BEFORE ENVIRONMENT SOUTHLAND AND SOUTHLAND DISTRICT COUNCIL

UNDER	the Resource Management Act 1991
IN THE MATTER	of a Resource Consent Application and Designation by Southland District Council to discharge treated wastewater to land and odour to air from the Te Anau Wastewater Treatment Plant

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STATEMENT OF EVIDENCE OF ROGER BERNARD OAKLEY FOR SOUTHLAND DISTRICT COUNCIL

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QUALIFICATIONS AND EXPERIENCE

1. My name is Roger Bernard Oakley.

2. My current employment is as the Water and Waste Team Leader, MWH (NZ) Ltd, Dunedin.

3. I am a Chartered Engineer in New Zealand, registration number 116 759, with a Bachelor of Engineering (Hons) in Civil Engineering from Canterbury University and a Diploma for Graduates in Regional and Resource Planning from Otago University. I also hold the qualification of Project Management Professional from the Project Management Institute. I have variously acted as project manager, reviewer or technical lead for infrastructure projects for more than 25 years, with an emphasis on water infrastructure.

4. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note. 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.

SCOPE OF EVIDENCE

5. I have been asked to prepare evidence in relation to assumptions around current and future wastewater flows, populations and growth projections. Also, the likelihood and consequences relating to outages in the system, and the cost of achieving a greater level of nitrogen removal. This includes:

   a. Description of initial population and wastewater flow design estimates;

   b. Reasons for revising the above;

   c. Outline of the process for the development of the current estimates, as detailed in Appendix F of the Resource Consent application;

   d. Rationale for seeking the designation of additional land beyond the needs for the 35 year consent;

e. A discussion regarding the causes and likelihood for outages, and the ways that these will be avoided or mitigated; and

f. A description of the typical scope of works required to achieve higher levels of nitrogen removal and associated costs.

EXECUTIVE SUMMARY

6. In the early stages of the project development, up to 2012, design horizons were based around 'population equivalent' projections of 20,000 and 40,000 for the medium (25 years) and long term (50 years) respectively. Wastewater flows were derived from these populations, allowing for different contributing flow rates for residents and for those in commercial accommodation.

7. In 2012 these projections were revisited, as they were considered too high. A design figure based on a 'population equivalent' of 15,000 was adopted and this allowed the irrigation site for this consent to be restricted to the North Kepler block. The final wastewater volumes were refined in the report below.

8. In June 2013 a MWH report finalised projections for the growth in population and wastewater flow for the next 35 years. This report was the most rigorous analysis to date, and showed that the earlier estimations could be reduced. It was based on the available statistical information and is consistent with generally accepted figures for wastewater generation from the different sectors of the population. This report shows that the likely wastewater flows over the next 35 years are compatible with the discharge quantities applied for in the Resource Consent.

9. At anticipated growth rates for Te Anau the North Kepler block is an appropriate size for a 35 year consent. If growth were to continue then parts of the South Kepler Block area could be considered for irrigation, and hence it is wise to signal this through a land use designation.

10. Consideration of the cause, duration and likelihood of outages in the proposed wastewater disposal scheme show that these are risks that can be satisfactorily managed.

11. The cost of treatment systems to achieve nitrogen removal has been considered in a number of reports with a range of $8.2M for a low technology approach with unconfirmed certainty of performance and the retention of the ponds, through to $20.8M for a conventional activated sludge process.

EARLIER POPULATION DESIGN FIGURES

12. My involvement with the Te Anau wastewater irrigation project began in August 2012. I was not involved in the initial work described in this section, this was led by Murray Sorrell (MWH) and Justin Reid (SDC) who have retired, and changed employment respectively. This section of evidence is restricted to summarising the work previously undertaken, and commenting upon it.

13. A 'Te Anau Stormwater and Waste Water Treatment and Disposal Strategic Review' workshop was held on 6 September 2005. This is the meeting mentioned in Table 9.1 (p67) of the supporting information of the resource consent application. This meeting provides the first reference I can find regarding population projections relevant to the Kepler irrigation proposal. At that meeting the present peak summer population was informally estimated to be 10,000, with increases to 20,000 and 40,000 suggested for 25 and 50 year horizons. There is no indication that at that stage those projections were based on a formal analysis.

