BEFORE THE COMMISSIONER

APPOINTED BY ENVIRONMENT SOUTHLAND

In the Matter	of applications for resource consent to operate a landfill (APP20202200, APP-205862-01-V2)
Between	**A B LIME LIMITED**
	Applicant

BRIEF OF EVIDENCE OF TIMOTHY MICHAEL BAKER

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BRIEF OF EVIDENCE OF TIMOTHY BAKER

Introduction

1. My name is Timothy Michael Baker. I hold the position of Senior Associate Hydrogeologist at Jacobs New Zealand Ltd. I have been in this position since January 2013. I have a total of 18 years' experience in the field of hydrogeology and water resources.

2. I hold a Bachelor of Science (BSc) in Geography and Environmental Science (2000) and a Master of Science Degree with Honours in Physical Geography (2003) from Victoria University of Wellington.

3. I am also a member of the Hydrological Society of New Zealand, Waste Management Institute New Zealand (WasteMINZ) and the Australasian Land and Groundwater Association (ALGA).

4. I have acted as an Expert Witness in groundwater related consent hearings in New Zealand for the past eight years. I have provided expertise in the fields of hydrogeology, groundwater quality and environmental monitoring plans designed for a range of local government clients including Greater Wellington Regional Council, Bay of Plenty Regional Council, Manawatu-Wanganui Regional Council, and other organisations such as Horticulture New Zealand and Fonterra.

5. The purpose of this evidence is to describe the hydrogeological setting and groundwater quality at the AB Lime landfill and discuss relevant performance criteria identified as part of this resource consent application. In this evidence I address:

   (a) Important background;

   (b) Proposed activities and effects on groundwater;

   (c) Geological setting, including:

      (i) Regional geology; and

      (ii) Site geology

(d) Hydrogeological setting, including:

(i) The receiving environment.

(e) Description of groundwater quality pre-landfill;

(f) Current monitoring including:

(i) Current consent requirements;

(ii) Landfill trigger levels; and

(iii) Monitoring wells.

(g) Proposed further monitoring

(h) The submissions made on the application that raise or are relevant to hydrogeological setting and groundwater quality; and

(i) The s 42A Officer's Report.

6. In preparation for this hearing I have been to the AB Lime landfill site.

7. Recognising this is a Council hearing and not under the jurisdiction of the Environment Court, I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Important Background

8. Limestone quarrying has occurred at the AB Lime site since 1947.

9. In 2003 a consent application was lodged with Environment Southland to allow for the operation of a municipal landfill within decommissioned parts of the quarry. This was granted in June 2003.

10. To support the 2003 application, an extensive hydrogeological investigation and assessment of groundwater effects was undertaken[1]. That assessment included:

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[1] Hydrogeology Technical Report. SKM, 2003.

(a) Description and review of regional geology and hydrogeology;

(b) Results of a site-specific drilling programme to ascertain groundwater levels and quality;

(c) Development of a conceptual hydrogeological model; and

(d) Assessment of effects from both quarrying and landfilling on groundwater quality.

Proposed Activities and Effects on Groundwater

11. The key changes sought in this proposal are:

(a) Removal of the annual weight limit of waste able to be deposited at the landfill annually; and

(b) Update and amendment of the suite of management plans for the landfill operation including establishment of a robust process for waste acceptance in emergency response scenarios.

12. In addition, operational changes proposed include:

(a) Reducing the working face of the landfill to 1000 m^2;

(b) Improved temporary capping;

(c) Reduction of the oversteep slopes; and

(d) Improved daily cover.

13. It is important to note that no change is proposed to the consented landfill footprint, final area, or capacity of the landfill.

14. AB Lime is currently a Class 1 landfill. None of the proposed alterations to the consent conditions will change this status. A Class 1 landfill meets the design standards outlined in the Centre for Advanced Engineering’s Landfill Guidelines (CAE, 2000). These standards include:

(a) Being sited in an area that reduces the potential for adverse environmental effects;

(b) Having an engineered system designed to provide a degree of redundancy for leachate containment; and

(c) Having an engineered system to collect landfill leachate and landfill gas.

15. As a landfill compliant with the Class 1 guidance, the AB Lime landfill has an underdrainage system keeping any groundwater away from the liner, an engineered leachate collection system, and it also has stormwater diversion infrastructure in place. This infrastructure minimises the likelihood of the landfill material affecting groundwater quality.

