

Kate Valley Landfill Peer Review Panel

**Annual Report Number 8
Covering the period July 2011 to January 2013**

February 2013

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CONTENTS

CONTENTS	1
1. Objective of Report	2
2. Background.....	2
3. Scope of Review	2
4. Membership of Panel.....	3
5. Landfill Design, Construction, and Management (General Consent Condition 12)	3
5.1 Overview	3
5.2 Design and Construction	3
5.3 Management and Monitoring Plans.....	4
5.4 Water Control, including Groundwater, Stormwater and Leachate Management	5
5.5 Landfill Gas.....	6
5.6 Compaction, including Method and Degree	7
5.7 Waste Acceptance	7
5.8 Cover Materials	7
5.9 Settlement.....	7
5.10 Monitoring, Modelling and Records.....	8
5.11 Rehabilitation.....	9
6. Managing Hydration Level of GCL (Condition 22, CRC021914).....	9
7. Water Supply and Silt Dams (Condition 14, CRC 021919)	9
8. Sedimentation Dam Slope Stability (Condition 13, CRC 021919).....	10
9. Stability of Northern Access Road (Condition 48, RC 020069)	10
10. References	11

Appendix 1

Consent Conditions Relevant to PRP

Appendix 2

Dates of PRP meetings and site visits

1. Objective

This Annual Report is in response to General Consent Conditions 12 and 13 (Appendix 1).

2. Background

The Canterbury Regional Landfill at Kate Valley is owned by Transwaste Canterbury Ltd (TCL), a public – private partnership between five Canterbury councils and Canterbury Waste Services Ltd. (CWS). The development and operation of the landfill is being undertaken by CWS.

Geotech Consulting Ltd has been responsible for site investigations for the project. This has included geological modelling, supervision of drilling and soil testing for detailed design, geotechnical advice to the designers and owners, and mapping of the subgrade during construction.

Tonkin & Taylor Ltd (T&T) have been the principal designers of the landfill and associated infrastructure. They have been involved in the preliminary planning of the landfill, undertaking the detailed geotechnical design, and overseeing construction of the landfill. They also provided quality assurance services, including a full time technician, during the initial construction phase. Subsequently T&T have overseen the work of the technician employed by CWS and provided a technician during the liner construction work of each phase.

The initial construction of the landfill was undertaken under an Alliance Contract between CWS and Fulton Hogan Ltd. The Alliance engaged subcontractors to carry out some of the construction work. While T & T were not formally part of the alliance they worked very closely with the contractors and provided quality assurance and testing services during the construction.

The Peer Review Panel (PRP) was established in 2004 by TCL in accordance with General Consent Condition 11 (Appendix 1). The condition provides for the establishment of a Peer Review Panel to “review the design, construction, operation, and after-care of the Landfill, and to assess whether or not the work is undertaken by appropriately qualified personnel in accordance with good practice”.

3. Scope of Review

The role of the PRP is one of independent technical review. It does not include design checks, oversight of construction, or checking compliance with consent conditions (which is the responsibility of the relevant councils).

The timeframe for this review (1 July 2011 to 22 January 2013) exceeds 12 months, in part reflecting the ongoing nature of the PRP’s involvement.. For some matters, the

lack of documentation means that a complete review of activities since 1 July 2012 necessarily has to be carried over into the next annual report.

Throughout the review period, the PRP has been kept fully informed on the design, construction, and operation of the project by way of (1) meetings convened by CWS or the PRP, (2) provision of draft or final reports prepared by CWS or T&T, (3) direct consultation with relevant personnel, and (4) site visits. This process has been applied to all the key elements of the project. The PRP has been provided with every opportunity to communicate its views to CWS and its technical advisors, and to receive feedback. Dates for meetings and site visits attended by the PRP are provided in Appendix 2. Key documents provided to the PRP and considered relevant to consent monitoring officers are listed in the References section of this report.

This review includes consideration of the draft TCL 2012 Landfill Annual Report. A draft report is used for peer review and for review by the relevant councils, and the final TCL report will be issued after completion of this review and those of the councils.

