

Kate Valley Landfill Peer Review Panel

Annual Report Number 14
Covering the period July 2017 to December 2018

February 2019

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CONTENTS

CONTENTS	1
1. Objective	2
2. Background	2
3. Scope of Review	3
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 Stormwater, Groundwater, 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.....	7
5.9 Settlement.....	7
5.10 Monitoring and Records	8
5.11 Rehabilitation.....	9
6. Managing Hydration Level of GCL (Condition 22, CRC157982)	10
7. Water Supply and Silt Dams (CRC157987, Condition 14, and CRC157990, Condition 7)	10
8. Sedimentation Dam Slope Stability (Condition 13, CRC 157987).....	11
9. Stability of Northern Access Road (Condition 48, RC 020069)	11
10. References	12

Appendix 1

Consent Conditions Relevant to PRP

Appendix 2

Dates of PRP meetings and site visits

1. Objective

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”. 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 (CWS), a division of Waste Management NZ Ltd. 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 considerable experience in the design and construction monitoring of landfills. T&T has 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 overviewed 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 closely with the contractors and provided quality assurance and testing services during the construction. Subsequent stages of construction have been undertaken by CWS using either plant hire or owner operated equipment. The landfill geomembrane liner has been supplied and installed by Viking Containment throughout the life of the project.

Several consents held with Environment Canterbury (ECan) were revised and reissued on 24 June 2016⁷⁶.

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 (the last of these is the responsibility of the relevant councils).

The timeframe for this review (1 July 2017 to 20 December 2018) exceeds 12 months, 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 2018 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. This review includes consideration of the TCL 2018 Kate Valley Landfill Annual Report¹⁶. Key documents provided to the PRP and considered relevant to consent monitoring officers are listed in the References section of this report.

4. Membership of Panel

The PRP comprises Dr Mark Milke, University of Canterbury, environmental engineering reviewer, and Dr Trevor Matuschka, Engineering Geology Ltd, geotechnical engineering reviewer. Until 1 July 2018, Dr Bruce Riddolls was on the Peer Review Panel. During this reporting period there was a transition with Dr Riddolls and Dr Matuschka both involved in peer review until 1 July 2018.

The PRP has the opportunity to call on specialist input under Condition 1.13 of CRC157982.

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

5.1 Overview

The PRP believes the landfill work has been 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 underdrainage system, earthworks (foundation preparation, liner, toe bund), liner systems, leachate collection system, perimeter landfill road and stormwater drainage. Design and associated documentation by T&T

is to a high standard. Some amendments to design details have been made by CWS as a result of operating experience and observations and this is appropriate.

The final design report for Phase 4A was released to the PRP in October 2017 for review⁴³. A preliminary Design Report and a preliminary set of Drawings for Phase 4A had earlier been produced^{39,40}. The final design report was reviewed by the PRP. Comments were provided, and additional supporting information relating to pipe strength and slope stability requested. The additional information satisfactorily answered the concerns of the PRP. As part of Phase 4A, local deepening and widening of existing front of bench drains adjacent to Phases 2C, 1B and 2B were proposed to increase the capacity from a 5-year return period storm to a 10-year return period storm. The PRP raised concerns about the risks associated with this work. After taking into consideration the risks, including damage to the liner, and the minimal benefit to be gained, CWS decided not to include upgrading of the existing front-of-bench drains.

The PRP provided comments on the geotechnical slope design report prepared by T&T for the Northern Service Platform.

Construction work in the reporting period included:

- Phase 4A earthworks and placement of the liner
- Placement of 800m³ of Type H and 1,200m³ of Type E liner protection material has been laid on the base and batters of Phase 4A
- Placement of intermediate cover along Phase 1A, 1A-3, 1B and 2C batters
- Two new 250m³ leachate storage tanks including a lined containment bund were constructed.

5.3 Management and Monitoring Plans

Management of the site is in accordance with good practice.

The PRP believes the site is well staffed, well equipped, and operated by well trained staff.

The Landfill Management Plan (LMP) was not revised or re-issued in 2018. The LMP provides a good overview of the management of the site. With regular amendment, it will prove an excellent resource for the site. The PRP recommends that a new issue is produced in 2019 in accord with the relevant resource consent.

