Wastewater discharge options for Queenstown – Trials and tribulations

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ABSTRACT

Land discharge options have been assessed for Queenstown by a number of consultants in the past 10 years, without success. The problems have been steepness of topography, freezing winter temperatures, high number of smaller holdings but most significant of all has been cost of and ready access to suitable land.

Glasson Potts Fowler (now Duffill Watts Consulting) and Queenstown Lakes District Council have undertaken a very robust assessment of land treatment and other discharge options - firstly within a 10 km radius with less than 140 m static lift and then a 30 km radius with 200 m lift. A number of land owners were contacted and workshops held with interested parties. Three land areas were short listed, however, this soon became two and then one as length of contract or land ownership discussions became more detailed.

The final land treatment option was at Gibbston Valley, a water short area well known for excellent Pinot Noir wines, 23 km from the sewage treatment plant. The pipe route had 180 m lift, a major river crossing, an unstable bluff to negotiate and seismic issues. After a risk workshop held with key stakeholders, land treatment was still one of the three favoured options but the risks and costs were appreciable higher. When risks were factored in, land treatment had a cost of $29 to $36 million, land disposal $9 million and wetland and river discharge $8 million, with the cost of an upgraded sewage treatment plant an additional $21 – 27 million, without any land costs. The Council has recommended proceeding with land disposal via rapid infiltration trenches.

Keywords: Land treatment; land disposal; difficult topography; rapid infiltration; LPED; consultation.

INTRODUCTION

The continued rapid growth and expansion of Queenstown and surrounds means that there are increasing pressures being put on the sewerage infrastructure in the area. In order to cope with the expected growth in the future is necessary to upgrade the wastewater treatment system for the area. The current method of treatment is by Oxidation Ponds, which can form part of an effective treatment process for smaller communities but given the projected population figures adopted by Council to 2026, it is estimated that the current system will be unable to treat the wastewater to the required levels past 2012 and therefore a new sewage treatment plant (STP) is required. As part of this, the discharge system for the new facility will have to be upgraded in line with the application for new discharge consent.

The current treatment system comprises two facultative ponds in parallel, followed by a dual cell maturation pond. It is a passive system that utilises solar and wind energy for treatment via wave action and algal photosynthesis. Features and issues of the current system are: low capital and operating costs; low energy usage; vulnerability of the system from climate variables; and potential for odour and bird strike.

The current discharge into the Shotover River has a conspicuous algal plume and is either discharged into a small braid of the river or directly onto the dry river bed, thus requiring braid training upstream. Isolated ponds containing the effluent get separated from the braid downstream of the ponds.

The current treatment system has very stringent consent limits on total nitrogen, ammonia-nitrogen, total phosphorous and discoloration. Although the limits are not low, they are difficult for a conventional facultative and maturation pond system to comply with.

With regard to impacts on the Shotover River, nutrient levels and coliform concentrations in the receiving water are elevated and consent conditions are regularly exceeded. Bacterial concentrations at times exceed recreational water guidelines, however, the annual compliance monitoring report states that no effects on benthic invertebrates are observable in the Shotover River (KMA, 2006). However, ORC have concerns due to the cumulative effect of nutrients in downstream lakes. This is currently judgemental rather than scientifically based.

TREATMENT PLANT OPTIONS AND EFFLUENT QUALITY

Population forecasts taken from the QLDC Long Term Community Consultation Plan (2006) for the design horizon relating to obtaining a new resource consent in 2008 for a 35 year duration (2043). The LTCCP covers years up to 2026, and population/visitor growth has been assumed to continue at a sustainable rate beyond that timeframe. The design flows and daily volumes are presented in Table 1.

Table 1. Population and flow forecasts.

Population	2006	2026	2043
Visitor (Average Day)	9,408	19,193	34,356
Resident	14,148	31,443	59,376
Total Average Day Population	23,556	50,635	93,732
Visitor (Peak Day)	32,206	55,338	89,884
Resident	14,148	31,443	59,376
Total Peak Day Population	46,354	86,781	149,260
Flows			
Average dry weather flow (L/s)	89.4	176.6	-
Peak instantaneous wet weather flow (L/s)	412.6	657.5	-
Average dry weather flow (m^3/d) *ADWF*	7,070	15,200	28,100
Average max dry weather flow (m^3/d) *PDWF*	13,900	26,000	44,800
Peak wet weather flow (m^3/d) *PWWF*	17,700	34,400	56,200

In summary, STP design is based on treating peak dry weather flow, with wet weather flow assumed to be balanced at the treatment plant utilising the existing pond infrastructure, i.e.

current peak dry weather flows are 14,000 m^3 per day and these are expected to increase to 26,000 m^3 per day by 2026 and 45,000 m^3/day by 2043.