16. No changes to this infrastructure are proposed.

17. As such, the likelihood of an additional effects beyond those assessed and consented during the 2003 application is negligible. The speed at which the landfill fills up is the key change. This will not increase the risk of leachate migrating to groundwater. If anything, the potential for leachate generation (and subsequent losses to groundwater) will reduce as the amount of time the site is uncapped for will reduce, and the working face area is being reduced. These factors combine to manage the volumes of leachate produced and therefore the risks of effects arising from it.

Geological Setting

18. The AB Lime quarry and landfill is located on the western flanks of Winton Hill, approximately 4 km east of Winton. The quarry rises from an elevation of approximately 80 m above mean sea level (m amsl) to approximately 160 m amsl. The valley floor where Winton and the Oreti River are located is at approximately 55m amsl.

Regional Geology

19. There are four main geological formations in the Winton region. These are:

(a) Fluvial-Glacial Gravels;

(b) Forest Hill Formation;

(c) Chatton Formation; and

(d) Basement Rock.

20. The fluvio-glacial gravels contain outwash gravels and glacial till that were deposited during the last glaciation. The alluvial gravels comprise of gravel, sand, silt, and clay. In the area around AB Lime the alluvium pinches out on the limestone and contains a high proportion of colluvium originating from the flanks of Winton Hill.

21. The Forest Hill Formation consists of thickly bedded limestone. The limestone is considered pure, making it suitable for agricultural and cement purposes.

22. The Chatton Formation comprises of shallow marine, fine to coarse grained sandstone, siltstone, and conglomerate. The formation is widespread but discontinuous and at the AB Lime locale, underlies the Forest Hill formation.

23. Basement rocks underlie the above units. They consist of sandstones, siltstones, and mudstones. The closest surface exposure of this formation is found in the Hokonui Hills, seven to ten kilometres northeast of the AB Lime site.

Site Geology

24. The site geology of AB Lime is made up of three formations: overburden material, limestone of the Forest Hill Formation, and siltstone of the Chatton Formation.

25. The overburden material consists of topsoil, silt and clay colluvium, and residual limestone clasts. Where quarrying activity has occurred, the overburden is absent.

26. The limestone of the Forest Hill Formation is slightly weathered and varies in the thickness of the bedding. The interbedding of thin clay and silt horizons generally occurs near the surface. Fractures and dissolution features (Karst features) decrease with depth and are

limited to above the water table. Karst is the name given to the areas of limestone geology characterised by landforms developed because of solution processes.

27. The siltstone of the Chatton Formation is slightly calcareous and contains occasional shell inclusions and mudstone/sandstone horizons. The interface between the Forest Hill Formation and the Chatton Formation is a sharp contact.

28. A cross section of the site (**Attachment A**) shows a typical section through the site (pre-quarrying, figure sourced from original AEE). To the right of the cross section (downgradient of the site) there will be the valley alluvium.

29. There have been sinkholes identified on the site, as shown in **Attachment B**.

Hydrogeological Setting

30. The regional groundwater system is referred to as the Lower Oreti Groundwater Management Zone (GMZ). The GMZ covers an area of 22,500 ha[2]. The western boundary of the GMZ follows the Oreti River channel south of the Hokonui Hills. The eastern boundary follows the boundary between the Oreti catchment to the west and the Makarewa catchment to the east.

31. The Lower Oreti GMZ hosts an extensive unconfined aquifer system that exists mainly in the Quaternary alluvium. Depth to groundwater in along the valley flow is typically 1 to 4 m, becoming shallower toward the Oreti River. The tertiary limestone sediments on the eastern part of the GMZ (i.e. around Winton Hill) host a poorly defined unconfined and semi-confined groundwater resource. Allocation of the GMZ is low.

32. Groundwater flow at the site can be simplified into two broad zones:

[2] *Lower Oreti – Groundwater Management Zones*, Environment Southland, https://www.es.govt.nz/environment/water/groundwater/groundwater-management-zones/lower-oreti, (Accessed on 23 April 2021).

(a) Karst (vadose) zone – water transmission zones comprising sinkholes, solution cavities and fractures within the upper 20 m and above the local groundwater table within the limestone of the Forest Hill Formation.

(b) Non-karst (saturated/phreatic) zone – aquifer zones beneath the local groundwater table consisting of massive low permeability limestone of the Forest Hill Formation and the underlying siltstone of the Chatton Formation. Flow characteristics of this zone conform to porous media flow governing equations.