4. Membership of Panel

Dr Mark Milke, Canterprise Ltd., environmental engineering reviewer and Dr Bruce Riddolls, Riddolls Consultants Ltd, engineering geology reviewer, with specialist input from Dr Trevor Matuschka*, Engineering Geology Ltd, landfill engineering reviewer and Mr Tony Pickford, Pickford Consulting Ltd†, dam engineering reviewer

5. Landfill Design, Construction, and Management (General Consent Condition 12)

5.1 Overview

The Peer Review Panel believes the landfill work is being undertaken by appropriately qualified personnel and that it is in accordance with good practice, apart from some minor exceptions as detailed below.

5.2 Design and Construction

Landfill design includes the under drainage system, earthworks (foundation preparation, liner, toe bund), liner systems, leachate collection system, perimeter landfill road and stormwater drainage. Some amendments to design details have been made by CWS as a result of operating experience and observations.

* Specialist member with expertise in landfill construction appointed under the provision in General Consent Condition 13.

† Specialist member with expertise in dams appointed under the provision in General Consent Condition 13.

During the period covered by this report the following design activities were undertaken.

- Design of Phase 2B Cell
- Design of Stage 1 of the Permanent Gas Flare system
- Preliminary Development of a Landfill Waste Settlement Model

CWS provided a draft Design Report and Drawings for Phase 2B in March 2012. Some amendments to the Design Report have since been made and we understand that a final version is close to completion. Design of Phase 2B was by T&T and is considered to represent best practice. Documentation of the Gas Flare system or the Settlement Model has not yet been provided.

The principle construction activity in 2011/2012 has been construction of Phase 2B. There were some difficulties during construction of Phase 2B due to the area being bounded on three sides by existing landfill batters which created some challenges in managing drainage. In addition, surface water leaked under the liner and eroded the underlying soil in places. This required cutting of the liner and repair to the subgrade and re-welding of the liner. Investigations were undertaken to identify the source of water, which was determined to be runoff entering via the liner anchor trench. It is recommended that consideration be given to amending the anchor trench detail to reduce the vulnerability to water entering and eroding the subgrade beneath the liner (e.g. lining the anchor trench with a geotextile). An as-built geology report for Phase 2B was prepared by Geotech Consulting in April 2012. The Phase 2B Construction Report is currently being compiled. On the basis of information provided and inspection of the works during construction, the PRP has no reason to believe Phase 2B works have not been undertaken in accordance with the design documentation. Confirmation of this will be possible once the final Design Report and the Construction Report have been received and reviewed.

Another large construction activity has been the construction of the Gas Flare system. This has involved civil, mechanical and electrical work. Some of the large components were manufactured overseas. The Gas Flare system was expected to be commissioned in late January 2013.

5.3 Management and Monitoring Plans

The TCL Landfill Annual Report⁸ is a clear, complete, and comprehensive review of landfill activities, and represents excellent practice in terms of landfill management and monitoring. The Landfill Gas and Landfill Leachate Annual Reports are valuable supplements to the Landfill Annual Report and they should be treated as having equivalent importance by TCL.

The Landfill Management Plan (LMP) was revised and re-issued in September, 2011. The LMP should be revised and reissued annually. The next reissue is overdue.

5.4 Water Control, including Stormwater, Groundwater, and Leachate Management

The PRP has no reason to believe that current stormwater systems are not appropriately engineered and maintained. The operation of the stormwater, groundwater, and leachate management systems represents good practice. The results reported in the draft TCL Annual Report indicate no water-related off-site impacts.

The stormwater management system works effectively and no signs of either major erosion or water quality issues are evident. However, surface drains require regular maintenance to remove sediment as the local soils are quite erodible and slip-prone in intense rainfall events. This is particularly important for drains located immediately above the liner (e.g. north side of Phase 2C and 2B) because, if they overtopped, water could potentially leak beneath the liner and cause damage to the subgrade. This potential vulnerability was experienced a few months after the principal construction of Phase 2B had been completed when a slip blocked a primary surface drain. This highlights the importance of maintaining the stormwater system so that it is capable of passing design flows.

The siltation dam has worked effectively to control erosion effects, and grassing of slopes has also helped reduce effects. The PRP has no reason to believe that current stormwater systems are not appropriately engineered.

The surface water quality monitoring data indicate no impact of the landfill - pH in surface water continues to be higher than historical values, but well within acceptable limits.

