BEFORE THE COMMISSIONERS
AT QUEENSTOWN

IN THE MATTER	of the Resource Management Act 1991 ("**the Act**")
AND	
IN THE MATTER	of an application under Part 2 of Schedule 1 of the Act
AND	
IN THE MATTER	of proposed Private Plan Change 44 to the Queenstown Lakes District Plan
BETWEEN	**RCL Queenstown PTY Limited**
	Requestor
AND	**Queenstown Lakes District Council**
	Territorial Authority

STATEMENT OF EVIDENCE OF ROBERT POTTS

26 JUNE 2015

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INTRODUCTION AND EXPERTISE

1 My name is Rob Potts.

2 I hold the qualification of NZCE (Civil), BE(Hons)(Ag), Dip Hydrology(groundwater), CPEng and Making Better Decisions. I am a Member of IPENZ, Water NZ (ex Chairman of Small Wastewater and Natural Systems (SWANS) Special Interest Group), NZ Land Treatment Collective (ex-President), Irrigation NZ and RMLA. I am currently on the Water NZ Technical Committee, am Convenor of the On-site Effluent Testing National Testing Program Advisory Group and am on the Industry Review Panel for On-site Wastewater Unit Standards Qualifications. I have also had experience as a hearing commissioner having recently sat on a number of plan changes and numerous Regional Council water and wastewater related consent applications.

3 I am currently employed by Lowe Environmental Impact Limited as their Principal Engineer and I am based in their Christchurch Office.

4 I have worked in the area of Environmental Engineering since 1977, firstly with Ministry of Agriculture and Fisheries, then private practice in the UK from 1985 – 1988, then from 1989 until 1994 with Lincoln University, and from 1994 I have worked in private practice in Christchurch. I have been involved in wastewater consenting and design since the mid 80's, particularly in land treatment of wastewater and small community wastewater design. Of particular relevance to this project is my role at the neighbouring Jacks Point development, where I assessed the suitability of the site, consented the discharge of the residential area and village from Otago Regional Council, put together the documents for the Design-Build-Operate contract and currently undertake the 6-monthly nutrient budget. I am also part of the technical advice group assisting Queenstown Lakes District Council with the upgrade of their Shotover Plant.

5 In preparing my evidence I have reviewed:

(a) Fluent Infrastructure Services Ltd report on reticulation to Queenstown;

(b) QLDC emails and report on modelling of capacities;

(c) A report prepared by Ian Gunn, titled Hanley Downs Development, Queenstown Proposed Plan Change Wastewater Management Review (December 2012);

(d) A Lowe Environmental Impact report, titled Hanley Downs Wastewater and Land Treatment Options Report (October 2013);

(e) A Lowe Environmental Impact report, titled Wastewater and Land Treatment Site Investigation Report (October 2013);

(f) Glasson Potts Fowler reports on Jacks Point (GPF, 2003); and

(g) Officer reports.

6 Although this is a Council hearing, in preparing my evidence I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving evidence before the Court. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

SCOPE OF EVIDENCE

7 RCL Queenstown Limited (RCL) proposes to establish a Hanley Downs community, located on the eastern side of Lake Wakatipu, south of Queenstown. Hanley Downs is located approximately 4.5 km south of Queenstown Airport and directly to the north of Jacks Point residential areas and golf course. Current access to Hanley Downs is via Kingston Road (State Highway 6) and Woolshed Road.

8 The Hanley Downs development area is currently zoned under the Queenstown Lakes District Plan for residential and other land use activities and is located directly to the north of Jacks Point residential areas and golf course.

9 RCL aims to increase the dwelling density and incorporate additional land use activities with the zoned area. The original zoning for the main residential area was based on a dwelling density of 10 - 12 dwellings/ha with a total of 561 dwellings and an additional high density village area allowing perhaps 800 dwellings. The plan change proposal is to increase the

dwelling density to around 15 dwellings/ha. A plan change proposal has been lodged (Plan Change 44) that allows for the higher density land usage.

10 In my evidence I have been asked by RCL to provide:

(a) An outline of viable options for the management of sewage, in particular whether there are viable treatment and discharge options within or near the development area, and whether it was viable to convey the sewage to Queenstown Lakes District Council (QLDC) infrastructure for treatment and discharge;

(b) A brief description of the receiving environment, in particular soils of the potential wastewater land treatment areas;

(c) Ownership and management of a sewerage system, should it be managed as a decentralised system on-site; and

(d) Briefly touch on the potential effects of effluent irrigation on soils and groundwater and likely consentability through Otago Regional Council if the wastewater is to be managed within or near the site.

PROPOSED WASTEWATER ACTIVITY

Wastewater Flows

11 Gunn (2012) states that following an initial review of wastewater servicing options and the availability of land for treated effluent irrigation, John Edmonds & Associates Ltd (JEA) had asked for an assessment of servicing requirements for up to 1,750 dwelling equivalents. I am told that this continues to be considered the 'most likely' development scenario, however the provisions allow an estimated maximum of 2,178 dwelling equivalents.

12 The design of the adjacent Jacks Point community wastewater treatment scheme is based the peak occupancy ratio on five people per household. This was derived from a Kingston Morrison population survey (150 houses – approximately 10 % of total properties) over the peak summer weeks in Wanaka for QLDC in 1995/1996. The survey showed permanent residents averaged at 1.6 people per household and occupancy peaked at just over five people per household for five days and over four people per household for 16 days.

13 The QLDC Community Plan (2004), states that in 2001, Wanaka had 3,300 permanent residents living in 1,400 dwellings. This equates to an average of 2.3 people per household. In addition to these occupied dwellings, there were around 1,100 dwellings that were not occupied on a permanent basis. During busy periods (summer and winter) the population numbers grow significantly and estimates suggest that residents and visitors could total up to 12,000 people on a peak day. Based on the total dwelling figures this equates to an average of 4.8 people per household.

14 The average household size in Queenstown Lakes District is 2.5 people, compared with an average of 2.7 people for all of New Zealand (NZ Statistics, 2006 Census). NZS 4404:2010 Land Development and Subdivision Infrastructure recommends that the design flow shall be calculated by the method nominated by the territorial authority. In the absence of such information, the average number of people per dwelling should be about 2.5, along with the average dry weather flow being between 180 - 250 L/person/day.

15 AS/NZS 1547:2012 "On-Site Domestic Wastewater Management" recommends a typical domestic wastewater flow allowance of 200 L/person/day for reticulated community or a bore water supply.

16 Table 1 summarises the recommended design flow rate and population/flow allowances for Hanley Downs. There are economies of scale when dwellings are at peak occupancy, such as with laundering, dishwashing, and the short-term nature of peaking, etc. Therefore a lower per capita flow is used in peak periods.

Table 1: Design Flow Rate – Hanley Downs

Number of Dwellings	Population per Dwelling (people)	Flow Allowance (L/person/day)	Design Flow Rate (m^3/day)	Annual Flow Rate (m^3/year)
1,750	4.8 peak	180	1,512	
1,750	2.5 avg	250	1,094	399,220
2,178	4.8 peak	180	1,882	
2,178	2.5 avg	250	1,361	496,856

17 There has been a significant amount of population data collected for the Queenstown Lakes District and the design specifications (as shown in Table 5) are in line with the

Kingston Morrison Survey, NZ Statistics data and the QLDC Community Plan.