The TCL Landfill Annual Report¹⁶ is a clear, complete, and comprehensive review of landfill activities, and represents excellent practice in terms of landfill management and monitoring. Landfill Gas and Landfill Leachate Annual Reports have been provided to the PRP for consideration. They are valuable supplements to the Landfill Annual Report. With refinements and improvements, they will become valuable for long-term management and monitoring. The PRP will provide additional advice to the landfill operators on improvements for these reports in 2019.

5.4 Stormwater, Groundwater, and Leachate Management

The operation of the stormwater, groundwater, and leachate management systems represents good practice. Based on the information provided in the Landfill Annual Report¹⁶ and occasional site visits, the PRP has no reason to believe that there are any environmental concerns related to these matters.

The stormwater management system was challenged at the site in this reporting period by rainfall rates not seen for a number of years. The system worked effectively. There was an incident of high conductivity detected at the siltation dam in April 2018 after a storm. A leachate seep was identified that was the suspected cause of the incident (See App. M, and end of App. T). The current monitoring system detected this seep and management systems removed its cause effectively. No evidence of an effect at the water supply dam was noted, and so the incident did not approach a breach of consent. Documentation of the incident is thorough and good practice.

The erodible nature of the local soils presents ongoing, manageable management risks. Because local soils are erodible, it is important for regular inspection of sediment accumulation and erosion in the surface drains. Accumulated sediment requires removal to maintain the flow capacity of the drains. The siltation dam has worked effectively to control sediment from outside of the landfill. Grassing of slopes has also helped reduce erosion potential at an erosion-prone site.

The water supply dam reservoir continues to show indications of excess siltation. The accumulation of sediment can have impacts on the visual quality of the outflow from the dam and affect spillway performance because of the reduced storage volume. Investigations into remedial action have begun. Action should be taken in the near-term to remedy the situation. In the meantime, the water supply dam should be more closely monitored for nuisance effects related to turbidity and eutrophication, and management systems developed to allow a quick response in case of more serious effects (e.g. a toxic algae bloom) over summer and autumn.

The wetland pond below the water supply dam reservoir shows high TLI3 values in the latest assessment period, indicating increased risk of eutrophication. Any future effects at this water body (e.g. toxic algae, odour, siltation, vegetation change) are more significant in terms of resource consent breaches, and also aesthetic concerns. The public currently have access to the wetland pond and the wetland is seen as an important feature of community engagement. We recommend that TCL reconsider their long-term vision for the wetland pond and then modify the catchment management regime to match the vision.

Underdrains are functioning adequately. The MS2 Underdrain pH, conductivity and flows for the period 1 July 2017 to 30 June 2018 are summarised in Appendix O of the Landfill Annual Report¹⁶. pH and conductivity values were generally consistent throughout the reporting period. pH was typically between 6.8 and 7.2 and well within the upper and lower trigger limits. Conductivity was typically 0.65 and below the trigger limit. Flows were generally between 0.5 and 0.7 litres/s, which is a little

greater than last year. This may be due to the higher rainfall. We continue to recommend that future Landfill Annual 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 reported.

Groundwater quality monitoring data from wells outside the landfill area indicate no impact of the landfill in terms of sustained high concentrations of multiple indicator constituents. The occasional elevated concentrations of various constituents appear to either represent natural variability, farming impact, or sampling/analytical errors. One well (BH18/30) with elevated nitrate concentrations shows no other indicators of potential landfill impact. Elevated phosphorus has been recorded in (BH21/12) and this appears to be related to variable chemistry arising from changes in local recharge from rainfall beyond the landfill.

The Peer Review Panel has seen a report describing a change of trigger levels for the groundwater and surface water monitoring points⁸³ and supports the use of those new trigger levels.

Management of leachate includes appropriate maintenance of the leachate collection system. CWS have developed procedures for flushing of the leachate drains and sump. The PRP has not seen documented procedures to assess whether they represent good practice, and recommends that they are provided to the PRP before October 2019.

