blenheim). During normal operation damage may occur by wind fall of trees (damage by this method has been observed by the experts at Wainui) or by hares gnawing dripper lines. At Wainui the surface laid tubing has largely been covered by pine needle debris and this reduces the risk of damage from hares. Surface drip-irrigation is also at risk of damage if the trees are pruned. During harvesting it is common to roll up the irrigation lines prior to harvest.

5.3. Sub-surface drip irrigation is less susceptible to damage, although if not buried deep enough vehicle movements on the ground surface may cause compaction of the drip line. Modern sub-surface drip irrigation is less susceptible to root intrusion than in the past through careful design of the dripper and the inclusion of a herbicide impregnated into the dripper. Sub-surface drip irrigation of trees would still be at risk of damage if trees are felled by wind as the root ball may rip up the drip line.

5.4. Cut and carry systems need paddock sizes and land slopes that are safely and practically accessible by mowing and baling equipment. The presence of rocks and other obstacles on the land surface could prevent a cut and carry approach at some locations. The general method for cut and carry is to irrigate for a period of around 40 days then rest the area for several days prior to cutting. If a k-line irrigation system is employed the k-line would need to be removed prior to cutting. Various fixed sprinkler options are used in New Zealand. The management requires that paddocks are cut in rotation as irrigation cannot occur on a paddock while the cut grass is dried and made into the final product. Cut grass is removed from the paddock and stored in a suitable location before sale.

5.5. The monitoring of an irrigation scheme (whether sprinkler or drip irrigation) is likely to include monitoring of the wastewater quality, climate (rainfall, ET), soil moisture, depth of wastewater applied to each irrigation zone, calculation of the nutrient load (based on wastewater quality and depth of wastewater applied) and soil sampling for nutrient and other soil parameters. Operating pressure in the system would be monitored to identify blockages or build up of biofilm (especially for drip irrigation). Build up of biofilm is often checked by cutting a drip irrigation line to physically observe the condition. These cuts are easily repaired using standard joiners. Groundwater may be monitored if there is considered to be a risk to the environment. If spray irrigation is used wind monitoring may be used to prevent irrigation in certain conditions (eg. direction and speed). There would usually be a complaints register. All the data is normally recorded, analysed and prepared into an annual report and compared against consent conditions.

5.6. Servicing and maintenance of an irrigation scheme will depend on the system selected. When comparatively poor quality wastewater is spray irrigated then blockage of sprinklers may occur. Blockages can be identified during walkover of the site by the scheme operator. The proposed effluent quality for Akaroa is very good so blockage of sprinklers is considered unlikely. Repair of damage, often caused by stock and by equipment during harvesting of the grass in spray irrigation systems is a routine activity. For drip irrigation lines flushing will be required. The frequency will depend on the solids buildup that occurs (this is generally associated with the amount of nutrients and organic solids present in the wastewater) but is typically one to 4 times per year. Walkover of tree irrigation sites after high wind/rainfall will also be required to check for dripper line damage.

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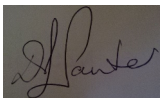
SIGNATURE SHEET

Signed by:…Andrew Dakers

Signature:  Date: 16/2/17

Signed by:…David Painter

Signature:  Date: 16/2/17

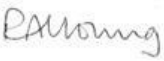
Signed by:…Andrew Brough

Signature:  Date: 16/2/17

Signed by:…Greg Offer

Signature:  Date: 16/2/17

Signed by:…Richard Young

Signature:  Date: 16/2/17