18 Traditional gravity sewerage systems have an allowance for wet weather flows of 2 – 2.5 times. However, as pointed out below, the likely system for Hanley Downs is a small diameter pressure sewer which does not need to cater for wet weather flows.

Reticulation Options

19 Lowe Environmental Impact Ltd (LEI) considers there to be three available sewer reticulation options for the Hanley Downs community wastewater treatment scheme, as follows:

(a) Sedimentation Tank Effluent Pumping (STEP) system;

(b) Modified gravity (MG) system; and

(c) Grinder pump (GP) pressure sewer system.

Sediment Tank Effluent Pumping (STEP)

20 **STEP** systems involve the wastewater from each dwelling or cluster of dwellings being collected in an on-lot Sedimentation Tank Effluent Pumping (STEP) Unit. From here a pumping assembly pumps liquid waste (effluent only, no solids) to the communal treatment system via a small diameter pressurised sewer network. By removing the solids from the wastewater prior to transporting it, there are considerable savings in the materials and installation of the network of wastewater collection pipes. The collection pipes can be smaller (e.g. 63 mm diameter) and can be laid in shallow trenches without the requirement for minimum gradients and velocities. The system will be effectively sealed meaning the treatment plant can be sized considerably smaller since it does not have to cope with large wet weather flows. There are also potential savings at the treatment plant as primary treatment has already occurred.

Modified Gravity System

21 In **MG** systems, wastewater is reticulated via gravity, from each dwelling to a community gravity sewer laid at a constant grade to one or more pump stations (this potentially can be at the sewage treatment plant). This option results in no solids removal prior to the treatment plant, thus pipes need to be larger and laid at sufficient gradient to convey solids. However, the modified sewers involve smaller diameter

flexible pipe systems with limited manholes compared to conventional systems. Modified gravity systems are not completely sealed and therefore can potentially result in a wet weather flow requiring larger capacity pipes and wastewater treatment plant. These systems are not suitable for areas with shallow groundwater or shallow basement rocks.

Grinder Pump Pressure Sewer System

22 A **GP** system involves a pump sump and grinder pump installed within each individual lot, although like STEP systems, these can be clustered. This system shreds influent solids prior to pumping to the sewer reticulation. The sewer reticulation pipe diameters required are likely to be similar but perhaps slightly larger than the 63 mm suggested for a STEP system; however, the required pipe diameters are still considered small in comparison to that of a gravity scheme. This system provides watertight reticulation and is similar to that of Option 1 in most facets. Primary treatment can take place at the treatment plant and if required the primary tank can be used as a carbon source for enhanced nitrogen removal.

Evaluation

23 The following issues are usually raised with regard to Options 1 and 3:

(a) Ownership: Is the sedimentation tank or sump and grinder owned equally by each residence, the Body Corporate or QLDC?

(b) Power: How much of the power does each residence pay; is this divided on a prorata basis or by the Body Corporate or QLDC?

(c) Maintenance: If maintenance is required due to a system failure, who takes responsibility for the cost of such maintenance. This is important if the failure is a result of poor management on the part of the occupants of one dwelling only. Who pays for septage pump-out at about 10 yearly intervals?

(d) Location: Which property is the STEP or sump and grinder unit sited on?

24 The answer to the above issues is dependent on the ownership option selected. In most cases, the ownership and thus all costs are borne by the single householder, but in cluster situations, the Body Corporate or Council are usually

the owners. The latter is the case for the resilient sewers going into Christchurch and for communities of similar size to Hanley Downs of Himatangi in the Manawatu district. I discuss issues related to ownership and management structures later in my evidence.

Summary

25 All sewer options are considered viable. Final selection will be a result of marrying in with either pumping system to QLDC infrastructure or the decentralised sewage treatment plant.

OPTION 1 – PUMPING TO QLDC INFRASTRUCTURE

26 QLDC wastewater engineers have been contacted regarding acceptance and development contributions. QLDC (Ulrich Glasner, Chief Engineer) have indicated that they would be willing to accommodate wastewater from Hanley Downs, subject to further details (see Email **Annexure C**). QLDC engaged Rationale to model the impact on the Shotover System and are satisfied that it can accommodate the extra flows.

27 The discussions have identified a number of options for connection to the QLDC sewerage system. These initially were direct to the Frankton Beach Pump Station, a manhole on the 675 mm main near the airport and a manhole on the 675 mm main near the Queenstown Event Centre. All options would enter the QLDC sewerage network and then be further conveyed to the Shotover WWTP located on the true right bank of the Shotover River, between the river and the Airport Terrace. Further assessment by QLDC has now discounted Frankton Beach as an option as it does not have sufficient redundancy. The options are likely to require odour mitigation at the manhole.

28 A rising main of approximately 5.4 – 6.5 km is required, depending on pipe route and final connection (routes are shown in Figure 1). A moderate pump station is required within Hanley Downs. Fluent have undertaken an assessment of the pump station and rising main requirements based on internal reticulation being either a STEP system or a gravity system. The STEP system would be based on 40 L/s and be 200 mm diameter and the gravity system on 90 L/s and 300 mm diameter. Note that the Rationale modelling was based on 70 L/s.