33. Groundwater flow from sinkholes is thought to travel laterally, discharging as karst springs on the valley sides and base at mid-level within the catchment.

34. Groundwater flowing in the massive limestone is likely to migrate downwards and toward the valley floor. Some springs are present around 60 to 70 m elevation.

35. Groundwater gradients were measured as part of the 2003 groundwater investigation (SKM, 2003) and have been confirmed through the subsequent 18 years of monitoring. The gradients can be described conceptually as:

(a) Downward groundwater pressure gradients are present in higher altitude recharge areas and upward pressure gradients in the lower discharge areas.

(b) Positive (i.e. upward) groundwater gradients currently exist beneath the base of the quarry, with groundwater seepage towards the ground surface.

36. This provides a form of hydrogeological security to the landfill site against leachate leakage impacting on the local groundwater resource as discussed further in paragraph [38].

Receiving Environment

37. There are 11 bores within the vicinity of the groundwater flow direction from the AB Lime landfill (as shown in **Attachment C**). A summary of

the bores is presented **Attachment D** providing an overview of the bores and showing the locations of the bores.

38. As described above, upward hydraulic gradients beneath the site limit the risk of groundwater moving vertically downward from beneath the landfill into deeper groundwater systems. As such, it is the shallow groundwater system beneath the landfill and downgradient of the site that is of interest with regards to groundwater quality. This includes spring fed streams down gradient of the landfill where shallow groundwater may emerge.

39. In my opinion, given the low permeability of the limestone and the low groundwater seepage rates to the adjacent alluvium, the groundwater quantity and quality effects of the landfilling is likely to be limited to less than 500 m of the site.

40. As such, in my opinion, the bores summarised in **Attachment D** are not considered to be affected by the landfilling operations.

Groundwater Quality Pre-landfill

41. A comprehensive groundwater investigation was completed at the site by SKM (2003) to characterise the groundwater body pre-landfill and provide a valuable baseline against which to assess the effects of the landfill operation to date. This investigation included baseline water quality sampling of four monitoring wells before any waste was placed in the quarry pit.

42. The four wells monitored are shown on **Attachment B**. They were:

    (a) SKM 101A

    (b) SKM 102A

    (c) SKM 104

    (d) SKM 108

43. It found that the pH was typically around 7.4, with limited variation between the bores. It also found that there were high bicarbonate and

total hardness levels recorded in all bores. This is typical of limestone aquifers and is of aesthetic significance only.

44. The chemical concentrations of all parameters were below the Australia and New Zealand Environment and Conservation Council (ANZECC) guidelines and the New Zealand Drinking Water Standards (NZDWS, 2000), with the exception of dissolved lead, dissolved copper, and nitrate-nitrogen. The dissolved lead in one bore was less than the ANZECC guideline but greater than NZDWS (2000). The dissolved copper concentration in one bore was marginally greater than the ANZECC guideline but less that the NZDWS (2000). The nitrate nitrogen was higher than the ANZECC guidelines in all groundwater samples obtained, but lower than NZDWS (2000). Nitrate-nitrogen is likely derived from stock effluent and fertiliser use.

45. Environment Southland's State of the Environment Groundwater Quality Report (2010) states that historical groundwater quality monitoring has identified areas within Southland that have elevated groundwater quality risk and elevated nitrate concentrations[3]. These areas reflect the effects of both current and historical land use such as grazing, fertiliser application and soil cultivation. The report showed that some areas around Winton have elevated groundwater nitrate concentrations and elevated groundwater quality risk.

46. In my opinion, the pre-landfill groundwater quality monitoring data indicates that groundwater has most likely been impacted by agricultural land use and the baseline groundwater quality pre-landfill has been impacted by farming practices.

Current Monitoring

Current Consent Requirements

47. AB Lime currently follows the existing consent conditions, these provide performance or environmental standards for the monitoring of groundwater.

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[3] *Environment Southland State of the Environment Report (2010) produced by Liquid Earth,* page 26

48. AB Lime are required to monitor groundwater quality in seven monitoring wells in accordance with current consent conditions, as shown in **Attachment B.**

49. The wells are monitored:

    (a) 6-monthly for the primary analytical suite of major anions and cations, field parameters, nutrients and bacteria, Carbonaceous Oxygen Demand (COD), Biological Oxygen Demand (BOD), and trace metals; and

    (b) Annually for Volatile Organic Compounds (VOC) and Semi-VOC's coinciding with summer groundwater minimum.