An automated alarm indicated elevated conductivity in the water exiting the sedimentation pond on 29 May 2012. A stormwater pond within the landfill had been disconnected from the normal stormwater system because of its potential to become contaminated and a pump left within the pond was inadvertently turned on, transferring the contaminated water into the sedimentation pond as if it were clean stormwater. The pump was turned off, and the outlet to the sedimentation pond closed. The contaminated water in the sedimentation pond was tested and treated as leachate until it had returned to normal concentrations. The water exiting the water supply dam showed no impact from the incident and so no consent violation occurred. It was notable that pH trigger levels were not exceeded during this event. The incident highlighted the value of an automated system for measuring conductivity, and the value of a fully effective sedimentation pond for controlling potential contamination from either leachate or contaminated water.

Underdrains are functioning adequately. Flows for the period July 2011 to June 2012 are summarised in Appendix O of the Landfill Annual Report⁸. Flows have increased with expansion of the Landfill into Phase 2C and extension of the drains, as would be expected. However, in Q1 and Q2 of 2012 the flow shows an erratic behaviour at times with large sudden changes in flow (e.g. 18 Jan, 7 and 15 Feb and 1

and 19 June 2012). CWS investigated these changes and concluded they were as a result of the recalibration of the V-notch weirs. We recommend that future reports include a plot of the complete historical flow record, and that an explanation for unusual data is included with the data. No contamination of the drains has been detected.

Groundwater quality monitoring data from wells outside of the landfill area indicate no impact of the landfill in terms of sustained high concentrations of multiple constituents. The occasional high concentrations of various constituents appear to either represent natural variability or sampling/analytical errors. A substantial data-set now exists from groundwater monitoring. The PRP believes that a reduction of monitoring requirements on groundwater quality and levels would now be appropriate.

The TCL Annual Report indicates a decrease in leachate pumped from the landfill in 2011/12 after three reporting years of elevated volumes. The PRP has not received the latest leachate report with details. Extreme rainfall events aside, the current leachate production levels should be considered more typical, provided that the final and intermediate cover area is maximized. Flushing of leachate drains was last undertaken in December 2008. It was proposed to be undertaken in 2011 but no equipment was available due to the Christchurch earthquake. It is now proposed to be undertaken again in early 2013. We also recommend that the leachate sump be flushed and de-scaled. This was last done in September 2009.

Approximately two-thirds of the leachate was recirculated to the waste in 2011/2012. Recirculation in 2011/2012 was through an above ground, K-line irrigation system, via special waste pits where the waste is amenable (i.e. sufficiently dry to allow leachate to be mixed), and also through irrigation of fresh waste with the waste compactor. The latter system has been viewed in operation and appears to be effective in managing leachate. Although leachate recirculation should not be seen as a complete substitute for treatment, it can be a valuable part of a leachate management system.

Based on the information provided in the Landfill Annual Report⁸ and occasional site visits, the PRP has no reason to believe that there are any environmental concerns related to water and leachate control.

5.5 Landfill Gas

During the reporting period, gas odour complaints have become a significant issue. To accommodate the increased gas generation, a larger and more permanent gas facility has been constructed. In addition, the placement of a thicker intermediate cover can be expected to decrease emissions.

The latest Annual Landfill Gas report has not yet been released to the PRP. Further comments on landfill gas issues may be made after that report is received.

5.6 Compaction, including Method and Degree

The compaction procedures as described in the LMP¹ represent good current practice. Appropriate and robust techniques are in use to monitor compaction, and PRP's occasional site visits confirm that appropriate compaction methods are in place. In addition, the attention paid at the site to small working faces and regularly sized daily cells has aided compaction and is commendable. The recent modification to the Compactor to allow spraying and mixing of leachate into the refuse appears to have the benefit of increasing the density of the refuse. The addition of leachate is akin to adding moisture to soils to bring them closer to the optimum moisture content. The PRP has no reason to believe that the current compaction operations are not appropriate.

5.7 Waste Acceptance

The waste acceptance procedures as described in the LMP¹ represent good current practice. On the basis of PRP site visits and the LMP, the current system appears clear and comprehensive with thorough documentation. The overview of waste acceptance issues in the Annual Plan is appropriate. CWS should continue to track problematic wastes and provide annual assessments to the PRP of their rate of occurrence. The PRP has no reason to believe that the waste acceptance system in place is jeopardising human health or the environment.

5.8 Cover Materials

The procedures for use of cover materials as described in the LMP¹ represent good current practice. Based on its occasional site visits, the PRP believes that application of daily cover is good. There are periods when the site generates substantial amounts of on-site litter. The site appears to receive the attention needed after these periods and no ongoing issues of wind-blown litter are evident.