Three potential STP options have been identified (CW/AWT, June, 2007). These are:

- An activated sludge (AS) plant with biological nutrient removal (BNR) capabilities and an optional micro-filtration or ultraviolet light (UV) disinfection stage to remove pathogens;
- A sequential batch reactor (SBR) with an optional microfiltration or UV disinfection system; and
- A membrane bioreactor (MBR).

In order to undertake preliminary assessment of options, likely effluent criteria for a variety of discharge options were discussed with Otago Regional Council (ORC). The possible effluent quality consent condition proposed in Table 2 are indicative only and used as a guide to the likely effluent quality required. However, they are considered to be representative of the effluent quality standards likely to be required for a long-term consent by the ORC. A discharge ‘to water’ relates to infiltration to the river via rapid infiltration beds or direct via a wetland and rock diffuser.

Table 2. Current and indicative future effluent criteria.

Parameter	Current Consent Conditions		Possible Consent Conditions	
			(To Land)	(To Water)
	95 Percentile	Mean	Average	Average
BOD_5 (g/m^3)	100	50	30	10
TSS (g/m^3)	130	50	30	10
NH_3-N (g/m^3)	30	20	N/A	5
TN (g/m^3)	30	20	20	10
TP (g/m^3)	10	5.5	N/A	10
Faecal coliforms (cfu/100ml)	50,000	5,000	200/10,000*	10
Dissolved Oxygen (g/m^3)	>2			

* For land treatment: 200 cfu/100 mL for above ground discharge, 10,000 cfu/100 mL for sub-surface discharge

The three short-listed options in the CW/AWT Report all meet the above effluent criteria, as well as meeting the following additional criteria: High level of reliability – ability of the process to consistently meet consent requirements for land and water; Reduced potential for nuisance – odour, noise, algae/colour, insects, foam, birds; Ease of operation – the degree of operator requirements and relative complexity of the process; Ease of expansion – potential for upgrade or staging of the plant; Reduced land requirements for the STP (small foot print); Process flexibility – ability to meet increased quantities and higher effluent quality limits in the future; and Ease of sludge management/handling.

The capital costs have been assessed by WT Partnerships (2007) and these show that the options are similar, at around $21 to 27 million in 2011, including sludge handling, with an additional upgrade cost in 2026 of $15 to 16.5 million.

The operating costs of the options vary from \$0.29/m^3 of wastewater treated to \$0.54/m^3. On analysis breakdown of operating costs, it was found that sludge disposal, alkalinity and aeration were the largest components. In addition, as the effluent nitrogen levels increase (i.e. less degree of treatment), the operating costs also increase, mainly due to alkalinity dosing, as the wastewater is relatively alkalinity deficient.

OVERVIEW OF DISCHARGE OPTIONS

Through a series of consultation meetings, wastewater workshops and risk assessment workshops involving stakeholders and interested and affected parties, a large number of potential options were reduced to three options suitable for further analysis. The three options considered suitable for discharge of the treated wastewater were:

Option 1 - LAND DISPOSAL at Shotover Delta;
Option 2 – RIVER DISCHARGE via wetlands and diffuser system; and
Option 3 - LAND TREATMENT at Gibbston.

The consultation meetings and workshops were seen as an essential part of getting a solution that will meet with stakeholders basic requirements. This reflects that Queenstown's popularity and appeal comes from the natural environment, so wastewater management must recognise this.

Option 1 - Land disposal

Land disposal involves high quality wastewater (generally of higher quality than the land treatment option) being discharged at high rates (200 to 675 mm/d) into specially-designed rapid infiltration beds within the Shotover River Delta and surrounding areas. This option is purely a mechanism for diffuse disposal, and only slight improvements in the overall quality of the effluent discharged to land, and eventually the river, are expected.