14. The next workshop of the above group that discussed population projections was in February 2006. A MWH presentation and draft report to this meeting discussed population trends and design horizons. This identified recent annual resident and tourist growth at 4% and 8% respectively. This represented a population doubling every 13 years, which was not seen as being realistic in the longer term, i.e. it was too high. Therefore it appears a value judgement was made at that workshop that the best estimate of population growth would be as first indicated, i.e. 10,000 peak at present, with increases to 20,000 and 40,000 suggested for 25 and 50 year horizons. This was based on a compounding annual growth rate of 3%. A subsequent MWH document (March 2006 'Future Flow Expectation') summarised the above.

15. At this time, the population figures were separated into the contributory elements of permanent residents, holiday makers and tourists. This is because the wastewater volumes generated differs for each of these sectors. For example, a person accommodated temporarily in a hotel may produce as little as half of someone living permanently in a house, due to differing water usage.

16. From the above, wastewater flows were calculated for the present, 25 year, and 50 year design horizons. A peaking factor of 1.2 for wet weather inflow and infiltration into the system was determined. This factor was lower than the usual factor of 2 because of observed local experience and the higher than normal proportion of tourist accommodation. The calculation of present-day flows for residents and visitors were calibrated against observed summer and winter flows. This is because there is a much lower visitor population in winter, and this allows an apportionment to them of the increased summer flow.

2012 REVISION OF PROJECTIONS

17. My involvement with the Te Anau wastewater irrigation project began in August 2012. I was not involved in the earlier work described in this section. This section of evidence is restricted to summarising the work previously undertaken, and commenting upon it.

18. In June 2012 the original proposal for the first stage of development to cater for a population equivalent of 20,000 was revised downward to 15,000. This was in recognition that growth in Te Anau had significantly slowed since 2007, and that estimates could be based on longer term trends rather than 2005 conditions. It also recognised that there was more stress on the rating dollar in recent times.

19. Reducing the design population growth was seen as a pragmatic measure to make the scheme more affordable and assist in allowing it to proceed at an earlier date. This would allow the underlying goal of removing the current wastewater discharge from the Upukerora River to be achieved.

20. At this time, it was also proposed that the existing ponds could remain much as they are, other than to add aeration as needed to boost their

peak capacity. The retention of the ponds allowed the smoothing of peak flows to the irrigation site, and the saving of capital cost.

21. This reduction of the design population reduced the design flows to those now being proposed in the current resource consent application.

2013 ESTIMATION OF POPULATION AND FLOWS

22. In August 2012 I took over the role of MWH's project manager for the project, following the retirement of my predecessor.

23. I arranged for a more formal assessment of the likely population growth that could be expected for Te Anau over the life of a 35 year consent. This was undertaken by an engineer well experienced in land development engineering projects, and the development of such projections, whereas I do not have that specific expertise. My role was to provide the briefing on the background to the project, provide relevant information that had already been assembled, and review the work on completion. There were also had a number of discussions during the preparation of the assessment, to ensure that there was a clear understanding of the wider context of the project.

24. The approach was to start afresh in the assessment of population growth, and from this derive the likely wastewater flows.

25. The result of the assessment is included as Appendix F of the resource consent application titled 'Te Anau Wastewater Flows Report, June 2013'.

26. In the introduction to the 2013 report, it states it is an update of the 2006 'Future Flow Expectation' report, and provides a methodology to forecast future wastewater flows in Te Anau for design purposes.

27. The 2013 report uses Stats NZ data as the basis for estimating population growth from current baselines.

28. The 2013 report took into account data subsequent to the previous report to improve the calibration of flow and population assumptions. However information from the 2013 census was not available.

29. Statistical sources relied on came from Stats NZ and included the census population (with the base year being 2006), dwelling and

occupancy numbers in conjunction with derived per capita flow demands. Tourist numbers were determined through 'Commercial Accommodation' reports also made available through Stats NZ.