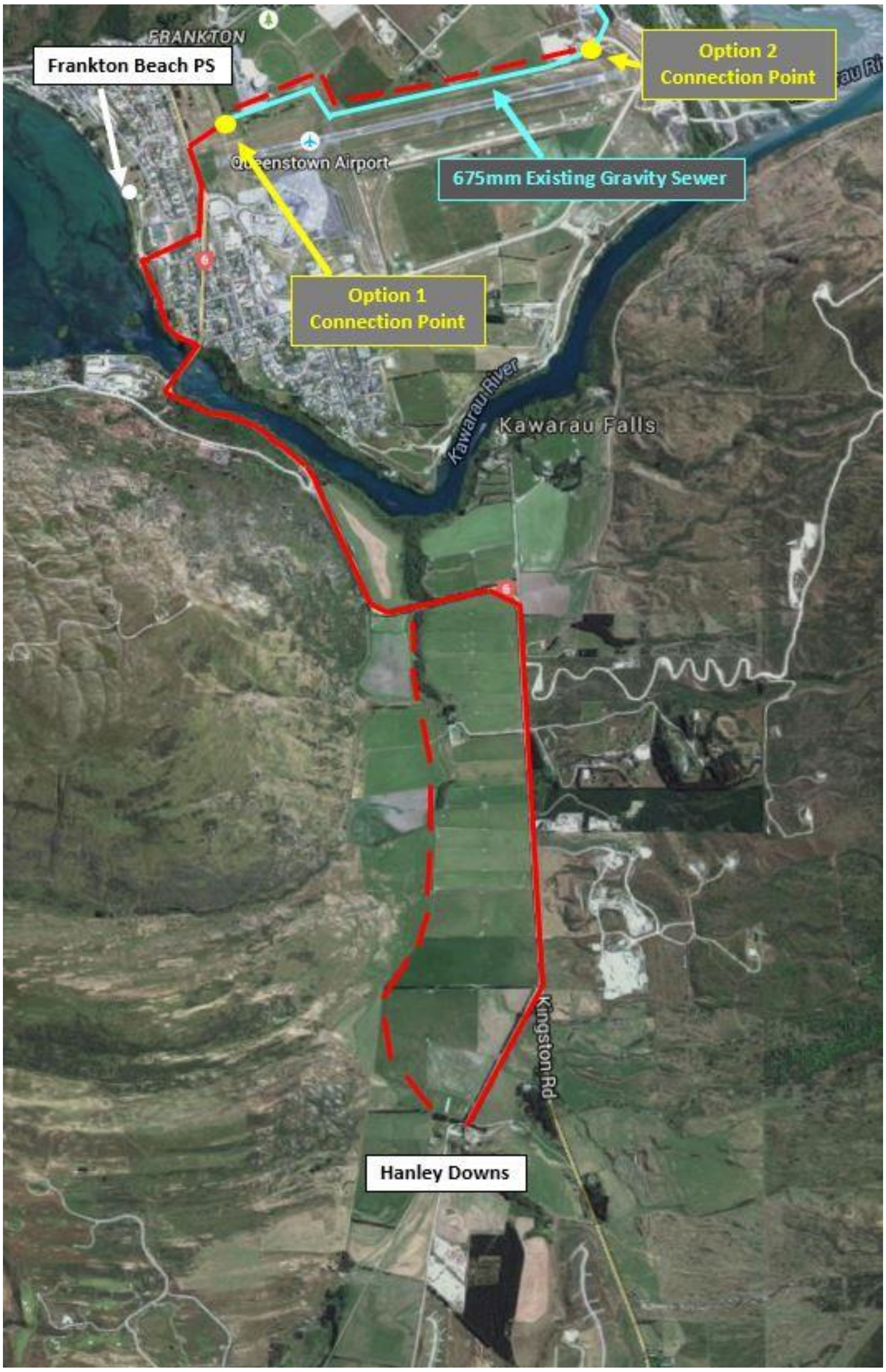

Figure 1: Possible Pipeline Routes

29 RCL would at their cost build the pipeline and the pump station. They have had preliminary costings undertaken and potential systems and routes have been considered.

30 Contact has also been made with NZTA around utilising the new Kawarau River Bridge and the preliminary specifications will accommodate this pipeline.

Summary

31 Based on my observations of the terrain and information I have reviewed, I see no reason that this pipe cannot feasibly be built to a nature and size which can accommodate the wastewater from Hanley Downs.

32 At this stage in the investigations, connecting to QLDC infrastructure is RCL's preferred option.

OPTION 2 – DECENTRALISED TREATMENT AND DISPERSAL TO LAND

33 Investigations into wastewater treatment and then land treatment options at either or both Hanley Downs and Jacks Point have been carried out. Background information, such as climatic, surface water, groundwater, sewage treatment systems and soils is attached (**Annexure B**).

34 In general, land application systems utilising low rate sustainable subsurface irrigation can be designed on 5 mm/d for peak periods (this is a permitted activity value for on-site systems in many regional plans) and this value forms a good starting point for sizing land treatment areas. Therefore, an area of around 37.64 ha is required for up to 1,882 m^3/d.

Sewage Treatment Options

35 If decentralised treatment and discharge within the site is selected as the preferred option, then there are a number of small community treatment plant options available to provide a decentralised system for Hanley Downs. These range from Sequencing Bach Reactors (SBR) (e.g. Project Pure) to specifically designed package plants. However, the SBR and similar technologies require significant operator input and produce a lot of sludge to manage. Therefore, should a decentralised system be selected, then we recommend a Recirculating Textile Packed Bed Reactor (rtPBR) as per the Jacks Point Development, as shown in the Tables' 7 and 8, **Annexure B**.

36 Therefore two treatment options were considered for the treatment of the Hanley Downs wastewater. These are:

(a) Decentralised rtPBR on site; and

(b) Reticulation to QLDC Shotover Municipal Treatment Plant.

37 rtPBR technology is well established in New Zealand for small communities, giving a high quality effluent and generally functions well under fluctuating loads. This type of system is commonly used for community on-site wastewater where a high level of organic treatment, nitrogen reduction and the removal of pathogens are important considerations.

Summary

38 Decentralised wastewater treatment within the site is considered technically and economically viable.

LAND TREATMENT SITE IDENTIFICATION

39 There are areas of land considered appropriate for land treatment, should decentralised wastewater treatment and dispersal be selected. These are:

(a) Land within the Hanley Downs development;

(b) More efficient use of the existing infrastructure land in and around the southern and eastern parts of Jacks Point; and

(c) Acquiring additional land in due course as required.

40 Previous reports (Gunn, 2012), identified five potential sites for treated wastewater dispersal with the Hanley Downs area. These are Sites A, B, 4 and H within the Hanley Downs residential development area and Site G, a hill plateau located directly to the south of Peninsula Hill and to the north west of the development area.

41 Other sites were identified by Gunn (2012) as being suitable for effluent irrigation but as these sites were within Jacks Point, and the soils in these areas were well understood, further investigations were not required.

42 A plan (attached as **Annexure A**) shows the location of the areas.

43 The suitability of the Wakatipu, Pigburn and Frankton soils for treated effluent land application was assessed by GPF (2003), whilst Gunn (2012) assessed the Shotover soils during a site visit (2012). Tables' 5 and 6 (**Annexure B**) are extracts from GPF (2003) and Gunn (2012).

44 In summary, the soil types and areas of each area observed on the site are shown in Table 2.

Table 2: Proposed LTA Soil Types

Site ID	Total Area (ha)	Soil type (ha)				
		Frankton silt loam	Shotover sandy loam and stony loam	Wakatipu sandy loam	Pigburn fine sandy loam	Arrow hill soil
Area A	22.8	13.9	8.9	-	-	-
Area B	28.2	14.9	11.1	2.2	-	-
Area 4	19.2	-	8.2	-	11.0	-
Area G	58	-	44	-	-	14
Area H	Discounted as unsuitable due to seepage on flat areas and bare rock on sloping areas					

Key: Less Preferred for wastewater discharge; Preferred for wastewater discharge

45 Since undertaking the investigations, land ownership changes and further development of the master plan has resulted in some of the areas being investigated now being unavailable. The following changes have occurred (refer to the Structure Plan in Annexure A for the names of areas):

(a) Area A is now proposed as Open Space Landscape/Farming. This is still considered suitable for a land treatment area;

(b) Area B is now mostly set aside for the Education Innovation Campus purposes and is not available;

(c) Area 4 is now proposed to be residential development and is not available;

(d) Area G is now proposed to be Farmland Preserve. These are approximately 40 ha lots that will be farmed with sheep. This area can therefore still be used for land treatment; and

(e) Areas 1, C, D, E, 2 and F within Jacks Point are likely to be available to be used if required. However, the nitrogen loading would need to work in with the conditions on the Jacks Point consents.

46 Looking at the land identified within Jacks Point; the 2009 Jacks Point consent requires 12 ha of land treatment area.

(a) Area 1 is mostly already utilised by the existing N1/N4 field of 3.3 ha. It is set aside for the proposed village. It is on suitable soils and is available.