However, the effectiveness of daily cover varies considerably in relation to the properties of the materials used. Site visits in October 2011, May 2012, and November 2012 indicated that good results were being obtained, but the visit of January 2013 exhibited only adequate coverage. This appears to be because of the use of loose, dry, sandy soil at that time. The PRP appreciates that, although the natural materials on-site are suitable for cover, there is variability with pockets of sandier material. More care should be taken when using sandier material, including increasing the moisture content.

During 2012 a temporary bench was made within the filled waste to improve stormwater management around Phase 2B. This cut exposing waste to the surface. Cuts like this should not be left uncovered because they provide access for vermin and increase the fire risk and violate consent conditions.

5.9 Settlement

The landfill has a total number of sixteen settlement markers. The PRP emphasises the importance of installing settlement markers as soon as possible after filling is completed. Settlement markers should also be re-established as soon as possible

following placement of new lifts of refuse. Settlement of refuse can be significant and the monitoring will assist with calibrating settlement predictions, so that the settled landfill profile will be close to design expectations. A plan outlining the proposed monitoring and interpretation, and how this information will be utilised in the design of the landfill, should be provided to the PRP. CWS are developing a settlement model that will be calibrated using monitoring results and other information on settlement of refuse. The model will be used to assist in determining the construction profile so that the long-term settled profile will be close to design expectations. Estimates of settlement are quite complex where fill of different ages occurs and the Settlement Model will be of considerable benefit. The work is ongoing and will involve review by the landfill designer.

5.10 Monitoring and Records

The Landfill Annual Reports to the regulatory authorities²⁻⁸ provide monitoring data. Taken together, they represent good landfill practice. Based on site visits and the data provided, the PRP has no reason to believe that thorough monitoring and record-keeping related to the consents does not occur.

Another aspect of 'good practice' with respect to records is timely documentation of work. There had been a notable improvement in documentation in the previous reporting period, but this improvement did not continue in the current reporting period. Overdue reports are:

1. Water Supply Dam: Operation, Maintenance and Surveillance Manual (expected August 2008, draft received in September 2009²⁹)
2. Sediment Dam: Operation, Maintenance, and Surveillance Manual (expected September 2009)
3. Phase 2C Construction Report (expected October 2009, draft of main report received February 2010²³, appendices received November 2011)
4. Phase 2B Design Report²⁶ (expected May 2012, draft received March 2012)
5. Phase 2B Construction Report (expected November 2012)

There is also an increased tendency for CWS to release draft reports to the PRP for comment without CWS providing final copies to the PRP. These reports are:

1. TCL Landfill Annual Report to 30 June 2011 (comments sent February 2012, no final report received)
2. TCL Landfill Leachate Annual Report to 30 June 2010, and to 30 June 2011 (comments sent April 2012, neither final report received)
3. TCL Landfill Gas Annual Report to 30 June 2011 (comments sent April 2012, no final report received)
4. TWC Landfill Management Plan (comments sent June 2012, no revision released)

Finally, the PRP has not received draft copies of the Landfill Leachate and Landfill Gas reports to 30 June 2012.

The Peer Review Panel appreciates the difficulties and unique situation occasioned by the Canterbury earthquakes; however, there is now an urgent need to address the backlog of recordkeeping. Landfills are enduring facilities with the potential for effects many years after activities take place. Because of this, thorough documentation is critical for future management. If the backlog of work cannot be eliminated, TCL should consider hiring additional staff, or letting additional contracts for work.

5.11 Rehabilitation

The PRP has not previously reported on the adequacy of rehabilitation at the site. Because of the long-term nature of the rehabilitation plans in place, it was not believed warranted. The PRP believes that now is a good time to begin reporting on rehabilitation. The current PRP members do not have the expertise to comment on the rehabilitation. The PRP has approached TCL about adding an expert to the PRP to comment on rehabilitation efforts at the site, and TCL has agreed to discuss with the relevant councils. It is hoped that the next PRP report will include comment on rehabilitation.

6. Managing Hydration Level of GCL (Condition 22, CRC021914)

CWS and T&T have a methodology³⁷ for evaluating the degree of hydration of the GCL so as to determine if it is within design limits. The results presented in previous Landfill Annual Reports indicate compliance with the condition.