In the 2017/2018 reporting year, roughly 10% of the leachate was removed from the landfill for treatment and 90% was recirculated. The leachate concentrations remained high. The ammonia concentrations have exceeded the 1500 mg/L concentration that the PRP would suggest is used as a trigger value to indicate a need to transport leachate off-site for treatment. From July 2018 to December 2018, there has been an increase in leachate transported off-site. Combined with the opening of a new landfill phase and the dilute leachate that creates, the leachate concentrations are expected to decrease through the next reporting period.

The latest landfill leachate report⁶⁷ represents good practice in landfill leachate management. The PRP advises that the report should not just consider the past year's data, but also include long-term evaluation of changes in leachate quantity/quality using the whole-of-life data. This type of evaluation has the potential to identify risks and better predict future behaviour.

5.5 Landfill Gas

Gas odour management practices are appropriate and represent good practice in landfill operation. There are ongoing odour issues, but these are treated in a thorough manner.

The latest landfill gas report⁵⁷ documents several aspects of the monitoring of the landfill gas system. A number of items mentioned in ECan permit CRC021915 are not addressed in the Annual Landfill Gas report. The operators intend to modify the report to more directly address the relevant consent conditions while also providing a

thorough report of long-term value to the operators.

5.6 Compaction, including Method and Degree

The compaction procedures as described in the LMP¹⁴ represent good current practice. Appropriate and robust techniques are in use to monitor compaction, and the PRP's occasional site visits confirm that appropriate compaction and covering methods are used. In addition, the attention paid at the site to small working faces and regularly sized daily cells has aided compaction and is commendable. 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 LMP¹⁴ 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 site has continued to have high amounts of asbestos-related wastes accepted during this reporting period. The use of a trench system to dispose of special wastes in a location separate from the working face continues. The trench does not expose non-special waste and is covered similar to operation of a daily cell. The PRP endorses this method for managing these dry special wastes. The LMP should be modified to incorporate this practice. The PRP has no reason to believe that the waste acceptance system in place is jeopardising human health or the environment.

5.8 Cover

The procedures for use of cover materials as described in the LMP¹⁴ 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, which seems related to loss of cover into waste. 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. This appears to be due to occasional use of loose, dry, sandy soil. The use of thicker and more appropriate intermediate cover can help significantly at the site to reduce the appearance of waste over time. The rapid establishment of grass has also helped.

5.9 Settlement

CWS commenced development of a Settlement Model to enable estimation of final cap settlements and installed settlement markers to monitor settlements. In 2017 T+T were engaged to undertake estimates of final cap settlement. The work was reported in 2018 and provided to the PRP in September 2018⁸⁰. The estimates are based partly on observations of settlements at other landfills and as such there is large inherent uncertainty. In order to verify settlement estimates T+T recommend settlement monitoring markers be installed in accessible areas of the landfill and that they be placed in areas immediately after filling has been completed. The markers should be

regularly monitored throughout the life of the landfill operation. T+T provide recommendations for the number of markers, how they should be monitored and the form of the markers. They also recommend that the results should be regularly reviewed and interpreted, and adjustments should be made to the selected settlement percentages where necessary. The PRP endorse the recommendations provided by T+T. Some settlement markers have previously been installed but have been filled over or destroyed. We understand that CWS intends to soon commence installation and monitoring of new markers. To allow for assessment of possible horizontal creep on the landfill surface the PRP recommend that monitoring include measurement of the co-ordinates of the settlement markers as well as the vertical movement (i.e. settlement).

The asbestos-contaminated waste associated with building demolition in Christchurch has a higher density than typical landfill material. The large quantities involved would not be typical of a landfill or considered likely during design. This could potentially result in increased loading on the leachate collection pipes and differential settlements within the landfill. CWS report that they have considered the implications of increased loading on the pipes and the loads are acceptable. They also report that differential settlement effects are expected to be minimal because this waste is not placed within 15 m of the edge of the landfill. It is recommended that the effects of asbestos-contaminated waste on the performance of the Landfill be confirmed by the Designer.