(b) Area C is also set aside for the village. It is on suitable soil and is available. It is significantly larger than the 5.2 ha set aside, possibly by another 5 ha.

(c) Area D has an ephemeral stream coming down its boundary with Area C that would reduce area. It is a bit steeper but the soils are suitable. Assuming about ½ the area available after buffer distances, then another 4 ha.

(d) Area E is available without constraint, an additional 2 – 3 ha.

(e) Area F has streams running through it that would make the area small; say 1 – 2 ha available.

(f) Area 2 is basically the existing N5/6/7 LTA, with minimal additional land available.

47 In total, the additional land available within Jacks Point that has been identified as being suitable for land treatment is 12 – 14 ha.

48 Taking into account buffer distances of 20 m to boundaries and 50 m to water courses, then the total area that is suitable for land treatment is:

(a) Area available within Hanley Downs on preferred soil types is 52.9 ha;

(b) Area available on less preferred soil types is 27.9 ha; and

(c) In addition to the land within Hanley Downs is the land within Jacks Point of 12 - 14 ha.

49 There is more than sufficient area available for land treatment on the preferred soils. Some less preferred soils could also be irrigated in the summer periods if desired by the developer for landscape or farming reasons, or to deal with peak flows.

50 Based on soil type and soil profile, soil permeability, groundwater levels, required treatment outcomes, land use options and the potential quality of the effluent from a secondary treatment plant, LEI considers that only subsurface irrigation will be appropriate for the land application of the Hanley Downs effluent.

51 There are three main landuse activities for land dispersal areas – these are:

(a) Cut and Carry;

(b) Grazing; and

(c) Cut and Leave.

52 "Cut" refers to cutting grass or grass type crops, tree felling (replanting with juvenile plants) or pruning vegetation back to stimulate regrowth; "carry" refers to removing all vegetation off-site for sale, disposal or energy.

53 Grazing results in uptake and removal of nutrients as meat and wool but with some return from urine and faeces but with losses to the atmosphere through volatilisation and denitrification.

54 Cut and leave, or turf management, is used on areas such as golf courses and sports grounds, or landscape areas or road verges. The net result is little nutrient removal off-site, the plant life cycle of regeneration and decay will inevitably result in most nutrients taken up by the plants, re-entering the soil matrix during the decay phase. However, plant uptake will slow the rate of nutrient leaching and evapotranspiration will reduce hydraulic pressure on the soils. Other mechanisms, such as denitrification remove nutrients from the soils.

55 The subsurface drip irrigation method is suitable for all three land uses providing there is careful management during wet weather and during harvesting.

Summary

56 Technically viable land application areas exist and there are viable land management and land application systems for these areas.

POTENTIAL OWNERSHIP, MANAGEMENT AND MAINTENANCE

57 Councils in New Zealand generally own and operate communal wastewater infrastructure. But that is not always the case as private provision of these utilities is lawful.

58 During the past 25 years, the options and alternatives available to treat and manage small community and on-site wastewater have increased dramatically. Central Government, Regional and District Councils have recognised

that alternatives to centralised treatment can form part of long term community infrastructure. Decentralised community wastewater management is now a common and attractive alternative to on-site and centralised wastewater servicing in New Zealand.

59 In 2005 the United States Environmental Protection Agency (USEPA) recognised decentralised wastewater treatment systems are becoming a permanent and essential element of the nation's wastewater infrastructure (Rubin, 2008)[1]. However, in New Zealand, like elsewhere around the world, historical decentralised wastewater system management structures have on occasion proven insufficient to meet the long term regulatory and health protection outcomes required. Rather than discounting decentralised wastewater management as an infrastructure option, focus is now being applied to future proofing decentralised wastewater systems, principally through better attention to resource consent conditions, maintenance and accountability. The result is reduced fiscal and environmental risk to councils.

60 Within New Zealand, there are a number of guidelines and design manuals that assist councils to ensure appropriate design of on-site and decentralised systems including ARC TP58, AS/NZS 1547:2000 and NZLTC NZ Guidelines for Utilisation of Sewage Effluent on Land (2000); however, there is limited information available to councils as to the regulatory approval needed to ensure the on-going management of the systems.

61 In small communities, failing or poorly maintained septic tanks and under-managed, poorly maintained or inadequately designed decentralised wastewater systems have led to investigation of options for rethinking current wastewater practices. The focus of the rethink is on sustainable development of wastewater resources and the need for operators and communities to 'own' wastewater solutions to public health and environmental problems, i.e. understand where the wastewater goes and its effect downstream and not have a flush and forget attitude.

[1] Rubin, R (2008). Decentralised Wastewater Management Options New Zealand Land Treatment Collective: Proceedings for the 2008 Annual Conference.

62 A Duffill Watts (2008)[2] survey of councils within New Zealand, and a literature review, has identified the key considerations relevant to decentralised wastewater system failure.

63 Analysis of those key considerations has resulted in a list of nine factors crucial to council regulatory control of the effects of privatised decentralised wastewater systems. The actual resource consent conditions needed for a particular system should be assessed on site specific basis. However, the majority of problems that have been experienced with decentralised systems can be largely avoided by the application of the following 11 Key Requirements:

(a) Standards – clear and consistent identification in Guidelines for officers and Applicants, the Regional Policy Statement and/or Regional Plan of the Standards that decentralised systems must reach;

(b) Design – assurance that the design is appropriate to meet the Standards;

(c) Installation – assurance that the installation is appropriate to meet the Standards;

(d) Operation and Maintenance – requiring a Responsible Management Entity with appropriate experience;

(e) Ownership – clearly define ownership structure;

(f) Financial Accountability – a means to legally recover costs;

(g) Asset Management – a system for managing current infrastructure and planning for future requirements;

(h) Monitoring and Reporting – a system of informing regional councils, territorial authorities and owners of system performance and pending issues;

(i) Enforceability – a means of allowing the territorial authority or regional council to take action to rectify a problem, at the beneficiaries' expense, if the management entity fails to do so;

(j) Transfer of Responsibilities – a clear and well defined method of transferring responsibilities to new owners

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[2] Duffill Watts Consulting Group (2008). Management of Decentralised and Small Community Wastewater Systems: Guidelines for Regulatory Control in Northland

and informing the new owners of their obligations; and

(k) Ease of Establishment – that the mechanism used can be efficiently established.

64 The core recommendation of the Duffill Watts report is that covenants be placed on titles, either by Consent Notices or Memoranda of Encumbrance, so as to notify and bind subsequent lot owners to responsibilities set out in resource consent conditions that are carefully framed so as to achieve the Key Requirements.

65 Most regional plans require that a resource consent be obtained for discharge from any decentralised wastewater system. Most applications for resource consent for discharge will be associated with and integral to a subdivision consent application lodged with the territorial authority. Joint hearings and close consultation between the two councils in these instances are advisable. Resource consent conditions should be carefully framed so as to achieve all of the Key Requirements.

66 Regional Council consent conditions will require that the Consent Holder maintain a contract with an appropriate contractor for maintenance and will also stipulate how often maintenance checks are required.