30. In comparing 2006 recorded wastewater flows to those recorded in 2012, it was concluded that they had remained relatively unchanged, or decreased slightly in some circumstances.

31. An analysis was undertaken that compared recorded flows in summer and winter to estimated numbers of permanent residents, holiday makers (staying in holiday homes and cribs), and tourists (staying in commercial accommodation). The purpose of this was to establish reasonable estimates for wastewater volumes generated per category, measured in litres per head per day (L/hd/day). It also allowed assumptions to be established for occupancy rates in the various types of accommodation in summer in winter. In all this allowed wastewater volumes to be estimated for future increases in these populations.

32. The above analysis required a variety of assumptions to be made that were calibrated by cross checking derived flows for the present day against measured flows. However, it is possible that the assumptions made will not hold entirely true in the future. For example water conservation measures could reduce flows per capita.

33. The conclusion was to confirm the same values per capita used in the 2006 report. These are 270L/hd/day for dwelling occupants (either permanent or holiday makers) and 154L/hd/day for tourists in commercial accommodation. These values are reasonably consistent with values used in the industry.

34. Stats NZ provided low, medium and high projections for growth of the permanent population up to 2031. For our planning purposes this was extrapolated out to 2048, being the 35 year term sought for the resource consent. Starting with a 2006 permanent population of 1,899, these projections for the year 2048 ranged from 2,010 to 2,652 for the low to high projections. This is significantly lower than the compounding 3% assumed in the 2006 report, which would give a population of 5,188. It is concluded the 3% figure was too high.

35. The same range of growth rates was also applied to the visitor accommodation. The flows arising from residents and visitors was then calculated and combined to give total daily flows.

36. Because trends in visitor numbers are not directly linked to population growth trends, as a sensitivity check, flows arising from higher visitor growth rates of 2%, 2.5% and 3% per annum were also assessed.

37. In the year 2048, in winter, estimated peak flows range from 892 to 1,178m^3/day using Stats NZ growth projections, and up to 1,788m^3/day if a higher visitor growth rate of 3% per annum is assumed. This compares to an average rate of 1,350m^3/day applied for in the resource consent, with an allowance of a maximum rate of 2,000m^3/day.

38. In the year 2048, in summer, estimated peak flows range from 1,897 to 2,503m^3/day using Stats NZ growth projections, and up to 4,131m^3/day if a higher visitor growth rate of 3% per annum is assumed. This compares to an average rate of 3,000m^3/day applied for in the resource consent, with an allowance of a maximum rate of 4,500m^3/day.

DESIGNATION OF THE SOUTHERN KEPLER BLOCK

39. From the above flows assessment it can be seen that at anticipated growth rates for Te Anau the North Kepler block is an appropriate size for a 35 year consent.

40. If population growth and flow increases were to occur at a faster rate than anticipated and/or beyond 35 years then a range of options exist. More intensive irrigation on the Northern Block could be feasible if actual effects arising from this application are less than anticipated, or further wastewater treatment is undertaken. This would be subject to the standards and planning rules of the time, which cannot be predicted at this stage.

41. Alternatively irrigation could be extended into parts of the South Kepler Block area, as investigations by Hydro Services Ltd show that this is feasible.

42. A significant amount of infrastructure and investment is required for the North Kepler consent, and it makes sense to use this infrastructure as efficiently as possible before extending to any new scheme in the future. In this regard the southern Kepler blocks are a logical location for extended irrigation. The southern Kepler blocks can in the future, if necessary, have reticulation extended to them from the proposed pipeline. This future ability to use the southern Kepler blocks "future proofs" the investment in the pipeline by ensuring there is discharge capacity in this area for the very long term. I note the southern Kepler blocks are a potential future option, but point out for clarity that discharge consents are not currently being sought to dispose of wastewater in that area.

43. For these reasons it is wise to signal the potential for this future use through a land-use designation. This ensures use is not made of this land that might compromise its potential for future wastewater disposal. Also, the community can have the potential use clearly signalled in the District Plan.