50. Mrs Smith in her evidence details how these wells are monitored[4].

Landfill Trigger Levels

51. As part of the existing consent, trigger levels are utilised as a set of standards used to gauge the effects on the environment from the operation of the landfill. There are two trigger levels set for each monitoring location to allow for early detection and interception of any issues with the groundwater. The first level, Trigger Level 1 (TL1), is a lower response limit and a warning level. Trigger Level 2 (TL2) is an upper response limit and an alarm level.

52. TL1 levels are currently based on the water quality results collected on site in 2010 and 2011. They provide an indication that the water quality at AB Lime has varied from the background levels. Exceedance of TL1 warns of potential adverse effects, and potential future non-compliance with the resource consent conditions and results in a review of landfill management practices to identify and remedy the cause of the exceedance.

53. TL2 levels were previously based on the ANZECC (2000) or the United States Environmental Protection Authority (USEPA, 1999) guidelines. The TL2 levels have been updated to reflect Australia New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). These

[4] Evidence of Mrs Smith at paragraphs [61] and [63]-[65]

levels have a focus on the protection of aquatic life. Exceedance of a TL2 is a strong indication that adverse effects and breaches of consent conditions may already be occurring, or could have occurred, or are about to occur.

54. In my opinion, the relevance of TL2 (i.e. the use of a freshwater ecological standard) is debatable in a groundwater environment that already has some pre-existing exceedances in Trigger Levels. Ecological standards (such as the ANZG) are derived for surface water ecosystems, not groundwater ecosystems.

55. I now turn to the groundwater quality data that has been collected to date with specific regard to these trigger levels.

Monitoring Wells

56. The locations of the current monitoring wells on site are presented in **Attachment B** and are numbered SKM 104, 106, 108, 201, 202, 203, 204. These sites have been monitored since 2004. They are briefly described below.

SKM 104 and SKM 106 – Upgradient Wells

57. SKM 104 is upgradient of the quarry and landfill and is treated as a background reference well. It has elevated concentrations of zinc, nitrate, carbonaceous oxygen demand (COD), and ammoniacal nitrogen as well as occasional elevated phosphorus concentrations compared to the trigger levels.

58. SKM 106 is also upgradient of the quarry and landfill and is treated as a background reference well. It has elevated concentrations of zinc and nitrate as well as occasional elevated phosphorus concentrations compared to the trigger levels.

59. In my opinion, SKM 104 and 106 are not expected to present appreciable change in groundwater quality since the landfilling operations commenced as they are upgradient of the landfill. As expected, SKM 104 showed very little change in groundwater quality between 2004 and 2010 - 2019. The only notable increases are in

sulphate, nitrate and total kjeldahl nitrogen. All of these are likely a reflection of the intensification of the pastoral land use surrounding the AB Lime property.

SKM 108 – Downgradient Boundary

60. SKM 108 is the southernmost monitoring well and is located on the downgradient boundary. At present it provides the best indication of shallow groundwater quality at the site boundary.

61. As with the background wells, SKM 108 has elevated levels of zinc and phosphorus but lower nitrate. In addition, it has sulphate, nickel, manganese, and ammoniacal nitrogen concentrations that exceed TL1 (historical median). Only copper and zinc exceed TL2 (ecological).

62. When compared to the pre-landfill data, concentrations are very similar, suggesting these contaminants were already present in groundwater prior to the landfill being operational. Nevertheless, and regardless of the source, concentrations are compliant with the NZDWS, (2008) so the risk to downgradient groundwater users is negligible.

63. In my opinion, overall, it is fair to conclude that there has been very little change in groundwater quality since landfilling commenced in 2004.

SKM 201 – Next to Leachate Tank

64. SKM 201 is located adjacent to the leachate tank, immediately downgradient of the toe of the first landfilled cell. It is in a location that should provide an early indication of any groundwater contamination but is not indicative of off-site discharges, as it is in the middle of the property.

65. SKM 201 has elevated zinc as well as occasional elevated concentrations of boron, chromium, and copper compared to the TL2 levels. Boron, chromium, and copper are common landfill leachate indicators however, they are still compliant with the NZDWS (2008).

66. In my opinion, results from this well show little to no effect from landfill leachate.

SKM 202, 203 and 204 – Downgradient of Landfill Cells

67. SKM 202, 203 and 204 are all located on a transect that cuts across the main groundwater flow path down gradient of the landfill. They should all provide data that is representative of the groundwater flow downgradient of the landfill.