The area required to meet the 2026 flows is expected to be approximately 6 ha of net disposal area. With gaps between beds factored in, the gross area required is 8 ha. Further rapid infiltration areas have been proposed up to 2043 flows that require a gross area of 12 ha. Due to uncertainties in the deltaic material conductivity and in modelling, up to 20 ha has been allowed for in calculations.

The rapid infiltration beds would be constructed by excavating each bed to a depth of 700 mm, removing the silty material from the excavated material, and backfilling the beds with cleaned and screened gravels. It is possible that during excavation and assessment, that some of the in-situ material could be left. Further build up of the delta by 1 – 2 m is proposed to account for groundwater mounding. Low pressure effluent dosing (LPED) pipework would be laid on top of the filled area, approximately 600 mm above the mounded water table. A Tensar grid and filter cloth would be laid on top of the pipework, resulting in a finished rapid infiltration bed that is mounded approximately 2 m above the original surface of the delta.

The design hydraulic loading is based on both long-term trials in the delta area carried out on the facultative pond effluent (DWG, 2007) and plate permeameter tests undertaken.

The results of the DWG trials indicated a long-term sustainable loading rate of around 500 mm/day using facultative pond effluent. The results of the permeameter tests indicate a long-term sustainable loading, based on 10% of near saturated hydraulic conductivity ($K_{-40\ mm}$) of 675 mm/d (GPF, 2007). The design loading rate used for costing purposes is 500 mm/d.

Groundwater mounding assessments using both analytical and numerical modelling, indicate that mounding could be significant due to the high groundwater and the geological constraints on the western (airport side). This mounding results in earthworks in the order of 350,000 m^3.

River protection works are proposed as part of the works to protect the filled area for a 1 in 100 year flood from the Shotover River.

Option 2 - River discharge

River discharge involves the production of a very high quality effluent in a modernised wastewater treatment plant. This effluent is then discharged through a course of two parallel wetlands, prior to the final liquid stream entering into the river via a diffuse-discharge device. The wetlands would be designed and constructed to provide maximum contact for the effluent with the land but depending on water fowl use, microbiological quality could deteriorate. In addition, constructed wetlands are a quasi-natural system, and many of their effects cannot be accurately accounted for.

The STP outlet flow would be split evenly between the two cells resulting in up to 13,000 m3/day directed through a single cell by 2026, based on Peak Dry Weather Flows predicted. The system should be designed to allow a third cell to be installed if necessary.

The water depth within the wetlands will be determined by vegetation and debris density and the influent flow rates. Fine tuning of water levels will therefore be necessary. This will be achieved by altering outlet weir levels. Although the designed water depth is 300 mm, plants will thrive within a range from 200 mm up to 400 mm, and can cope with temporary inundation to depths up to 600 mm.

An outfall pump station has been allowed for at this stage, as it is likely that the effluent will be piped to the Shotover/Kawarau confluence. If selected for further investigations, assessment of whether gravity can perform this will be assessed.

The final discharge from the wetland is a rock rip-rap diffuser system, placed on the banks of the Kawarau River, just downstream of the confluence with the Shotover River on the true left bank. This site has been selected as it is stable during floods and would still allow discharge down the Kawarau River when the Shotover River was backing up into Lake Wakatipu.

A 50 m section of the Kawarau Riverbank would be excavated and replaced with large (300 - 500 mm) rock rip-rap. The section would be required to be constructed so that the Q5 low flow (5-year low flow) was still above the base level of the diffuser, so that river water would be able to flush into the base of the diffuser, removing the effluent to the river.

There is no expectation of additional treatment within the wetland. The wetland system is generally a socially and culturally acceptable mechanism for purification of wastewater. While modest treatment is generally achieved in the short–to–medium term, long term, wetlands can become decadent, and a source of nutrients and pathogens in the final effluent stream. It is therefore important to have the quality of effluent assessed, for resource consent purposes, at the outlet from the wastewater treatment plant, and not at the outlet of the wetland, or at the diffuser point. However, local iwi have indicated that unless the wetland is offering further treatment and is not there as a “token gesture” to satisfy their cultural needs, then they would not support or accept it. In addition, ORC have indicated that they consider the wetland part of the treatment system and would thus require monitoring post the wetland. This means that either the design ensures no or minimal wildfowl, or shifting the STP tertiary treatment (i.e. disinfection) post the wetland.