THE CAUSE, LIKELIHOOD AND CONSEQUENCE OF OUTAGES

44. This evidence is based on my general experience of more than 25 years in implementing a range of water and waste infrastructure projects, many of which include similar elements to those found in the Te Anau wastewater system. This includes a wide range of pipelines, treatment plants and earthworks.

45. In forming the opinions below, I have assumed that the new infrastructure between the existing Te Anau ponds and the Kepler Block is as described in the consent application, and that the existing Te Anau wastewater system from individual properties to the ponds is typical of such infrastructure found in New Zealand.

46. The present Te Anau ponds have a surface area of 4.81 hectares and can be operated so that 100mm of freeboard is available for storing inflow if for some reason discharge to the irrigation site needs to be held back. This equates to 4,800m^3 of storage.

47. The following calculations do not use the peak summer/winter flows of 4,500/2,000m^3/day. This is because these peak flows are assumed to

occur when wastewater temporarily retained in the Te Anau ponds is being pumped out at the same time as the normal flows from the Te Anau township.

48. At the maximum summer/winter flows of 3,000/1,350m^3/day, at the 35 year consent horizon, the above gives storage of 1.6 to 3.5 days.

49. MWH's Te Anau Wastewater Flows Report of June 2013 reports that present peak/base flows, as adopted, are summer 1,800/1,000m^3/day and winter 850/600 m^3/day. With 4,800m^3 of storage this gives total storage times of 2.6 to 4.8 days in summer and 5.6 to 8 days in winter.

50. Therefore there is the ability to store between 1.6 and 8 days of Te Anau's waste water at the existing ponds. This gives the time period in which any outage would need to be remedied.

51. The first element in the new works for which this consent relates is the pumping system to transfer treated wastewater to the Kepler Block. Conventional mechanical and electrical components will be used, and such pump stations are a very common element in wastewater infrastructure. The pumpstation will have redundancy within it such that any one pump or its associated electrical and control system can fail without affecting overall performance.

52. The pumpstation structures and connecting pipework will be designed to current standards and allow for earthquake effects. In practice, pumpstation structures tend to be reasonably monolithic and naturally earthquake resistant. The pipework connections to a pumpstation are an area that need careful design to ensure they are resilient in an earthquake, or they can be a failure point. Careful design in this area would properly control this risk.

53. Should there be a wider failure of the electrical control system then normal design is for a form of local control of the pumps to be possible.

54. Should there be a failure of the power supply to the site, which cannot be repaired in time, then this would require a temporary generator to be provided.

55. The pipeline between the Te Anau ponds and the Kepler Block will be constructed with pipes made of either rubber ring jointed PVC or continuously welded polyethylene. These are conventional and cost

effective solutions. In the recent Christchurch earthquake these materials proved to be the most resistant pipe options for ground movement. I have attended several presentations at conferences where the performance of these pipes in the Christchurch earthquake was illustrated.

56. A slip jointed PVC pipeline can pull apart at a joint if ground movement is excessive. This prevents damage to adjoining pipe sections and is straightforward to repair, a working day would be a comfortable period of time.

57. A polyethylene pipe has all the joints welded, or otherwise mechanically fastened, so that the pipe is continuous, for example, like a garden hose. Polyethylene is able to stretch considerably before failure. It is therefore very resilient to ground movement. Repairs are normally effected by replacing the affected section, with a fusion coupling at the new joints. Fusion couplings are available within New Zealand and repair time would be governed by their delivery to site. On straight sections of pipe, which is the usual situation for this pipeline, a slip-on coupler could be used temporarily if there was a delay in the supply of a fusion coupler.

58. Pipelines may conceivably need repair for reasons other than earthquake, for example accidental damage from excavation. Repairs in these situations should be readily able to be achieved within the time period afforded by the storage capacity of the ponds. Such repair work is a common part of keeping a wastewater pipe network in operating condition and there is a substantial pool of expertise and materials in New Zealand in this regard.

59. The pipeline design will include isolation valves along the length of the pipes. This is to facilitate repair and mitigate the consequences of any pipe failure, by preventing the whole pipeline draining out through a damaged area. At this concept stage, these isolation valves have been allowed for at 1km intervals, although exact placement will take into account such matters as the location of natural low points.