Three samples were taken during April 2012. Detailed test results are provided in Appendix E of the 2012 Landfill Annual Report⁸. The samples had a water content of close to 20% and exhibited no evidence of significant hydration. The measured water content is well below the assumed design water content of approximately 50% necessary to reach full clay hydration. We confirm compliance with CRC021914 Condition 22.

Because compliance with this test requires cutting and then repair of the carefully constructed liner, the PRP is concerned that ongoing monitoring to meet this condition could jeopardise the long-term integrity of the liner. The PRP recommends that TCL examine alternative methods of meeting the intent of this condition, and that TCL and the councils reach agreement on an alternative condition.

7. Water Supply and Silt Dams (Condition 14, CRC 021919)

This condition (Appendix 1) relates to design and construction in an earlier reporting period and is discussed in the PRP's Annual Report No. 1. The PRP considers that Condition 14 has been met. The PRP has not received any dam monitoring results. The PRP assumes that both structures are being monitored in accordance with NZSOLD Dam Safety Guidelines, and that results have been within design expectations.

Construction reports and as-built drawings for both dams are long overdue. . Tony Pickford conducted an initial review of the available documentation for both dams in April 2010 and concluded that there was a need to finalise all documentation and records for the ongoing management and care of both dams. The current information gaps preclude informed comment in this report and this will be reported on in the next Peer Review Panel Report. This is part of a larger lack of timely documentation noted in section 5.8 of this report.

8. Sedimentation Dam Slope Stability (Condition 13, CRC 021919)

This condition (Appendix 1) relates to work in a previous reporting period and is discussed in the PRP's Annual Report No. 1. The PRP considers that Condition 13 has been met.

9. Stability of Northern Access Road (Condition 48, RC 020069)

It is understood that this condition relates to the perimeter access road that will be constructed in the next few years. It is likely that the design work for this part of the site will be undertaken in 2012/2013. The investigation and detailed design of this work will be subject to specific review at that time.

10. References

The list below gives the key documents (and dates of issue) available to/referenced by the PRP for Annual Report Number 8. The documents have been re-ordered by topic. The documents received since the release of the last PRP report are repeated in a list at the end.

Landfill Annual Reports and Landfill Management Plan

1. Landfill Management Plan, Issue 2, September 2011, by Transwaste Canterbury, incomplete.
2. Landfill Annual Report to 30 June 2005, September 2005, by Transwaste Canterbury.
3. Landfill Annual Report to 30 June 2006, September 2006, by Transwaste Canterbury.
4. Landfill Annual Report to 30 June 2007, November 2007, by Transwaste Canterbury.
5. Landfill Annual Report to 30 June 2008, December 2008, by Transwaste Canterbury.
6. Landfill Annual Report to 30 June 2009, received 12 February 2010, by Transwaste Canterbury.
7. Landfill Annual Report to 30 June 2010, May 2011, by Transwaste Canterbury.
8. Draft Landfill Annual Report to 30 June 2011, received 14 February 2012, by Transwaste Canterbury.
9. Draft Landfill Annual Report to 30 June 2012, received (body) January 2013, and (appendices) December 2012, by Transwaste Canterbury.

Phase-by-Phase Design and Construction Reports

10. Phase 1A-1 Design Report, 22 September 2004; plus amendments of 14 March 2005, by Tonkin & Taylor Ltd.
11. Phase 1A-1 Construction Report, September 2006, by Tonkin and Taylor Ltd.
12. As-built geology of the Cell 1A footprint and middle valley areas of the Canterbury Regional Landfill, Kate Valley, North Canterbury, April 2005, by Geotech Consulting Ltd.
13. Phase 1A-2 Design Report, 26 June 2009, by Tonkin and Taylor Ltd.
14. Phase 1A-2 Construction Report, reissued, October 2011, by Tonkin and Taylor Ltd.
15. Phase 2A Design Report, reissued, September 2011, prepared by Tonkin & Taylor Ltd.
16. As-built geology, Phase 2A construction works, Kate Valley Landfill, North Canterbury, August 2008, by Geotech Consulting Ltd
17. Phase 2A-1 Construction Report, August 2011, prepared by Tonkin and Taylor Ltd.
18. Phase 1A-3 Design Report, October 2011, prepared by Tonkin and Taylor Ltd.
19. Phase 1A-3 Drawings, Issue 2, October 2009, by Tonkin and Taylor Ltd.
20. Phase 1A-3 Construction Report, October 2011, prepared by Tonkin and Taylor Ltd.