Option 3 - Land treatment

Land treatment of wastewater involves applying treated wastewater to land in order to utilise the soil's natural ability to further treat wastewater in a sustainable manner. Land treatment offers the potential to reuse the water and nutrient resource that is produced by the wastewater treatment plant. It is the only option of the three that achieves this type of reuse, and can directly improve the gross value of the district's pasture, arable, or horticulture crops through sustainable management of the wastewater resource.

Land treatment requires land to be located within reasonably close proximity (preferably within 10 km) to the Shotover STP for further final treatment through the natural processes of soil filtration and adsorption, and plant uptake. If land treatment is selected as a preferred option, it will be necessary to either purchase land outright, engage in long-term land leases, or award treated effluent irrigation supply contracts.

At this stage, potential land treatment areas have been targeted based on a number of factors, such as locality, current and likely use of land in the future and topographical considerations.

Land was originally examined for land treatment possibilities using a ten kilometre radius from the STP site, and a planned vertical lift of no more than 140 m. Out of an initial 35 potential land treatment sites identified in this area, initially only two potential land areas were identified as candidate sites for a Queenstown Land Treatment System due to owner interest. In addition, due to a request from landowners, the Gibbston site was added as an option to be assessed. However, since the initial assessment and discussions with land owners, only the Gibbston Valley land treatment option remains. The other options have been removed due to either the owner wanting to sell part of the land, or because it is located within the nutrient enriched Lake Hays Catchment, or due to the lack of long-term commitment from the owner.

The Gibbston Valley landowner has approximately 158 ha available for land treatment. There are also 286 ha of vineyards potentially interested in the use of the water, however, no firm offers or commitments to take up the treated wastewater have been made to date. The landowner wishes to sell part of the land to QLDC, approx 40 ha and the rest could be secured by entering into a long-term lease (initially a 99 year lease was discussed but now at least 35 years would be acceptable to the landholder) for effluent to be applied to the land in question. The Gibbston and wider community are very much in favour of utilising the wastewater.

Profile available water (PAW) at the Gibbston site indicates the site has low to moderate PAW and could benefit from the hydraulic addition throughout much of the year, particularly in the growing season, as the site experiences water deficits. This also means that the use of effluent for irrigation could allow current irrigation water (accessed from bores and the river) to be used for further development in the area, as the access to water from groundwater is difficult (Dr Selvarajah, ORC pers. comm. 2007).

This site also has the advantage of being outside the Lake Wakatipu catchment, ensuring that no nutrient leaching will migrate back to the environment of the lake.

The main disadvantage of the site is that is the longest distance from the proposed STP site, at 18.8 km and a 170 m vertical lift.

In this case, the landholder has stated a preference for QLDC to both operate the system and manage the area, so it would be likely that QLDC either sublease the area to a neighbouring pastoral farmer, or contract out the harvesting operation (hay, silage, balage or other cut and carry crops).

Costs initially discussed with the landholder were for $300,000 as an annual lease of the land.

Two application systems were assessed and costed – centre pivots and subsurface drip. The centre pivot system is significantly cheaper but there are issues in the Queenstown area over long periods of frozen ground. Temperature probes have been installed at 0 – 5, 10 and 30 cm below ground and early indications are that at least 10 cm will be required to be below frozen ground. Whether the temperature of the wastewater is sufficient to allow the application to be absorbed is currently unknown.

The expected nitrogen (N) and phosphorus (P) loadings to potential land treatment areas under the various management systems is presented in Table 3 below. The nitrogen loadings have been developed in discussion with the ORC and are considered the maximum annual permissible N loadings to land considered environmentally sustainable, i.e. nitrogen into the soil/plant system matches nitrogen out with acceptable nitrogen leaching loss.

Table 3. Estimated wastewater nutrient and hydraulic loadings to land under various land use options.

Land Use Option	Maximum N Loading (kg N/ha/yr)	Estimated P Loading (kg P/ha/yr)	Area for 2026 flows based on avg 10 g/m^3 N (ha)	Area for 2043 flows based on avg 10 g/m^3 N (ha)	Estimated Average 2026 Irrigation Rates (mm/d)
Grazed Pasture	300	75	185	340	8.2
Cut and Carry	550	138	100	185	15.1
Cut and Leave	200	50	275	515	5.5
Forestry	250	63	220	410	6.8

Utilising a cut and carry management type system where the pasture is harvested for hay, balage or silage, there would be enough feed harvested from the land to support 20 SUs, increasing the gross income from the land to $1,400/ha ($0.26 million for 185 ha cut and carry system), an increase of 82%.