60. In order to facilitate the early detection of a failure, and therefore mitigate consequences, the pipeline will have flow measurement at either end. These flow meters will be connected by telemetry, and will

be able to identify a discrepancy between flow in and out. This can trigger an alarm, and if desired, a shut down of the pumps.

61. Noting the above, and as a general comment from observing the effects of the Christchurch earthquakes, it is reasonable to say that the Kepler irrigation infrastructure will be more resilient than the existing Te Anau wastewater infrastructure.

62. At the Kepler irrigation site the two key components of infrastructure are the odour treatment and centre pivot irrigators.

63. The odour treatment is described in Kevyn Lockyer's evidence. In summary it has two key components, the trickling filter and the oxidation dosing. Either component would be able to be bypassed while still achieving a high level of odour treatment, and redundancy is provided in this way.

64. For the pumpstations at the Kepler site, the previous comments about pumpstation resilience apply.

65. There are two centre pivot irrigators, with either or both being able to be operated. This provides a significant level of redundancy, as with a capacity of 2,250m^3/day each, the ability of one irrigator to distribute the entire wastewater flow would only be exceeded on high use days in summer, towards the end of the 35yr consent period.

66. Being wheel mounted, centre pivot irrigators are inherently resilient against earthquakes.

67. Wind is a natural hazard that could affect both irrigators simultaneously. Their resilience in this regard, and mitigation measures are discussed in Dr Tony Davoren's evidence.

68. Frost and snow resilience are also discussed in Dr Davoren's evidence, where effective means of mitigation are discussed.

69. In my experience, a risk management philosophy should be taken when considering natural hazard (and other) risks. Taking this approach it is appropriate to consider the well established infrastructure in the South Island to install and maintain centre pivot irrigators. In the Te Anau region there is not the intensive installation of these irrigators that you see in Canterbury, for example. Therefore, should a severe event occur that affected both irrigators, then it is

reasonable to conclude that there will be sufficiently available materials and expertise to get at least one of the two irrigators into service promptly, even if in the worst case this means initially making one good irrigator out of the two.

THE COST OF NITROGEN REMOVAL

70. As stated previously, my involvement with the Te Anau wastewater irrigation project began in August 2012. I was not involved in the work described in this section, this was led by Murray Sorrell (MWH) and Justin Reid (SDC) who have retired, and changed employment respectively. This section of evidence is restricted to summarising the work previously undertaken, and commenting upon it.

71. In developing the current proposal, the cost of nitrogen and nutrient removal has been reviewed a number of times as described below.

72. MWH prepared a report in October 2006, 'Te Anau Sewerage Scheme Development. Initial Consideration of Future Treatment and Disposal Options'. Refer Appendix C of the consent application. The purpose of this report was to outline the broad range of treatment and disposal options, with budget capital and operating costs, to allow comparison and selection of a preferred long term sewerage scheme for Te Anau. This report looked at a variety of options, including Option D which was an advanced plant based at the Te Anau ponds site, to achieve 're-use' quality to allow discharge to continue at the existing Upukerora River location.

73. In broad terms the proposal was for activated sludge treatment which would achieve reduction in nitrogen and Biochemical Oxygen Demand (BOD). This was followed by membrane filtration with UV disinfection to achieve a higher final water quality. Appendix C of the 2006 report gives a cost breakdown of the various components of this option, and identifies that the activated sludge treatment comprises $11.5M of the total estimate of $14.2M. An additional $187,000 per annum of operational costs were identified for the sludge disposal and power usage associated with the activated sludge process. Actual operation costs would be considerably higher once operator time and maintenance costs were included. The above costs were based on a scheme capacity providing for a population equivalent of 20,000.

74. An MWH report in June 2007 'Te Anau WWTP Upgrade – Local Disposal Options' was prepared to look in more detail at the options for continued treatment and surface water discharge at the present WWTP site.