5.10 Monitoring and Records

The Landfill Annual Reports to the regulatory authorities 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 have been a series of difficulties over a number of years in the provision of timely documentation to the Peer Review Panel. The difficulties have decreased greatly over the past four years, but the situation is still short of good practice. The PRP believes the following reports are outstanding:

1. TCL Landfill Gas Annual Report to 30 June 2012 (expected November 2012).
2. TCL Landfill Gas Annual Report to 30 June 2013 (expected November 2013).
3. TCL Landfill Gas Annual Report to 30 June 2016 (expected November 2016).
4. Dam Safety Management System report for the Silt and Water Supply Dams (incomplete draft dated Sept. 2017 provided in January 2019, final report expected December 2017).
5. Phase 4A Construction Report (expected June 2018).
6. Comprehensive Dam Safety Review reports (expected September 2018).
7. Landfill Management Plan, Issue 5 (expected October 2018).

In addition, there are reports that were issued to the PRP as drafts^{9,38, 41, 45, 52, 60, 68}. Either final versions of these reports should be provided to the PRP or else the PRP should be notified that the draft documents can be taken as final documents.

Recent turnover of staff at the landfill has highlighted that the facility is at risk of staff being inadequately informed and then making decisions with negative consequences. There now exists extensive information on the site in the form of environmental quality data, geological assessments, construction reports, dam safety reviews, etc. There currently does not exist a clear bibliography for the site with the function of assisting staff new to the site to be able to access key information. Such a bibliography would also greatly assist local councils to more quickly find relevant information. Landfills are enduring facilities with the potential for effects many years after activities take place. Because of this, a bibliography is important for efficient future management by the operators and future regulation by the councils.

5.11 Rehabilitation

General Consent Condition 12 asks the Peer Review Panel to comment on rehabilitation as part of its annual report (see Appendix 1). Rehabilitation is a long-term process where small, yearly reviews are less appropriate than thorough reviews conducted every few years. At the time of consenting, a “Kate Valley Landscape Management Plan (KVLMP)” was developed by Boffa Miskell Ltd., and this report has been the basis for rehabilitation work to date.

The review of rehabilitation requires specialist advice, and the PRP gained approval to appoint Chris Glasson as a specialist peer reviewer on rehabilitation. He made two site visits in 2017, and provided a report⁷⁹. The report concludes that the rehabilitation work to date has been provided by suitably qualified and experienced personnel and that the KVLMP has provided an adequate basis for rehabilitation. Overall, rehabilitation outcomes at the site have varied from very good to adequate, depending on the situation.

The review has also identified deficiencies with the KVLMP including that, while it does provide a functional solution, it does not have a clear guiding philosophy. This makes it more difficult to judge the preferred direction for any changes that may become necessary (for example, because of unsuitability of specific species, or pest problems). The KVLMP also does not mention recommended plant preparation, e.g., the necessary soil depth and appropriate spraying regime associated with planting. Another weakness of the KVLMP is the lack of a process for developing maintenance plans, which are a key item. The recommendation of the PRP is that the KVLMP is modified and re-issued to address these matters.

In addition, the PRP recommends that the landfill operator develops a five-year maintenance plan concurrent with the above revision to the KVLMP. This maintenance plan would address issues with landscaping in specific areas as outlined in the recent review report⁷⁹. The PRP also recommends that a CWS staff member be identified as the landscape maintenance operator, and that this person produces annual programmes of work from the five-year plan, and also provides short annual status reports to the PRP on landscape maintenance. These three documents (five-year plan, yearly programmes of work, and yearly status reports) should be included in future TCL annual reports to facilitate review of rehabilitation.

The 2018 TCL Annual report (App. F, section 9) indicates an intention to action these recommendations in the next year.

6. Managing Hydration Level of GCL (Condition 22, CRC157982)

Condition 22 of CRC157982 requires preparation of a Management Plan to control, manage and monitor the hydration level of the GCL liner so as to maintain it within the design standard. The reason for this is to ensure that the degree of hydration is within design limits and will not result in any elevated risk of mass failure. Condition 22 requires the inspection of the edge of any exposed part of the liner system and recording of the liner at the completion of each stage of construction of the liner, and prior to the commencement of waste filling. In practice this involves inspection and sampling in areas where the geomembrane liner is exposed during the tie-in of a new cell to an existing cell. Condition 22 also requires the geotechnical engineer to provide details of these inspections in a report to the Consent Holder and the Canterbury 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 elevated risk of mass failure.