There is potential for Queenstown to enhance its environmental image with tourists through the reuse of the resource. The clean green image is a powerful brand that New Zealand tourism relies on.

However, there are potential drawbacks to a land treatment system. The main drawback of the options proposed, are the insecurity of leases, the cost of the proposed systems, currently available land, ongoing maintenance of irrigation systems, the potential need for long-term monitoring of land treatment sites, and possible initial public resistance to the concept.

CONSULTATION - INTERESTED OR AFFECTED PERSONS

A series of meetings and workshops were held with those identified as major stakeholders or interested and affected parties. Unfortunately not all of those invited to attend were able to do so, however all are included as being consulted, as they were sent the information relevant to the meetings and feedback received was included in the process, even if they did not attend. These are listed as follows:

Key Stakeholders:
- Queenstown Lakes District Council
- Otago Regional Council
- Kai Tahu Ki Otago
- Te Runanga O Otakou
- Kati Huirapa Runanga Te Puketeraki

Interested and Affected Parties:
- Queenstown Airport Corporation
- Queenstown Chamber of Commerce
- Destination Queenstown
- Fish and Game
- Department of Conservation
- Gibbston Community Association
- Queenstown Rafting
- Shotover Jet
- Kawarau Jet
- Residents on the true left bank of the Shotover Delta
- Short listed landowners in the area
- All business's and contractors operating on the Shotover Delta
- Lakes Contract Services Ltd

Workshops were also held with Council and the Utilities Committee to ensure that information on progress was provided.

OPTION RANKING

To help evaluate each of the discharge options for its suitability and preference for use in a practical sense, each of the three short listed options are discussed under the headings below. Ranking was based on the risk and stakeholder workshops, with 1 being poor and 5 being desirable.

- Consentability;

- Constructability and Durability to Environment;
- Ease of Operation and Maintenance;
- Emergency Management; and
- Electricity Requirements.

Consentability

The fact that Options 1 & 2 are within land owned by QLDC and designated for wastewater is a huge advantage. Clearly a lot of consultation and agreement had to be achieved in order to get a wastewater designation on this site. This should make getting consent for the Delta area simpler and straight forward.

Table 4. Consentability ranking.

Discharge	ORC	Iwi & Runanga	Fish & Game	Public Health South	Water Users Group	Affected People in Gibbston	Delta Residents	Average
Land Disposal Option 1	4	3	5	5	4	4	4	4
Wetlands 2	4	1	5	4	3	3	5	3
Land Treatment 3	4	5	5	5	5	4	4	4

Constructability and durability

All options are constructible and will survive in the environment they are placed. This criteria assesses how practical it is to construct them and after that, how much effort will be required to maintain the constructed option in normal working order.

Option 1 is a relatively straight forward construction process similar to others in the District. There may be some sorting of the Delta gravels required in order to ensure long term permeability of the existing materials. Construction is straight forward using bulk earthwork machinery and normal drain laying techniques. Durability in the environment is not considered an issue. Because of the large volumes of liquid moving through the pipes and into the disposal area, as well as the slightly higher wastewater temperature, freezing is not expected to be a sigificant issue. Flooding may happen but provided the erosion of pipes is prevented, which ties in with the proposed flood protection works, then the disposal would not be compromised. Out of the three options this is the one that would be least affected by an earthquake, which is a major consideration due to the likelihood of seismic activity in the area. Build up of organic material over time may mean that areas need to be rested or re-worked to remove the undesirable growths, but as stated previously, this is a straight forward earthworks issue.

Option 2 requires a higher level of more complicated earthworks than the other two options. Ponds that are lined to prevent leaking would have to be constructed, similar to the existing ponds. Unlike the existing ponds however lining will have to be secure to prevent any liquid reaching the ground water. This is achievable but may involve the importation of clay to seal the ponds or use of a lining material. While it is possible to do this, there is more risk associated with this than the other two, as any defects during construction may not be picked up until much later. Durability of a pond or wetland system is more difficult to ensure, as tremors, large floods or the freeze/thaw effect of winter temperatures may cause failures of the lining over time. The final effluent disposal will be through a rock diffuser, this is reasonably straight forward to maintain, however large floods may potentially cause blockage or severing of pipe work if major river bed movements occur.