67 There are a number of other mechanisms recommended in a Duffill Watts report on this matter for ensuring landowner awareness and responsibility with respect to community wastewater infrastructure systems. These include conditions of consent, private covenants, consent notices, memoranda of encumbrance, bonds and 'rent charges'. 'Best practice' examples of consent conditions and memorandum of encumbrance are included within that report. I believe these are a useful guide which can be applied or adapted subject to legal and expert advice for community wastewater schemes in a range of circumstances.

68 A very good example of private ownership and operation is the neighbouring Jacks Point development, where the system is managed by the Residents' Association and they contract operation and maintenance to the equipment installer. This management and operation scenario was used in the Duffill Watts report as one of the case studies.

Summary

69 Sound asset management and governance arrangements can be stipulated through subdivision and discharge consents. There are resources available to assist Councils and commissioners in assessing proposals and setting appropriate conditions to provide assurances with respect to these matters.

POTENTIAL EFFECTS AND REGIONAL COUNCIL CONSENTING

70 The effects usually considered critical for consenting wastewater systems through the Otago Regional Council (ORC) are hydraulic loading (issue is runoff or ponding), nutrient leaching into groundwater and therefore surface waters, and pathogens on public health.

71 Land application systems in the region have been granted with a range of nitrogen loads. Jacks Point was allowed a moderately high loading onto the land (746 kg N/ha/yr) as the area being retired from farming resulted in an overall reduction in N leaching from the farm. The ranges given below are likely to be acceptable to ORC based on previous experience:

(a) Cut and carry 350 – 550 kg N/ha/yr;

(b) Grazed 200 – 300 kg N/ha/yr;

(c) Cut and Leave 150 – 250 kg N/ha/yr

72 Nitrogen loading is based on average annual loading, so for 1,750 lots with an average occupancy of 2.5 and N concentration of 25 mg/L, the annual load is 9,980 kg/yr. For 2,178 dwellings, the annual load is 12,421 kg N/yr. Based on the allowable loading criteria above, the land area required for Hanley Downs is shown in Table 3 below.

Table 3: Land Area Requirements (ha)

Parameter	**1,750 Dwellings**	**2,178 Dwellings**
Cut and Carry	18 - 29	23 – 35
Grazed	33 - 50	41 – 62
Cut and Leave	40 - 66	50 – 83

73 Another option to assessing land area requirements is based on nitrogen leaching, is to look at pre and post development drainage losses through the soil to groundwater and then

surface water and ensure post development is less than pre-development. This was the method used for Jacks Point. This could be done in conjunction with Jacks Point and would result in less land being required for land treatment based on nitrogen leaching rather than soil loading.

74 Jacks Point allowable leaching after village development is 3,607 kg/yr. This is based on predevelopment leaching of 420 ha at 9 kg N/ha/yr (= 3,780) with a 5% reduction to allow for uncertainties. This value also has to accommodate the leaching from 100 ha of sheep farming and the golf course;

75 With 520 ha in Hanley Downs and assuming similar predevelopment stocking density and post development safety factors, then a likely acceptable leaching load is 4,446 kg/yr. Using 25 mg/L N concentration, and also assuming about 100 ha of farming remains, then an additional 20 ha of land treatment area is required. Alternatively, denitrification beds could be added to the rtPBR to reduce the effluent N to 5 mg/L, resulting in land area requirements of 4 ha.

76 Hydraulic loading is driven by the peak loading. From above, this is calculated to be 1,512 m^3/day for 1,750 dwellings. From the soils section, the calculated maximum DIRs are 12 – 18 mm in summer when the peak will occur. Areal requirements are 13 ha in summer. In winter the DIRs would be 6 mm/day but peak loads would not occur. Assuming 75% of peak, then 19 ha is required. For 2,178 dwellings, the summer area required for hydraulic loading is 16 ha and winter of 24 ha.

77 Sewage effluent contains pathogens. These are filtered out through soils with 1 log reduction every 150 mm of soil passage and are generally not considered a risk to groundwater with land treatment systems, i.e. for rtPBR effluent, passage through 600 mm of soil should result in no residual pathogens.

Summary

78 There is sufficient area available to satisfy likely nutrient and hydraulic loading depending on selected land use. I consider that the above proposal would be consented, with conditions, by ORC.

SUMMARY AND CONCLUSIONS

79 Reticulation of wastewater to the QLDC Shotover Wastewater Treatment Plant is a viable and economic option. Should this

not prove the preferred option, there are also viable options for decentralised wastewater treatment and land discharge.

80 After allowing for buffer areas to waterways and boundaries, there is sufficient land area of the preferred freer draining soils to allow any of the three land use practices to occur. An area of 24 ha is required for hydraulic loading which is less than ½ of the preferred soil areas. The lesser preferred areas can also be used but these will need more careful management in the wetter periods. The likely area requirement for nitrogen renovation is 4 - 41 ha.

81 The wastewater treatment and land application systems should be granted consent by the Regional Council.

82 Ownership, governance, management and maintenance arrangements can be established to ensure these systems continue to operate appropriately over the longer term.