CWS and T&T developed a methodology⁶⁸ for evaluating the degree of hydration of the geosynthetic clay liner (GCL) so as to determine that it is within design limits. The results presented in previous Landfill Annual Reports indicate compliance with the condition. A GCL hydration report covering this reporting period was prepared by T+T and is included in Appendix E of the TCL Annual Report¹⁶. A visual inspection of the GCL exposed at the Phase 2C and 4A boundary was undertaken and did not show any signs of significant hydration except for a small localised patch (15m long x 2m wide) in the floor of the cell. A sample was taken along with one sample each about midway up the north and south walls of the Phase 2C/4A boundary. The section of hydrated GCL was assessed to be due to stormwater from Phase 4A entering the exposed GCL in the tie-in weld area. The hydrated area of GCL was removed where practical and replaced with new GCL. The average degree of hydration from the other two samples was consistent with previous sampling and within design limits. Based on their inspection, sampling and testing of the GCL and the remediation of the small area of hydrated GCL T+T provided certification that the degree of hydration is within design limits and that the degree of hydration does not result in elevated risk of mass failure.

7. Water Supply and Silt Dams (CRC157987, Condition 14, and CRC157990, Condition 7)

These two conditions (Appendix 1) relate to design and construction of the two dams. This has been discussed in the PRP's Annual Report No. 1. The PRP considers that, with respect to design and construction, these conditions have been met.

Both conditions mention that the PRP will review the monitoring of the two dams. Intermediate Dam Safety Reviews (IDSR) were conducted in 2015 by T+T^{47, 48}. A number of recommendations were provided. Some have yet to be actioned. The IDSR

was peer reviewed as part of the PRP by AECOM⁴⁹ and additional recommendations were made. According to the NZOLD Dam Safety Guidelines, the IDSR should be conducted every 1-2 years.

The 2015 IDSR reports recommended that in accordance with the latest NZSOLD Dam Safety Guidelines, a Comprehensive Dam Safety Review (CDSR) is needed. A review of the Potential Impact Category (PIC) for each dam was conducted in 2015 by T+T⁴⁶. According to the NZOLD guidelines, these should be reassessed as part of a CDSR.

Another recommendation of the IDSR reports was the production of a Dam Safety Management System (DSMS) report. This was produced in draft form in September 2017 by T+T⁵⁰ but has not been finalised because of a need for TCL/CWS input and comment. The report is in accordance with the 2015 NZSOLD Dam Safety Guidelines.

The PRP recommends the following:

- i. IDSRs should be undertaken in 2019
- ii. CDSRs should be undertaken in 2019. A CDSR would include review of the PIC; independent assessment of dam design, construction, operation, maintenance, monitoring and surveillance; review of monitoring data; evaluation of existing safety of the dams, dam safety management and emergency plans; new dam safety recommendations; and comment on the status of outstanding recommendations. This should all be benchmarked against the NZSOLD Dam Safety Guidelines.
- iii. CWS actions in 2019 the remaining recommendations in the 2015 IDSRs and in the Aecom review.
- iv. The DSMS report is finalised early in 2019.
- v. A bibliography of dam-related information is compiled.

8. Sedimentation Dam Slope Stability (Condition 13, CRC 157987)

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)

This condition relates to the perimeter access road that will be constructed prior to filling in the upper levels of the northern boundary of the site. As indicated in the whole-of-life plan, the intention is not to fill in the relevant areas for a number of years (5-10 years). Appendix B of the Annual Report¹⁶ shows the relevant areas as Phase 3B and Phase 4C. Because construction work has been programmed for near this area in less than 5 years, the operators have decided to start this investigation. This consent condition will be reviewed after the investigation is conducted.