Option 3 carries the most challenging construction aspects. It is by no means impossible or requiring complex methods but the sheer scale of the pipe route means it is more complex than either of the other options. Combined with this the requirement to cross through private land and Transit Road corridor mean that this option is very much threatened by delay or design change in order to appease the landowners and road authorities. Following the Kawarau River, the pipe route will need major flood protection in some areas, landslip protection elsewhere and a need to tunnel through the Chard Farm Bluff. The durability of this option will be a design challenge. It is unlikely that winter temperatures will affect the main delivery time, however, the irrigation pipe work and receiving land are difficult to protect from freezing. Ground freeze to 150 mm will effectively block the ground from passing the liquid and result in surface build up or run off to collection drains. A freeze happened this winter which lasted for 5 - 6 weeks is very difficult to mitigate against.

Because of the length of the pipe and the different terrain it covers, it is very difficult and possibly labour and capital intensive to ensure the lifetime security of the pipe.

Table 5. Constructability and durability.

	Constructability	Flood	Earthquake	Freezing	Accessibility	Average
Land Disposal Option 1	5	4	5	5	4	5
Wetlands Option 2	4	3	4	4	4	4
Land Treatment Option 3	3	4	3	2	3	3

Operability

The practicality of operating and maintaining the discharge option is the key to ensuring the long term costs are kept as low as possible. This, along with electricity, is the main long term cost and most subject to escalation. Through careful design and construction these costs can be minimised, however it still depends on the nature of the discharge option selected.

Option 1 would be identical to the disposal field in Project Pure, therefore there would be no learning curve to allow for. The normal running of the discharge does not require attention, only periodic inspection to ensure it is functioning properly. If there were to be any blockage or pipes not functioning, then digging them up and changing bedding material would not be such a major issue, as it is basically a bulk earthworks exercise. What ever the final landscaping requirement around the area, or if it is being used for recreational purposes, then parks and reserves would be maintaining the above ground features.

Option 2 would require regular inspection to ensure that the designed layout was being maintained and weeding or planting may be required to ensure proper functioning, on an ongoing basis. It is unclear at this point what the exact nature of the planting would be or the exact plant types, some input from parks and reserves may be useful on this and it may well be that general maintenance would be monitored and supervised by them.

The diffuser system would be situated below the lowest river level at the junction of the Shotover and Kawarau Rivers, therefore access to it would be difficult. Regular maintenance would not be required however; a flood could break pipe work or knock over the diffuser system, resulting in difficult and costly maintenance.

Option 3 would require infrequent visits, perhaps twice weekly, but the distance involved means that this is a reasonably time consuming task. Occasional drives along the entire pipe route would also be required to assure the normal operation of the pipe.

The sheer scale of the electrically powered pumped pipe network compared to the other two options mean that the land treatment has a much higher operating and maintenance cost. Having to use private access routes could also potentially create issues with landowners, i.e. gates left open, etc. The ranking is shown in Table 7.

Emergency Management

In the event of an emergency, such as earthquake or flood that may cause physical damage to the constructed assets, each of the discharge options can be ranked as to how they would perform, or rather be handled.

Both Delta options are close to contractor's bases, they can be easily observed to determine where any problems may be and are both of straight forward construction techniques that are easy to repair. Ease of access to get to Option 1 means that work can be carried out and repairs effected almost immediately. Because of the network of pipes in the ground repairs can be carried out by isolating sections, or if the main feed line is ruptured, a temporary bypass can be put in place very quickly.

Repairs can be carried out relatively quickly on Option 2, and because the final effluent is going directly to water, rupture of the line would not cause any immediate threat or concern. Damage to the lining of the wetlands would be more difficult to identify and repair and may go undetected for some time.

Option 3 – Normally when rising mains (pumped pipe work) are being designed, emergency storage or an extra rising main are included. Due to the scale of the work involved and the volume of the flows, neither option has been included for practical reasons. This would mean that an emergency overflow line direct to the Shotover would be required. If a break were to occur on the main trunk line, then the final effluent could be discharged directly to the river for days at a time. Because of high quality of the effluent coming from the new plant, there would be no health concerns, however the prolonged time of direct discharge may not be acceptable to people. The emergency procedures to deal with such as a rupture, ground freezing or an inability to use the rising main would have to be clear and specific. The ranking is shown in Table 7.