68. SKM 202 has elevated zinc and occasional elevated copper concentrations compared to the trigger levels. However, the zinc concentration is 50% lower than that observed in SKM 104 and 106 (the background wells upgradient of the landfill) so is not of concern.

69. SKM 203 has elevated manganese, zinc, and phosphorus and occasional exceedances of copper, chromium and nitrate concentrations compared to the trigger levels. The zinc and phosphorus concentrations are less than the background levels.

70. The nitrate present in this well may be a result of upwelling of deeper groundwater, rather than a landfill leachate indicator. This is because nitrogen in leachate is typically found in the unoxidized form of ammoniacal nitrogen, rather than nitrate-nitrogen.

71. SKM 204 is currently compliant with all the trigger levels, other than a very occasional exceedance of phosphorus concentrations.

72. The wells are proportionally high in bicarbonate and calcium, as expected from a karst aquifer.

73. SKM 202, 203 and 204 all provide data that is representative of groundwater flowing downgradient of the landfill, toward the site boundary. These sites all display some very low concentrations of compounds that may indicate landfill leachate. In my opinion, this will not affect any other users or off-site receptors.

Site 13 and Site 17 – Landfill Underdrainage

74. Two sites are also monitored from the landfill underdrainage system and the leachate pond underdrainage system, which serve as an early warning of liner failure. These two sites are Site 13 and 17. These sites are only monitored for pH, electrical conductivity, chloride and total ammoniacal nitrogen as they are key indicators of landfill leachate.

75. Site 13 is from the landfill underdrainage system. Since 2006, pH results have increased from 7.2 to 7.8, perhaps a reflection of the increased upwelling of groundwater coming from the base of the quarry. The electrical conductivity has varied, which indicates a level of influence of contaminants on the groundwater. Chloride and ammoniacal nitrogen concentrations have shown no significant change.

76. In my opinion, this indicates that the landfill liner is effective (not leaking) and is preventing leachate from entering groundwater.

77. Site 17 is from the leachate pond underdrainage system. The electrical conductivity has varied, which potentially indicates a level of influence of contaminants on the groundwater. The chloride and ammoniacal nitrogen concentrations at this site vary considerably.

78. In my opinion, this suggests that there may be some limited influence on the groundwater from the landfill leachate pond. The increases are not consistent, so it is unlikely to be from pond failure. I understand AB Lime routinely empty the leachate tank and assess the tank integrity.

Monitoring Data Conclusions

79. The landfill is well-sited from a geological and hydrogeological perspective due to the natural upward hydraulic pressures beneath the site that prevent the downward migration of groundwater beyond the site boundary. This minimises the risk of leachate affecting offsite groundwater receptors.

80. Pre-landfill groundwater quality data has provided a useful dataset from which to assess the effects of the past 17 years of landfilling. Groundwater monitoring sites have been monitored since 2004, and

data between 2010-2019 was reported in the Groundwater Quality Technical Memo[5].

81. In my opinion, the comparison of pre and post landfill data shows that overall, the landfill is having very little, if any effect on groundwater quality moving beyond the boundary of the site.

82. SKM 108 (downgradient) is the well closest to the southern boundary and best reflects the groundwater quality moving offsite. At this location copper and zinc exceed TL2 (ecological), and there are other typical leachate indicators present, but at levels at or below TL1 (historical median).

83. Worthy of note are the concentrations of nitrate, phosphorus, sulphate, and zinc in the upgradient wells. These compounds all exceed TL2 as a result of the surrounding agricultural land use, and in fact have higher concentrations than observed downgradient of the landfill. This indicates that the discharge of groundwater from the base of the quarry is likely to be diluting groundwater downgradient of the landfill.

84. Overall, the results indicate that the current management practices onsite are effective in managing groundwater quality. Whilst some trace concentrations of landfill leachate indicators are present at the boundary well SKM 108, in general the concentrations observed are compliant with the current trigger levels, and in the case of copper and zinc, whilst above the current TL2 (ANZG level) are still compliant with the NZDWS (2008).

Proposed Further Monitoring

85. From the Jacobs (2020) Groundwater Quality Technical Memo, I have recommended that two further downgradient monitoring wells are installed at AB Lime. These should be installed either close to or on the southern boundary to give greater confidence in measuring potential offsite discharges.