10. References

The list below gives the key documents (and dates of issue) available to and/or referenced by the PRP for Annual Report Number 14. 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.
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. Landfill Annual Report to 30 June 2011, received 16 March 2015, by Transwaste Canterbury.
9. Draft Landfill Annual Report to 30 June 2012, received (body) January 2013, and (appendices) December 2012, by Transwaste Canterbury.
10. Landfill Annual Report to 30 June 2013, received as draft on 20 March 2014, and confirmed as final report on 9 April 2014.
11. Landfill Annual Report to 30 June 2014, received on 28 January 2015, by Transwaste Canterbury.
12. Landfill Annual Report to 30 June 2015, received on 3 February 2016.
13. Landfill Annual Report to 30 June 2016, received on 7 December 2016, revised report received 8 February 2017.
14. Landfill Management Plan, Issue 4, May 2017, received August 2017.
15. Landfill Annual Report to 30 June 2017, received on 22 December 2017.
16. Landfill Annual Report to 30 June 2018, received on 20 December 2018.

Phase-by-Phase Design and Construction Reports

17. Phase 1A-1 Design Report, 22 September 2004; plus amendments of 14 March 2005, by Tonkin & Taylor Ltd.
18. Phase 1A-1 Construction Report, September 2006, by Tonkin and Taylor Ltd.
19. 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.
20. Phase 1A-2 Design Report, 26 June 2009, by Tonkin and Taylor Ltd.
21. Phase 1A-2 Construction Report, reissued, October 2011, by Tonkin and Taylor Ltd.
22. Phase 2A Design Report, reissued, September 2011, prepared by Tonkin & Taylor Ltd.

23. As-built geology, Phase 2A construction works, Kate Valley Landfill, North Canterbury, August 2008, by Geotech Consulting Ltd
24. Phase 2A-1 Construction Report, August 2011, prepared by Tonkin and Taylor Ltd.
25. Phase 1A-3 Design Report, October 2011, prepared by Tonkin and Taylor Ltd.
26. Phase 1A-3 Drawings, Issue 2, October 2009, by Tonkin and Taylor Ltd.
27. Phase 1A-3 Construction Report, October 2011, prepared by Tonkin and Taylor Ltd.
28. Phase 2C-1B Figures, 4 November 2008, by Tonkin and Taylor Ltd.
29. Phase 2C-1B Drawings, 5 December 2008, by Tonkin and Taylor Ltd.
30. Phase 2C Design Report, October 2009, prepared by Tonkin and Taylor Ltd.
31. Phase 2C Construction Report, August 2010, by Tonkin and Taylor Ltd.
32. Phase 2C Construction Report Appendices, by Transwaste Canterbury, 2011.
33. As-built geology, Phase 2C Construction Works, Kate Valley Landfill, North Canterbury, May 2009, by Geotech Consulting Ltd.
34. Phase 2B Design Report, received 16 March 2015, by Transwaste Canterbury.
35. Phase 2B Drawings, received 7 March 2012, by Transwaste Canterbury.
36. Phase 2B Construction Report (including as-built geology report), March 2015, by Transwaste Canterbury.
37. Phase 1B Design Report, dated March 2015, received 8 April 2015, by Transwaste Canterbury.
38. Draft Phase 1B Construction Report (appendices final), received 15 December 2016, by Waste Management NZ.
39. Phase 4A Design Report, March 2016, received 25 October 2016, by Tonkin and Taylor.
40. Phase 4A Drawings, Client Review Issue, December 2015, received 25 October 2016, by Tonkin and Taylor.
41. Draft Phase 4A (part) and Western Projects Construction Report, August 2016, received 25 October 2016, by Tonkin and Taylor.
42. As-built drawings, Western Projects, November 2015, received 7 July 2016, by Tonkin and Taylor.
43. Phase 4A Design Report, August 2017, received October 2017, by Tonkin and Taylor.