Electricity requirement

The energy required in pumping wastewater from the Shotover Delta to Gibbston, or indeed any of the other Land Treatment locations looked at, is substantial. There are already issues with the reliability of power supply to the Gibbston area and it is likely that the implementation of this scheme would require the upgrade and an overhaul of the power supply to the area. This would be a benefit as far as local people are concerned. However, over time the draw on power will increase and given the conditions and reliability of power supply, it is going to become more expensive over time. It is stated that such a project may result in the diversion of power supplies from the north island. While this may seem unlikely, it would be a disaster from a publicity point of view if Queenstown went from being the number one Alpine resort in the southern hemisphere to being the town that caused the Manapouri dam level to be raised by a metre! While all of this may appear far fetched it is critical that all environmental effects be considered. There is a very real possibility that an effort to appear clean and green could backfire if it were found that the already overworked national grid were pushed further towards the brink by this project.

The exact power requirements of any of the options are not finalised at this point in time, however it is very clear that Options 1 & 2 will require substantially less than Option 3. It is not just the main pumping line that will require power for Option 3, so also will the irrigation method, be it a travelling irrigator or subsurface drip lines, these all will have to have booster pumps.

Perhaps another, less obvious, power requirement is that of fuelling the vehicles to get and from the discharge locations. A trip to Gibbston will consume far more energy than one to the Shotover Delta. Over a prolonged time, this cost would add up to have significant cost and environmental footprint. The ranking is shown in Table 7.

Costs

All options have been priced by WT Partnership Quantity Surveyors. The estimated costs produced include contingencies and escalation to the current projected construction date of 2011. They are to an accuracy of +/- 20%. This increases the estimated cost from the figures previously supplied by the engineers, who were working on current day dollars. The following are not included in any of the cost estimates: Excavation in Rock / Unsuitable ground conditions, Resource Consent/Planning Services, Land Acquisition Costs.

The land treatment options have two costs, A and B. Price A assumes that the irrigation pipe work can be installed above the ground, i.e. centre pivots, traveling irrigators, booms, etc. Price B is the cost to install the irrigation pipe work below the ground. The reason for this is to allow for frost protection when heavy frosts, such as experienced this winter, mean that the ground surface will be frozen and not allow water through. It is likely that some form of mitigation will have to be accounted for.

Table 6. Total scheme cost ($million or $million/year).

	STP Capital Cost (2011)	STP O & M Cost (2026)	Discharge Capital Cost (2011)	Discharge O & M Cost (2026)	Total Scheme Cost (2011)	Total Scheme O & M Cost (2026)
Option 1	$27.6	$3.3	$9.5	$0.25	$37.1	$3.6
Option 2	$27.6	$3.3	$8.5	$0.07	$36.1	$3.4
Option 3	$26.4	$3.1	A $28.6 B $35.7	$1.3	A $60.0 B $67.1	$4.5

Summary of assessment criteria ranking

Other factors, including costs, likely effect on rates and development contributions, social, cultural and environmental benefits have been rated and these together with the criteria above are all grouped into the Table 7.

DISCUSSION

The three main stakeholders in the application for this wastewater discharge consent are the:

- Territorial Authority – QLDC
- Regional Council – ORC
- Iwi and Runanga – Kai Tahu Ki Otago, Te Runanga O Otakou and Kati Huirapa Runanga Te Puketeraki

In order for the QLDC to secure a long term discharge consent under the Resource Management Act, all parties must be in agreement, but in particular the Regional Council must ensure that its key requirements under the RMA are satisfied.

Iwi and Runanga, as Tangata Whenua, must ensure that their requirements for Kaitiakitanga are also satisfied. This is possibly one of the more contentious areas for any Council, as unlike the Regional Council requirements, these concerns and requirements cannot be measured as percentages, volumes or concentrations. Throughout the last 18 months every effort has been made to involve and get feedback from Iwi and Runanga. They are quite clear that their preference has been Land Treatment in the Gibbston area.