75. This report reviews the activated sludge process again, noting its suitability for nitrogen removal. The report also notes that the activated sludge process achieves more treatment outcomes than just nitrogen removal, but would regardless be a good, well proven option if nitrogen removal is required. This report contained estimates indicating that 75% of the nitrogen would be removed by this process.

76. The 2007 report gives a capital cost for an activated sludge plant of $15M, but did not revisit operational costs. It was again for a population equivalent of 20,000.

77. There were no further reports relating to nitrogen reduction until a draft MWH report of June 2012. This report primarily considered reducing the scheme capacity to a population equivalent of 15,000 based on more recent trends. This was adopted. The report also briefly commented upon an approach by a specific technology supplier (Biofiltro) offering their treatment process as an option for improving effluent quality and reducing nitrogen. The report estimated this process would cost $6.3M, but also noted that there were unquantified risks with this relatively untried process. Predicted levels of nitrogen removal were not stated. As with the other options, operating costs would also need to be considered.

78. The Biofiltro process relies on retaining the existing Te Anau pond system, whereas the activated sludge process does not require them.

79. A general comment regarding the selection of any option for wastewater processing is that care is needed to understand the wider effects it might have. For example some processes produce more sludge, and this has to be dealt with. Another implication is that any process selected now will affect the relative feasibility of the options for future upgrades, for example Biofiltro requires the ponds to remain. The overall caution in this regard is that the cost of nitrogen removal processes may have additional implications that become apparent at a later stage.

80. The 2006 and 2007 estimates were based on larger schemes, for 20,000 population equivalent versus the 15,000 presently proposed. In broad terms, this affects the cost by about 20%. Some components of the price may vary with the plant size, but other components are less affected by the capacity. For example, the cost of constructing a buried pipe is relatively insensitive to whether the pipe is a size larger.

81. The 2006/07 prices are now at least seven years old, and some escalation should be allowed. Therefore, it is reasonable to use the original figures for the larger scheme as a current-day broad estimate for the smaller scheme proposed today.

82. The net present value of operating costs should be included to provide a proper estimate of the cost of nitrogen removal. It is considered that a minimum allowance should be made of $200,000 per annum for the lower technology Biofiltro process and say $400,000 per annum costs for the activated sludge schemes. At a 6% discount factor over 35 years, these equate to net present values of $2.9M and $5.8M

83. In summary, information from previous reports indicate that the net present value of significantly reducing nitrogen in the treated wastewater proposed to be discharged to the Kepler block ranges from $8.2M for a low technology approach with unconfirmed certainty of performance and the retention of the ponds, through to $20.8M for a conventional activated sludge process.

CONCLUSION

84. The 2013 revised population and flow projections show that wastewater flows are expected to stay within approx. 80% of the limits applied for in the resource consent. This is over a 35 year period, if the highest Stats NZ growth projection for the resident population is used for both the resident and tourist growth.

85. Using an assumed higher growth rate of 3% per annum for the tourist accommodation sees the consent average wastewater flow rate limits reached on a peak day by 2036. This is considered a worst case scenario.

86. At anticipated growth rates for Te Anau it is concluded that the North Kepler block is an appropriate size for a 35 year consent. If growth

were to continue then parts of the South Kepler Block area are suitable for, and could be considered for irrigation. Hence it is wise to signal this through a land use designation.

87. The infrastructure for transporting and irrigating the Te Anau treated wastewater will be resilient to events that might cause outages. In conjunction with the storage at the existing Te Anau ponds almost any outage should be able to be resolved without creating a wider effect.

88. The net present value of significantly reducing nitrogen in the treated wastewater proposed to be discharged to the Kepler block ranges from $8.2M for a low technology approach with unconfirmed certainty of performance and the retention of the ponds, through to $20.8M for a conventional activated sludge process.

DATED this 27th day of June 2014

Roger Oakley

REFERENCES

Te Anau Wastewater Flows Report – MWH June 2013

Te Anau Sewerage Scheme Development. Initial Consideration of Future Treatment and Disposal Options. MWH October 2006

Te Anau WWTP Upgrade – Local Disposal Options. MWH June 2007