Dam Reports

44. Kate Valley Landfill Silt Dam: Construction Testing Review, September 2009, by Tonkin and Taylor Ltd.
45. Draft Kate Valley Landfill Water Supply Dam: Operation, Maintenance, and Surveillance Manual, September 2009, by Tonkin and Taylor Ltd.
46. Review of the PIC of the Kate Valley Water Supply and Silt Dams, 4 November 2015, received 5 May 2016, by Tonkin and Taylor.
47. Intermediate Dam Safety Review: Silt Dam, November 2015, received 5 May 2016, by Tonkin and Taylor.
48. Intermediate Dam Safety Review: Water Supply Dam, November 2015, received 5 May 2016, by Tonkin and Taylor.
49. Kate Valley Dams (Peer) Review, 22 December 2016, received 30 December 2016, by James Robinson, AECOM.

50. Dam Safety Management System for Kate Valley, draft, Sept. 2017, received January 2019, by Tonkin & Taylor Ltd.

Landfill Gas Reports

51. Phase 1A Landfill Gas Management System Design Report, November 2006, by Tonkin and Taylor Ltd.
52. Draft Landfill Gas Annual Report to 30 June 2011, received 13 March 2012, by Transwaste Canterbury.
53. Landfill Gas As-Built Drawings as of 30 June 2011, received 12 April 2012, by Transwaste Canterbury.
54. LFG Stage 1 Flare: As Built Records, received 3 November 2014, by Transwaste Canterbury.
55. Landfill Gas Annual Report to 30 June 2014, received August 2017, by Transwaste Canterbury.
56. Landfill Gas Annual Report to 30 June 2015, received August 2017, by Transwaste Canterbury.
57. Landfill Gas Annual Report to 30 June 2018, by Transwaste Canterbury, received December 2018.

Landfill Leachate Reports

58. Leachate Report to 30 June 2008, November 2008, by Transwaste Canterbury.
59. Leachate Report to 30 June 2009, received 12 February 2010, by Transwaste Canterbury.
60. Draft Landfill Leachate Report to 30 June 2010, received 13 March 2012, by Transwaste Canterbury.
61. Landfill Leachate Report to 30 June 2011, received 13 March 2012, by Transwaste Canterbury.
62. Landfill Leachate Report to 30 June 2012, received 10 May 2016, by Transwaste Canterbury.
63. Landfill Leachate Report to 30 June 2013, received 20 May 2016, by Transwaste Canterbury.
64. Leachate Management Review, received 28 August 2013, by Transwaste Canterbury.
65. Landfill Leachate Report to 30 June 2014, received August 2017, by Transwaste Canterbury.
66. Landfill Leachate Report to 30 June 2015, received August 2017, by Transwaste Canterbury.
67. Landfill Leachate Report to 30 June 2018, by Transwaste Canterbury, received December 2018.

Other Reports

68. Draft GCL Hydration Condition and Related Inspection Procedure, 16 December 2005, by Tonkin and Taylor Ltd.
69. Review of Groundwater Divide and Baseflow Changes at Kate Valley Landfill, September 2009, by Pattle Delamore Partners.
70. Geotechnical visual inspection of storm-induced shallow soil failures, Kate Valley Landfill upper slopes, 28 November 2013, by Geotech Consulting Ltd.

71. Geotechnical visual inspection of storm-induced soil failure near Silt Dam, Kate Valley Landfill lower slopes, 5 June 2014, by Geotech Consulting Ltd.
72. Kate Valley Landfill, Whole-of-life Model as at 20 June 2013, June 2014, by Transwaste Canterbury
73. Review of Groundwater Divide and Baseflow Changes at Kate Valley Landfill, September 2014, by Pattle Delamore Partners.
74. Kate Valley Landfill Financial Assurance (Bond) Review, October 2014, by Jacobs NZ Ltd.
75. Geotechnical visual inspection of slope failure on water supply dam road, 31 July 2015, received 3 February 2016, by Geotech Consulting.
76. Revised Environment Canterbury Resource Consent Conditions, 24 June 2016, by Transwaste Canterbury, received 7 December 2016.
77. Water Supply Dam Access Road Rockfall, 30 June 2016, by Opus Christchurch, received 25 October 2016.
78. Geotechnical inspection of Kate Valley landfill and access road post the 14 November 2016 Kaikoura Earthquake, 2 January 2017, received, 18 January 2018, by Geotech Consulting Ltd.
79. Peer Review of Landscape Management Plan and Rehabilitation, November 2017, received Nov. 2017, by Chris Glasson Landscape Architects Ltd.
80. Kate Valley Landfill, Canterbury – Final Cap Settlement, July 2018, received Sept. 2018, by Tonkin & Taylor Ltd.
81. Kate Valley Landfill, Canterbury – Final Cap Design, July 2018 draft, received Sept. 2018, by Tonkin & Taylor Ltd.
82. Kate Valley Landfill, Canterbury – Geotechnical Slope Design (for Northern Service Platform), May 2018 draft, received Sept. 2018, by Tonkin & Taylor. Ltd.
83. Revised Trigger Level Calculations for Groundwater and Continuous Surface Water Monitoring at Kate Valley Landfill, Sept. 2018, received Nov. 2018, by Pattle Delamore Partners Ltd.