Iwi and Runanga are very much in favour of Option 3, however, this was before the cost differences were presented. As Options 1 & 3 meet with the requirements of these groups, the decision should be evenly between options, rather than a bias towards one, given the amount of money involved and the similar environmental outcomes.

Projected revenue generated by land treatment can not be used with any degree of certainty for the future. The reality of the situation is that the dollar value for the nutrient benefits cannot be used because this is the benefit that is being offered to the land owner in return for a lease which will give surety for Council. So it is in fact compensation to them. However, once the line is established and in place there will be an ability to ‘sell’ water volumes to various parties interested at a commercial rate. While this may not be attractive in the short term, the availability and simplicity of purchase of the irrigation water in the long term will almost certainly guarantee a reasonable and reliable return against O&M costs.

An interesting, if not obvious point to make is that to put a proper water supply and irrigation network in place in Gibbston, would cost significantly less than the proposed wastewater irrigation supply and would also have lower ongoing operating and maintenance costs. If such as system were put in place it would be the end users of the water and irrigation systems that would pay for the construction and running of the scheme, as is the case elsewhere in the district.

Land Treatment would appear to be a very good option as part of any discharge systems, however, because of the issues of land availability and geological form, the distances required to be covered in this area make it perhaps less environmentally friendly than one would imagine. The reality is that the Gibbston area would be better serviced with a dedicated potable and irrigation supply, sourced locally and at a substantially lower cost with the benefactors carrying the cost of the scheme.

CONCLUSIONS

Considering all of the information that has been compiled to date, there is very little to choose between the three short listed options. However, it has come to a point in time where the Project Team must make a recommendation to Council on which option they see as the preferred one. This report has been put together from all of the various investigations and feedback from the stakeholders and interested and affected parties.

The table above titled "Table of the Ranking of Factors Affecting Discharge Options from the Shotover Sewage Treatment Plant" best summarises the rating of the options under the various criteria that needs to be considered in selecting the preferred one.

Initially it was considered that the Councillors would wish to put a weighting on the various headings, so as to give a more balanced result. For example, things such as cost, power consumption and ease of operating and maintenance may be considered to be more heavily weighted than some of the other criteria. Following discussion with Councillors it was decided to present the table in its current format.

The option with the highest score in the Total column provides the preferred option. This is Option 1 – Land Disposal on the Shotover Delta.

Option 3 is the lowest scoring of all the options and this reflects the sheer scale and costs of the project and the various risks that would be associated with it. Option 2 is a close second place, but there are two major areas of concern regarding this option, that is the fact that Iwi and Runanga are not in favour of this option because it is not an effective part of the treatment process and the other point is the concern over the increased risk of bird strike on aircraft using the nearby Queenstown International Airport. While measures may be taken to reduce the likelihood of birds being attracted, there are no guarantees as to the success of these.

Table 7. Ranking of factors affecting discharge options from the Shotover sewage treatment plant.

	Consentability	Constructability & Durability	Ease of O & M	Emergency Management	Power Consumption	Social	Cultural	Environmental	Capital Cost Discharge	Capital Cost Treatment Plant	Total Scheme Cost *	O&M Cost	Effect on Rates	Effect on Development Contributions	Total
Land Disposal Shotover Delta Option 1	4	5	5	5	4	4	4	5	4	5	9	4	5	5	59
Wetlands & Diffuser Pipe Shotover Delta Option 2	3	4	4	3	5	3	3	5	5	5	10	5	5	5	55
Land Treatment Gibbston Option 3	4	3	2	2	1	5	5	5	1	5	6	1	2	2	38

* These figures are not included in the final total.

Option 1, Land Disposal on the Shotover Delta within the designated area, is the option that emerges as the preferred choice from the criteria used. This is the same as the option selected by earlier working parties, however the design criteria that will be applied is very different and a much lower volume of treated effluent would be applied over a larger area.

Given the thoroughness of the investigations and the broad range of consultation that has taken place to provide the information for this report, Option 1 is the recommended option to Council.

The selection process and criteria used are clear and defendable and open to scrutiny by anyone who wishes to do so. The fact that it is the same recommendation as the earlier working party of 2002 will doubtless cause some to question the logic in going through the process that has been followed. However the reality now is that the recommended option can be demonstrated to best meet the communitie's requirements and therefore the ultimate aim of the process, which is to achieve a 35 year consent, can be achieved.

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