Robert John Potts
26 June 2015

Annexure A: Figure 2 Location of Potential Land Treatment Areas

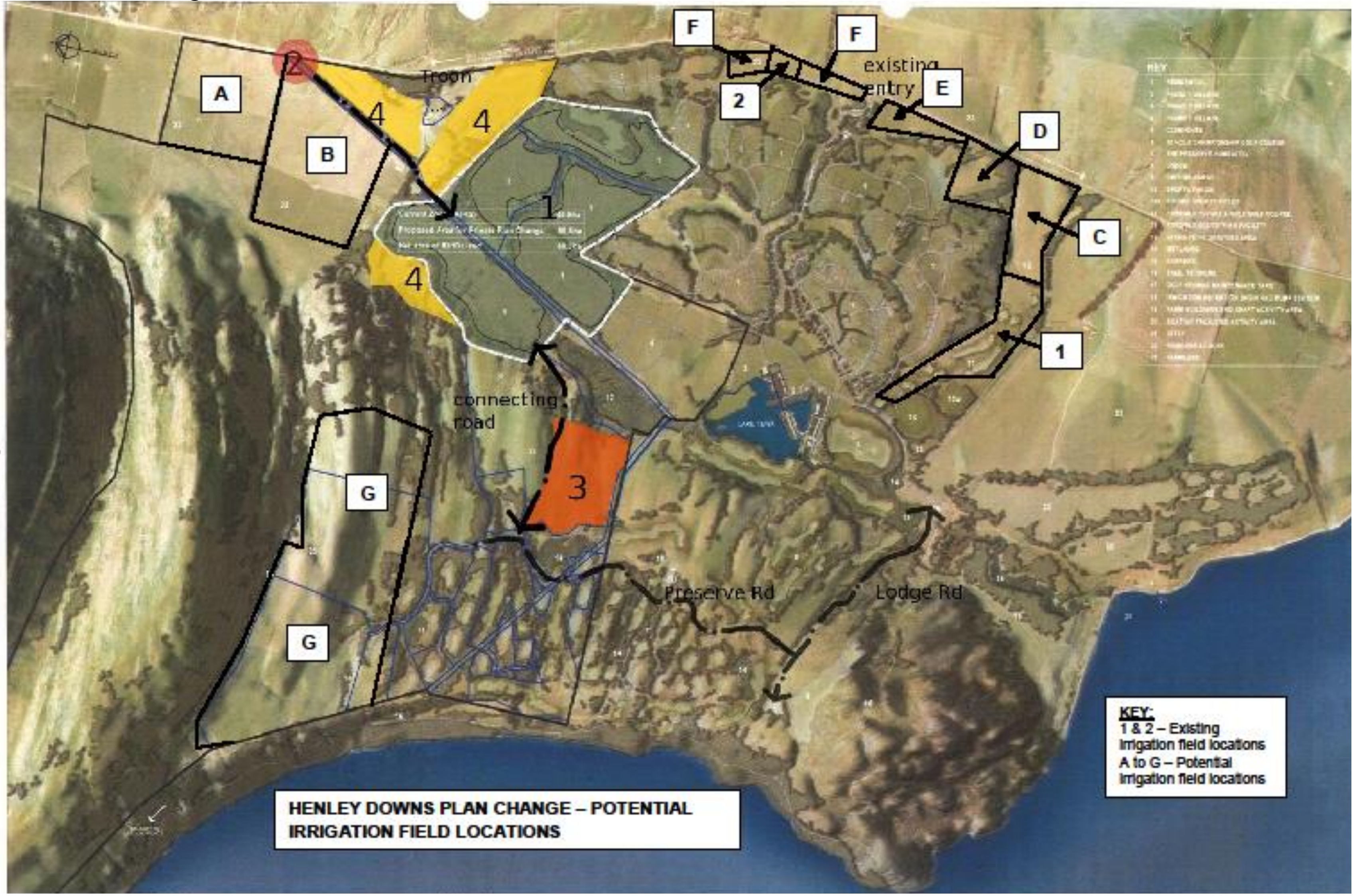
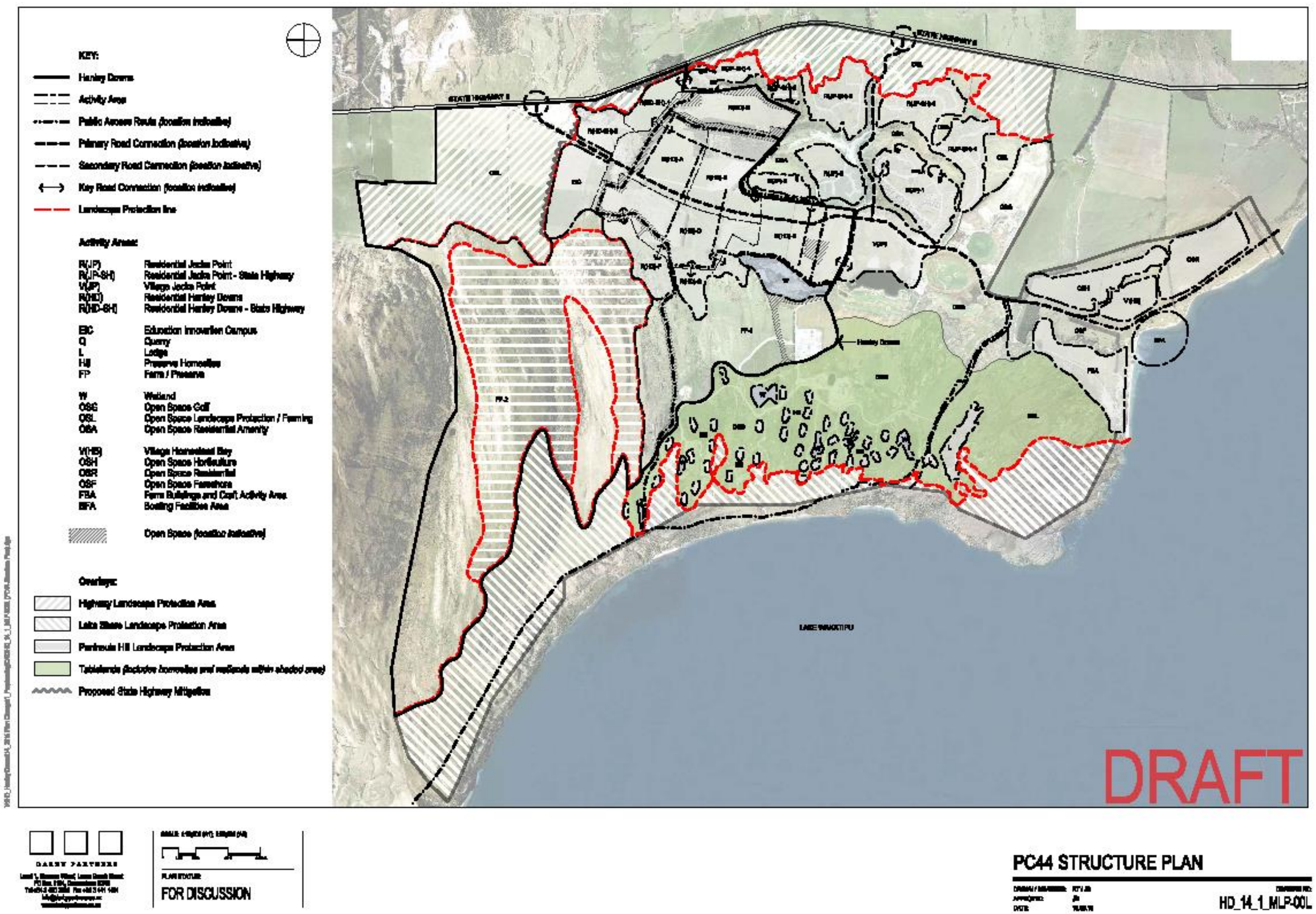


Figure 3: Structure Plan



ANNEXURE B: BACKGROUND INFORMATION

Environment Description

1 The areas identified for domestic wastewater dispersal are located within a basin bounded by up-faulted block forming ranges. The nearest of these to the area is The Remarkables, located on the eastern side of SH6. Peninsula Hill is sited on the west-north west side of the area.

2 The landforms present in the area are generally representative of discontinuous deposit of glacial till - undulating, glacially modified ridge sections and an undulating plateau incised by streams.

Groundwater

3 Currently available groundwater information is limited to that reported for Jacks Point. GPF (2003) reported that there were no bores within a 3 km radius of Jacks Point. However, Mr Troon, adjacent to Area 4 had a shallow bore. An agreement was put in place with Jacks Point for water to be provided from the Jacks Point water supply, so it is unlikely this bore is now used. Assuming no bores have been drilled since the 2003 investigation period and, based on the relative size and location of Hanley Downs in relation to Jacks Point, it can be assumed that there are no other bores within a 2 km radius of the Hanley Downs development area. Further investigation will be required to determine the location of any groundwater takes relative to the finalised land application area.

4 Piezometers within the Jacks Point locality, installed for geological investigations, indicate water levels at 18 – 19 m below ground level (mbgl) (GPF, 2003). Groundwater quality sampling within the Jacks Point locality in July 2013 indicated an average nitrate-nitrogen of 0.015 mg/L and E. coli of <1.0 cfu/100 ml.

5 There is little information on groundwater direction in the area. It is likely that shallow groundwater follows the surface topography towards the Kawarau River and deeper groundwater flows towards Lake Wakatipu.