Documents received since the last Peer Review Panel report

- Kate Valley Landfill, Canterbury – Final Cap Settlement, July 2018, received Sept. 2018, by Tonkin & Taylor Ltd.
- Kate Valley Landfill, Canterbury – Final Cap Design, July 2018 draft, received Sept. 2018, by Tonkin & Taylor Ltd.
- Kate Valley Landfill, Canterbury – Geotechnical Slope Design (for Northern Service Platform), May 2018 draft, received Sept. 2018, by Tonkin & Taylor. Ltd.
- Revised Trigger Level Calculations for Groundwater and Continuous Surface Water Monitoring at Kate Valley Landfill, Sept. 2018, received Nov. 2018, by Pattle Delamore Partners Ltd.
- Landfill Leachate Report to 30 June 2018, by Transwaste Canterbury, received December 2018.
- Landfill Gas Annual Report to 30 June 2018, by Transwaste Canterbury, received December 2018.
- Landfill Annual Report to 30 June 2018, received December 2018.
- Dam Safety Management System for Kate Valley, draft, Sept. 2017, received January 2019, by Tonkin & Taylor Ltd.

Appendix 1: Consent Conditions Relevant to PRP

Condition 1.11, CRC157981

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:

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

Condition 1.12, CRC157981

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

- a. management and monitoring plans
- b. site preparation, including hydrogeological and geotechnical issues
- c. liner design and construction and use of on-site materials
- d. water control, including stormwater and leachate management
- e. compaction, including method and degree
- f. waste acceptance
- g. cover material used
- h. monitoring, modelling and records
- i. rehabilitation

The Peer Review Panel shall take into account the matters covered by CRC157982 Condition 22, RC020069 Condition 48, CRC157987 Condition 13 and CRC157987 Condition 14 and address any issues arising.

Condition 1.13, CRC157981

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 31 December each year, unless otherwise agreed in writing with Hurunui District Council and the Canterbury Regional Council.

Air Discharge Permit CRC157984, Condition 24

The Consent Holder shall submit a summary of landfill gas monitoring results to the Peer Review Panel at the end of each year.

CRC157982 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, and record the condition of the liner at the completion of each stage of construction of the liner, and prior to commencement of waste filing. The geotechnical engineer shall provide details of these inspections in a report to the Consent Holder, and the Canterbury 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.

CRC157987 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.

CRC157987 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.

CRC157990 Condition 7

The water storage dam shall be designed, constructed, and monitored following the procedures set out in the NZSOLD Guidelines November 2000, and the procedures shall be reviewed by the Peer Review Panel.

Appendix 2: Dates of PRP Meetings and Site Visits in this Reporting Period (1 July 2017 – 20 December 2018)

10 August 2017	Site visit and PRP meeting
1 December 2017	Meeting at Marshs Rd. with CWS and Scott Wilson (PDP)
18 January 2018	Site visit and PRP meeting (with Drs. Matuschka and Riddolls)
2 May 2018	Site visit and PRP meeting
11 September 2018	Site visit and PRP meeting
14 November 2018	Meeting at Marshs Rd. with CWS and Scott Wilson (PDP)
20 December 2018	Site visit and PRP meeting