21. Phase 2C-1B Figures, 4 November 2008, by Tonkin and Taylor Ltd.
22. Phase 2C-1B Drawings, 5 December 2008, by Tonkin and Taylor Ltd.
23. Phase 2C Design Report, October 2009, prepared by Tonkin and Taylor Ltd.
24. Draft Phase 2C Construction Report, October 2009, by Tonkin and Taylor Ltd.
25. Phase 2C Construction Report Appendices, by Transwaste Canterbury, 2011.
26. As-built geology, Phase 2C Construction Works, Kate Valley Landfill, North Canterbury, May 2009, by Geotech Consulting Ltd.
27. Draft Phase 2B Design Report, received 7 March 2012, by Transwaste Canterbury.
28. Draft Phase 2B Drawings, received 7 March 2012, by Transwaste Canterbury.
29. As-built geology, Phase 2B Construction Works, Kate Valley Landfill, North Canterbury, April 2012, by Geotech Consulting Ltd.

Dam Reports

30. Kate Valley Landfill Silt Dam: Construction Testing Review, September 2009, by Tonkin and Taylor Ltd.
31. Draft Kate Valley Landfill Water Supply Dam: Operation, Maintenance, and Surveillance Manual, September 2009, by Tonkin and Taylor Ltd.

Landfill Gas Reports

32. Phase 1A Landfill Gas Management System Design Report, November 2006, by Tonkin and Taylor Ltd.
33. Draft Landfill Gas Annual Report to 30 June 2011, received 13 March 2012, by Transwaste Canterbury.
34. Landfill Gas As-Built Drawings as of 30 June 2011, received 12 April 2012, by Transwaste Canterbury.

Landfill Leachate Reports

35. Leachate Report to 30 June 2008, November 2008, by Transwaste Canterbury.
36. Leachate Report to 30 June 2009, received 12 February 2010, by Transwaste Canterbury.
37. Draft Landfill Leachate Report to 30 June 2010, received 13 March 2012, by Transwaste Canterbury.
38. Draft Landfill Leachate Report to 30 June 2011, received 13 March 2012, by Transwaste Canterbury.

Other Reports

39. Draft GCL Hydration Condition and Related Inspection Procedure, 16 December 2005, by Tonkin and Taylor Ltd.
40. Review of Groundwater Divide and Baseflow Changes at Kate Valley Landfill, September 2009, by Pattle Delamore Partners.

Documents received since the last Peer Review Panel report.

- A. Draft Landfill Annual Report to 30 June 2012, received (body) January 2013, and (appendices) December 2012, by Transwaste Canterbury.
- B. As-built geology, Phase 2B Construction Works, Kate Valley Landfill, North Canterbury, April 2012, by Geotech Consulting Ltd. (received May 2012).

Appendix 1: Consent Conditions Relevant to PRP

General Consent Condition 11

The Consent Holder shall establish, at its own cost, an Independent Peer Review Panel, to review the design, construction, operation and after-care of the Landfill and to assess whether or not the work is undertaken by appropriately qualified personnel in accordance with good practice. The Independent Peer Review Panel shall comprise at least two persons who shall be:

- independent of the Consent Holder
- experienced in landfill design, construction and management
- experienced in landfill geotechnical, groundwater and surface water aspects
- recognised by their peers as having such experience, knowledge and skill
- approved in writing by the Hurunui District Council and the Canterbury Regional Council.

General Consent Condition 12

The Independent Peer Review Panel shall prepare an annual report for the Consent Holder on the adequacy of the following matters:

- management and monitoring plans
- site preparation, including hydrogeological and geotechnical issues
- liner design and construction and use of on-site materials
- water control, including stormwater and leachate management
- compaction, including method and degree
- waste acceptance
- cover material used
- monitoring, modelling and records
- rehabilitation

The Peer Review Panel shall take into account the matters covered by CRC021914 Condition 22, RC020069 Condition 48, CRC021919 Condition 13 and CRC021919 Condition 14 and address any issues arising.

General Consent Condition 13

Where the Independent Peer Review Panel does not have the expertise in any of the areas it is required to report on, as detailed above, it may, with the agreement of the Consent Holder and Canterbury Regional Council, engage the services of an appropriate expert to report on the relevant matter to the Independent Peer Review Panel. The report shall form part of the review provided by the Independent Peer Review Panel as required by the condition. Copies of all reports shall be sent to the Consent Holder, Hurunui District Council and Canterbury Regional Council by 1 October each year.