Surface Waters

6 There are two main surface waters within the Hanley Downs vicinity:

- Lake Wakatipu to the west; and
- Kawarau River to the north.

7 The general area is incised by streams/tributaries originating from the elevated hill areas to the west and mountain ranges to the east. The streams/tributaries form a single confluence and discharge into the Kawarau River south of Queenstown Airport. A number of ephemeral tributaries run through the Hanley Downs site, as outlined in the evidence of Gary Dent.

8 The Lake Wakatipu outfall into the Kawarau River is 1.3 km upstream from where the inland stream network joins the Kawarau River.

Rainfall, Evapotranspiration and Soil Moisture

9 Climate data was sourced from the National Institute of Water and Atmospheric Research (NIWA) National Climate Database. The closest meteorological data point is Queenstown Aero AWS (Agent No. 5451), located 3.6 km north of the area. Rainfall

and potential evapotranspiration (PET) for the period 1982 – 2013 is summarised in Table 4.

Table 4: Rainfall and Evaporation (1982 – 2013)

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Rainfall (mm)	67	50	53	53	64	70	52	63	56	70	55	68	721
Penman PET (mm)	157	121	91	50	26	14	17	32	59	93	122	146	928
Surplus/ -Deficit	-90	-71	-38	2	38	56	36	31	-3	-23	-66	-78	-207

10 The area has low to moderate mean rainfall at 721 mm/year. Rainfall on average is fairly evenly distributed throughout the year. Rainfall generally exceeds PET for the months of April to August and the surplus is usually small.

11 Figure 4 presents the daily soil water balance for the year 1 July to 30 June, for 2013 (red curve) and the previous season 2012 - 2013 (blue curve). The black curve represents the average soil water balance developed from long term historical data (1972 - 2013). These curves are developed by tracking the rainfall entering the pasture root zone and the evapotranspiration or use by plants. The soil considered is an average type where the available water holding capacity is 150 mm.

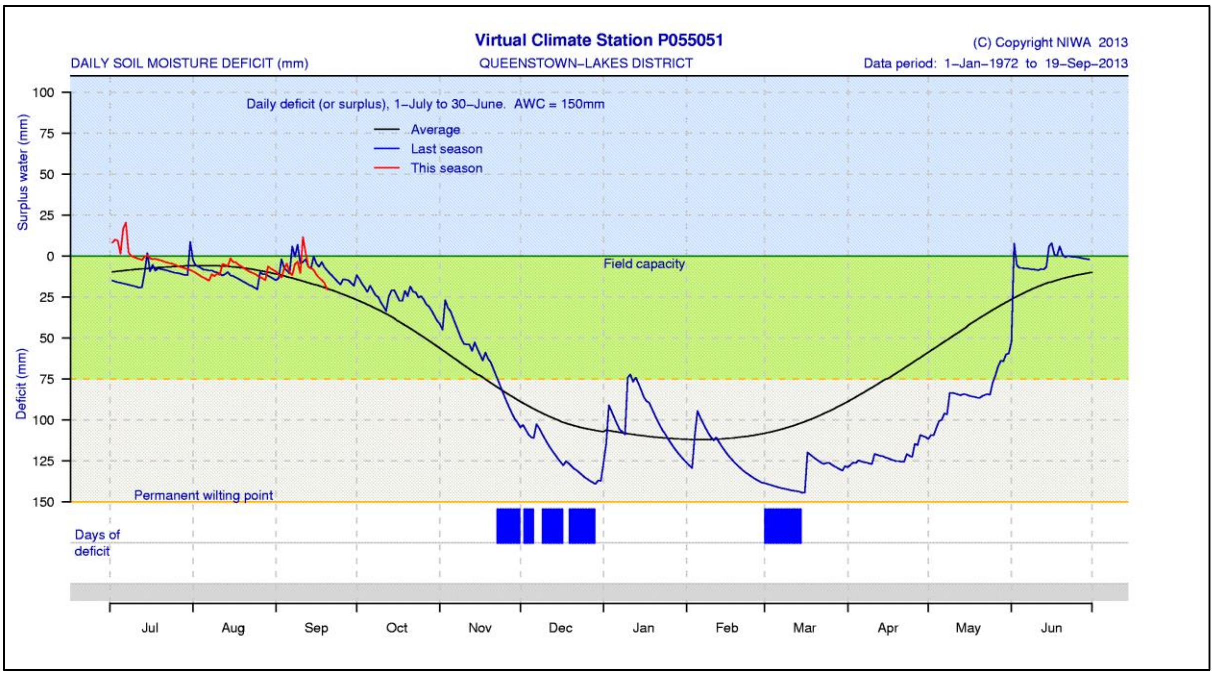


Figure 4: Hanley Downs Soil Moisture Deficit

12 Figure 4 indicates that there were approximately 50 days in the 2012/2013 year of significant soil moisture deficit (blue bars) (less than ½ soil moisture available). The September through to November 2012/2013 period and the month of January are considered to be wetter than on average due to the data being above the average line. The December and February to the end of May 2012/2013 period is considered to be dryer than average because the data is significantly below average (black line). The actual number of days of soil moisture deficit to be expected in any particular year may lie anywhere within the range demonstrated in Figure 4, i.e. from mid-August to June.

Soil Temperature

13 Figure 5 below presents the daily and monthly soil temperature for the year 1 July to 30 June, for 2013 (red curve) and the previous season 2012 to 2013 (blue curve). The 2013 season started in July; therefore, only three months' worth of data is provided. The black curve represents the average 10 cm soil temperature developed from long term historical data (1 January 1972 to 19 September 2013). This graph shows, that on average, soil temperatures at 100 mm below ground do not freeze but some days go below zero. The lowest recoded soil temperature is – 9.9 degrees Celsius, so periods of frozen ground will have to be designed for.