[5] AB Lime Limited Resource Consent Application Groundwater Quality Technical Memo. IZ000400-LFC-NW-RPT-0003. 29 May 2020

86. This is now included as a proposed condition of consent[6].

87. In my opinion, the installation of the additional well monitoring sites will increase the amount of monitoring data which can be used to determine any impact from the landfill. Having two additional monitoring sites will also provide better opportunity for early detection of changes in the groundwater and enable AB Lime to have early intervention should any problems occur.

88. The potential for the proposed location of the new monitoring sites are presented in **Attachment B** These wells are located on the downgradient property boundary. One well is proposed to be located approximately 120 m to the east of SKM108, and the other being located approximately 240 m north/north-west of SKM108. These wells, alongside SKM 108, would provide a high level of confidence in the ability of the monitoring network to measure the groundwater quality moving off-site.

Submissions

89. The submissions provided by Mr Hamilton, Mr and Ms McKerchar, and Mr and Mrs Sinclair are relevant to groundwater matters.

Mr Hamilton

90. The groundwater concern in Mr Hamilton's submission pertains to the possibility of leachate entering the groundwater and causing risks for nearby users.

91. I have addressed these concerns in this evidence. In summary, the downgradient well at AB Lime indicates copper and zinc exceed the TL2 trigger levels, with other leachate indicators at or below TL1 trigger levels. The concentrations of compounds in this well are similar to pre-landfill concentrations. Furthermore, the concentrations of these compounds are compliant with the NZDWS (2008).

[6] Refer to Condition 2 of land use permit for drilling of bores or wells of proposed conditions of consent

92. It is my opinion that the current management practices onsite are effective in managing groundwater quality and the landfill has very little, if any, effect on the groundwater quality past the site boundary.

Mr and Ms McKerchar

93. Mr and Ms McKerchar's submission identifies that there was concern during the original consent application regarding possible leachate leakage flowing into the Tothills Creek and then into the Winton Stream and Oreti River.

94. As stated in paragraphs [52] – [56] of this evidence, AB Lime utilise trigger levels to detect any issue with the groundwater quality. The trigger levels provide an indication that water quality has varied from background levels. This allows AB Lime to review the landfill management practices in order to remediate the cause of the exceedance.

95. Additionally, as stated in paragraph [61] of this evidence, the boundary well SKM 108 provides the best reflection of groundwater quality moving off-site. This well generally complies with the trigger levels, other than copper and zinc. However, despite these two compounds being detected above the TL2 level, they are still compliant with the NZDWS (2008).

96. In my opinion, the levels detected in SKM 108, show that the landfill operations pose very little risk to the groundwater quality beyond the boundary of the site.

Mr and Mrs Sinclair

97. The submissions from Mr and Mrs Sinclair, with respect to groundwater, concerns the toxicity of leachate flowing into the natural springs.

98. This concern has been addressed in this evidence. In summary, the groundwater quality effects of landfilling are well monitored by the existing monitoring wells, and the proposed additional wells will strengthen this. Additionally, off-site springs and surface water are

monitored through the existing stormwater discharge consent. The stormwater consent is not being amended.

99. It is my opinion, that the leachate caused by the landfilling operations is having very little, if any, effect on the groundwater quality of surrounding water bodies.

Officer's s 42A Report

100. The s 42A report raises two issues of relevance to groundwater effects:

    (a) Deviation from the Class A Landfill Waste Acceptance Criteria and potential for altered leachate chemistry affecting groundwater

    (b) Extent of monitoring post 2038 (end of consent) and legacy effects

101. The concerns are addressed in the evidence of my colleague Mr Walter Starke. I agree with Mr Starke's response to these concerns.

Conclusion

102. The landfill is well-sited from a geological and hydrogeological perspective due to the natural upward hydraulic pressures beneath the site that prevent the downward migration of groundwater beyond the site boundary. This minimises the risk of leachate affecting offsite groundwater receptors.

103. A comparison of groundwater quality collected pre-landfill vs present day shows that overall, the landfill is having very little, if any effect on groundwater quality moving beyond the boundary of the site.

104. I have recommended that two additional groundwater monitoring wells are installed at the downgradient property boundary. These wells will further strengthen the groundwater monitoring at the site.

105. Overall, the results indicate that the current management practices onsite are effective in managing groundwater quality. In my opinion, the proposed changes to annual waste limit will not affect the risk to groundwater quality.

Date: 26 April 2020

Tim Baker