CRC021914 Condition 22 (formerly Special Condition 1)

The applicant shall prepare a detailed Management Plan to control, manage and monitor the hydration level of the GCL liner so as to maintain it within the design standard. A suitably qualified geotechnical engineer shall inspect the edges and any

exposed parts of the liner system, on at least an annual basis, and after weather events capable of causing surface water infiltration, in any situation where such infiltration has occurred and at the completion of each stage of filing. The geotechnical engineer shall provide an annual report to the consent holder, and the Regional Council and shall provide certification that the degree of hydration is within design limits and that in his or her view the degree of hydration does not result in any elevated risk of mass failure. The Management Plan shall outline the processes to be followed in the event that such certification cannot be provided. This shall include a process for deciding whether further development of the landfill can safely occur and for determining appropriate mitigation measures. (Copies of the management plan, report, and certification are to be provided by the consent holder to the Regional Council and to the Peer Review Panel within seven days of completion of the document.) In the event that the certification outlined above cannot be obtained at the end of any phase of filing, subsequent stages shall not proceed until redesign work demonstrates that a satisfactory level of stability can be assured and certified by the design engineer (such certification to be provided to the Peer Review Panel and the Regional Council).

RC020069 Condition 48 (formerly Special Condition 2)

In the area upgradient of deep cuttings along the northern access road which will have its toe support removed, all soil material above the Tokama Formation (soft rock) shall be removed prior to excavation of the cuttings. The lateral extent of the soil removal shall be defined by the points to the east and west of the cutting where the soil is undercut by the final excavation. The upgradient extent of the soil removal shall be determined during the final investigation of this area (prior to final design) and shall be certified by the design engineer as having a factor of safety of at least 1.2 (see AEE). (A copy of such certification to be provided to the Peer Review Panel and to the Regional Council.) Prior to excavation of the deep cutting into the Tokama Formation at these two locations, an investigation of the rock slope stability of these areas shall be carried out taking into account the unfavourable bedding at these locations. The design engineer shall certify that the rock cuttings have a factor of safety (FOS) greater than 1.1 under both design groundwater conditions and design earthquake loadings. (A copy of such certification to be provided to the Peer Review Panel and to the Regional Council.) In the event that stability cannot be certified (FOS > 1.1) under "Design Earthquake Loading and Design Groundwater Levels" the potentially unstable rock mass shall be excavated to provide a stable batter over the life of the landfill and its extended after care period.

CRC021919 Condition 13 (formerly Special Condition 3)

Prior to construction of the Siltation Control Dam an investigation of the slopes adjoining the dam embankment footprint and the pond area shall be carried out to assess the long-term stability of these batters. This investigation work shall take into account the result of the required detailed investigation of the proposed siltation dam and its foundations. The permanent slopes around the siltation pond and embankment shall be designed with appropriate factors of safety for design groundwater and seismic loadings. Where natural slopes exhibit potential mass or shallow instability the slopes shall be stabilised by soil removal, buttressing,

drainage, or such other measures as determined to be necessary. The design engineer shall prepare a report addressing the design of these slopes that shall be provided to the Peer Review Panel and to the Regional Council prior to construction.

CRC021919 Condition 14 (formerly Special Condition 5)

Both the siltation control dam and the water storage dam shall be investigated and designed in accordance with the New Zealand Dam Safety Guidelines as promulgated by the New Zealand Society on Large Dams (as agreed by the applicant). The investigation, design, peer review and monitoring of the dam shall take into account the following factors:

- the public are known to frequent the lower end of Kate Valley and the beach at the Kate Creek outlet
- the potential incremental consequences of failure in terms of socio-economic, financial and environmental matters would cause major damages in that the landfill would likely need to be closed, requiring extensive rehabilitation work.

**Appendix 2: Dates of PRP Meetings and Site Visits in this Reporting Period
(1 July 2011 – 22 January 2013)**

2 September 2011 (meeting with Transwaste Canterbury Board)

26 October 2011

12 January 2012 (Trevor Matuschka site visit)

18 May 2012 (meeting at Abros Place)

30 May 2012

5 November 2012

19 December 2012 (meeting at Abros Place)

22 January 2013 (Trevor Matuschka site visit)