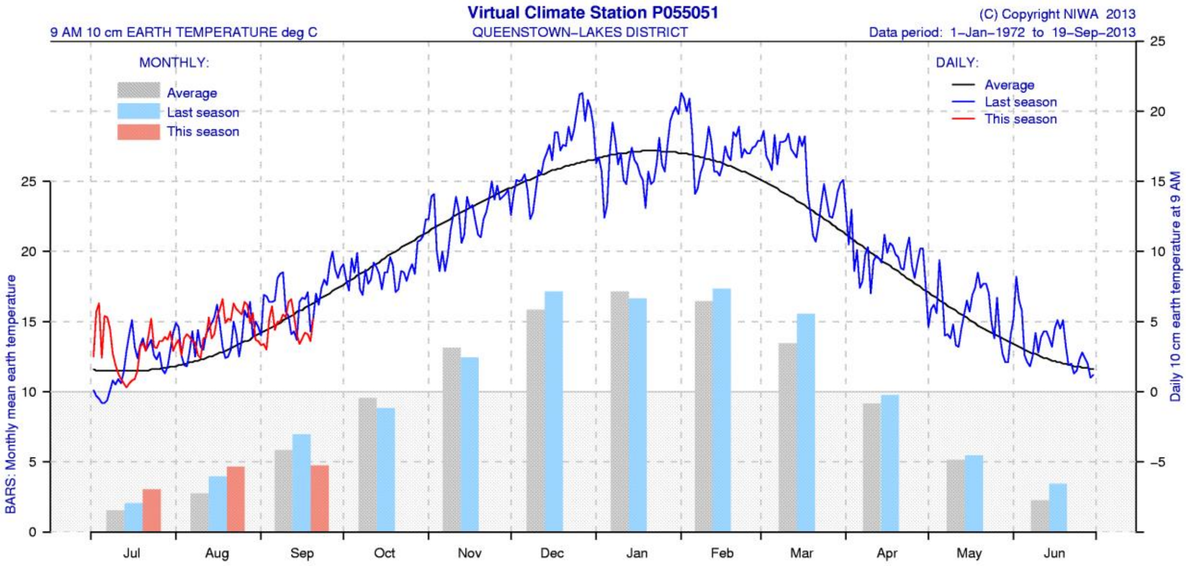


Figure 5: Hanley Downs 10 cm Soils Temperature

Soils

14 Soil descriptions and investigation results in Tables' 5 and 6 are from GPF (2003) and Gunn (2012).

Table 5: Relevant Soil Types for Land Areas

Land Area	Soils Description
Area A	– **Frankton** silt loam strongly gleyed variant (60%) (Gley soils) – Shotover moderately deep sandy loam/sand undulating (30%) (Melanic soils)
Area B	– **Shotover** moderately deep sandy loam/ sand undulating (Melanic soils)
Area 4	– **Wakatipu** shallow sandy loam rolling (Melanic soils) and Pigburn shallow fine sandy loam rolling (Melanic soils)
Area G	– **Wakatipu** shallow sandy loam rolling
Area H	– **Frankton** silt loam strongly gleyed variant (70%) (Gley soils) – **Shotover** moderately deep sandy loam/sand undulating (20%) (Melanic soils) – **Pigburn** shallow fine sandy loam rolling (10%) (Recent soils)

Table 6: Soil Assessment Summary (GPF & Gunn)

Soil Type	Characteristics	Irrigation Suitability	Recommended DIR
Wakatipu	Sandy loam topsoil overlying loamy gravel till; free draining	– Subsoil infiltration limitation – Year round irrigation possible	Winter: 6 mm/d Summer: 18 mm/d
Pigburn	Sandy loam topsoil over massive sandy loam. Deep rooting and high water holding capacity; free draining	– Subsoil infiltration limitation – Year round irrigation possible	Winter: 12 mm/d Summer: 18 mm/d
Frankton	Deep loamy silts in low areas; poorly drained with persistent high water tables in winter; subsoil probably dispersive; risk of winter wetness unless drained.	– Subsoil infiltration limitation – Should not be used for irrigation in winter	Winter: 0 mm/d Summer: 6 mm/d
Shotover	Loamy silt (slightly sticky) overlying loamy sand at 760 mm. (Loess covered alluvial fan areas.)	– Potential for year round irrigation at low application rates, confirmed by LEI	Winter: 6 mm/d Summer: 12 mm/d

Decentralised Wastewater Treatment Plant Selection

15 Tables' 7 and 8 rank the rtPBR against other options.

Table 7: Summary of Wastewater Treatment Options
(3 = Best, 2 = Moderate, 1 = Least Desirable)

Parameter	SBR		rtPBR	
	Description	Score	Description	Score
Capital expenditure	High	1	Moderate - High	1 - 2
Running costs	High	1	Moderately Low	3
Additional carbon dosing	Possibly	2	Probably but depends on target N	1
Power requirement	High	1	Low	3

Maintenance requirement	High	1	Low	3
Sludge production	High	1	Low	3
Suitable for intermittent flow regimes	Yes with balancing	2	Yes	3
Noise	Moderate	2	Low	3
Remote servicing and trouble shooting	Yes	3	Yes	3
Visual impact	Moderate	1 - 2	Low	3
Operation simplicity	No	1	Good	3
Anaerobic pre-treatment	Not necessary	3	Needed	1
Odour production	Low - Moderate	2	Low	3
Reliability	Moderate - High	2	High	3
Effluent treatment	High	3	Good	2
Total Score		**26 - 27**		**38 - 39**

16 The recirculating packed bed reactor (**rtPBR**) is a multiple pass packed bed aerobic wastewater treatment system. The packed bed media is an engineered textile, which has a high void capacity allowing for a large surface area. Wastewater enters a processing tank (recirculating tank) where anaerobic digestion and suspended solids removal can take place. Effluent is then pumped to the secondary treatment chamber where it percolates down through a textile media and is collected in the bottom of a filter pod. This process does not utilise forced aeration. From the filter pod the flow is split (diverted) between the processing tank and the final discharge, usually on a 3 to recycle to 1 to discharge. During extended periods of no flow, 100% of the treated effluent is returned to the processing tank.

17 The expected effluent quality from the rtPBR wastewater treatment plant is summarised in Table 8, along with current and proposed Stage 1 Upgrade of QLDC Shotover WWTP effluent quality as a comparison.

Table 8: Expected Final Effluent Quality

Parameter	rtPBR(1) (Mean)	Shotover Current (Mean)	Shotover Proposed (Mean)
Biological Oxygen Demand (BOD, mg/L)	5 - 15	23 - 48	30
Total suspended Solids (SS, mg/L)	15	29 – 76	30
Total Nitrogen (TN, mg/L)	5 - 25	28 – 43	23
Total Phosphorus (TP, mg/L)	12	5 – 6	7.5
Faecal Coliform (cfu/100 ml)	< 10^4	$2x10^3$ – $6x10^4$	< 2.6 x 10^2

(1) Note: Performance data sourced from Innoflow Technologies Ltd and ARC (2004).

18 The rtPBR effluent is considered to have been treated to an acceptable high standard and is accepted by regulatory authorities as being suitable for land application.

ANNEXURE C: EMAIL FROM Urlich Glasner, QLDC

From: Ulrich Glasner [mailto:Ulrich.Glasner@qldc.govt.nz]
Sent: Tuesday, 23 December 2014 11:47 a.m.
To: Dan.Wells
Subject: RE: HD Wastewater Connection Letter (2)

Hi Dan

Please accept my apology for the time I needed to come back to you.

In regards to your letter from the 23 September QLDC confirms that at this point of time based on the preliminary assessment Council agrees that a scheme to pump wastewater from Hanley Downs to Council owned Frankton infrastructure is a viable option.

All parties are clear that in order for this project to proceed, project details will need to be agreed with Council. This includes several significant matters of detail, including (but not limited to):

- Scheme design, including matters such as:
  - the point of connection in Frankton
  - the route of a pipeline
  - treatment requirements prior to conveying wastewater from Hanley Downs
- Timing
- Ownership of assets
- Legal matters such as agreements and easements
- Financial matters

If you need anything else please let me know.
Merry Christmas and a good start in 2015.

Cheers
Ulrich

Ulrich Glasner | Chief Engineer | Infrastructure Queenstown Lakes District Council DD: +64 3 450 1721 | P: +64 3 441 0499 | M: +64 27 222 4813 E: ulrich.glasner@qldc.govt.nz	QUEENSTOWN LAKES DISTRICT COUNCIL www.qldc.govt.nz