Franz Joseph Wastewater Treatment

PERFORMANCE REVIEW AND UPGRADE ASSESSMENT

- Revision A – Draft for Client Review
- 06 October 2009

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1. Executive Summary

Franz Joseph has a wastewater treatment plant comprising 2 oxidation ponds that operate in series with discharge of the treated effluent to the Waiho River. The first pond has an area of 0.60 hectares and the second pond has an area of 0.38 hectares.

The peak tourist season occurs from January to March. A projection of visitor numbers suggests that the number of overnight visitors will increase during the peak month, from an average of approximately 1,300 in year 2006 to an average of almost 2,500 by year 2031. This is based on a low growth scenario.

The total overnight population (residents, seasonal workers and visitors) is expected to grow to over 3,000 by year 2031 and in addition there is projected to be an increase in day visitors to almost 1,000. The treatment capacity required for the normally resident population is of the order of only 15% of the peak demand.

There is no flow monitoring on the treatment plant inlet, but inlet quality monitoring indicates a weak municipal wastewater which implies a significant quantity of inflow and infiltration. Predicted peak month daily flows range from 750m3/day to almost 1200m3/day by year 2031.

The treatment plant is overloaded with the first pond receiving, in the peak month, nearly twice the load that it should ideally receive according to usual design practice. The second pond is acting as a polishing pond to enhance the quality of the poor effluent from the overloaded first pond.

The treatment plant is regularly failing to meet its consent compliance limits, in particular suspended solids, biological oxygen demand and faecal coliforms. The performance is deteriorating over time. The Regional Council has written to Westland District Council (WDC) requesting an explanation for the non compliance and immediate action to ensure future compliance.

It is not clear that the non-compliance is actually giving rise to an adverse effect on the receiving environment. This is mainly due to the relatively small scale of the discharge and the discoloured and high suspended solids content of the receiving waters of the Waiho River.

There is very little justification in previous documentation for the compliance limits, which appear to have been based on samples taken on only one day during the winter low demand period and do not appear to have accounted for peak summer demand or variability in pond performance. The limits are also strict for a two pond treatment system. WDC may be able to seek a variation to the compliance limits to better reflect normal performance of a two pond system and an appropriate standard for the receiving environment.

In order to provide a basis for option assessment we have proposed a new set of compliance limits that would allow for the continued use of standard oxidation ponds. The proposed limits are less stringent than the current limits but reflect a higher standard of performance than the currently overloaded ponds can achieve. The proposed limits are:

- Biochemical Oxygen Demand 40mg/l
- Suspended Solids 60mg/l
- Ammonia Nitrogen 20mg/l
- Faecal Coliforms 75,000 cfu/100ml

The existing ponds are considerably undersized to provide optimum performance and the expected long-term increase in wastewater demands indicates that treatment upgrading will be required. The recommended upgrade is to double the capacity of the first pond by constructing another 0.60 hectare pond in parallel. Pond 1a (existing) and Pond 1b (new) would each treat half of the incoming flow which would then be further treated in the existing Pond 2.

The estimated capital cost of this upgrade is **$590k** and it is projected to provide sufficient treatment capacity through to year 2021 when additional secondary [disinfection] pond capacity may be required. This cost estimate does not include for desludging which we recommend should be carried out as part of a district wide desludging programme.

Note that the $590k estimate is based on an unlined pond. The existing ponds were not designed with an impermeable liner and WDC hold a consent allowing for seepage through the base of the ponds. It is expected that the insitu materials have a low permeability and that the permeability will decrease over time when the pond is in use as fine particles infiltrate and block pore spaces. If an impermeable liner is required then the cost estimate would rise to approximately **$870k**. These estimates are preliminary and should be refined as the design progresses.

Due to the significant cost of this upgrade we recommend that WDC undertake a structured review of flows, sludge depth, discharge quality and a receiving environment assessment. This would allow a factual and reasoned argument for relaxed consent conditions to be developed and at this stage the preferred upgrade option can be confirmed. A meeting with the Regional Council, to outline and discuss this approach and a programme, should be a priority.

2. Introduction

The Westland District Council is responsible for the collection and treatment of wastewater in the township of Franz Josef, located in South Westland.

The treatment facilities at Franz Josef consist of two oxidation ponds operating in series configuration, with discharge of treated effluent to the Waiho River adjacent to the southern boundary of the treatment plant site. The treatment plant is located approximately 1.8km to the NNW of Franz Josef township and adjacent to the Waiho River as indicated in Figure 1 .

- **Figure 1 – Aerial Photo of Franz Josef Township and Wastewater Treatment Plant**

Tourism to the Westland District and specifically to the glacier townships has increased considerably in recent years and as a result, Franz Josef and Fox Glacier townships have experienced considerable growth. This has resulted in the wastewater treatment facilities regularly failing to meet compliance standards during the peak tourist seasons, a situation that the Westland District Council wishes to remedy.

This report provides an assessment of wastewater demands, an assessment of the performance of the existing wastewater treatment plant, a summary of the resource consent compliance history, a discussion of the receiving environment characteristics and recommendations on future upgrading requirements and options.

3. Wastewater Demands

3.1. General

Wastewater generation in Franz Josef Township includes contributions from residents, transient workers, overnight visitors and day visitors.

The wastewater contribution from all but the resident population differs throughout the year, with the peak tourism period between January and March generating the greatest demand.

Wastewater contributions will vary over time in line with population changes. Changes in the resident population are slow and small compared to the rapid and large changes that can occur in the transient population. Assessment of treatment capacity must take into account this potential for variable and relatively fast changing visitor demand both within a year and into the future.

The assessment of appropriate populations and wastewater demands for these contributing sectors is detailed below.

3.2. Resident Population

The current and projected resident population numbers for Franz Josef prepared by Statistics NZ are presented in Table 1.

▪ **Table 1 - Statistics NZ Current and Projected Resident Population (2006 Census)**

2006	2011	2016	2021	2026	2031
340	350	360	370	380	380

Data to allow us to assess with accuracy the proportion of this resident population that is connected to the wastewater treatment system is not readily available. Residents remote from the wastewater reticulation may still contribute periodically to the load on the treatment plant due to emptying of septic tanks. It is assumed that, over time, all residents will be connected.

3.3. Non-Resident Population

Visitor Projections

The visitor population comprises day visitors and overnight visitors and it is necessary to consider their respective numbers differently as their wastewater contributions will differ considerably.

Average daily visitor numbers during the peak visitor month is typically considered an appropriate level of detail for the assessment of an oxidation pond treatment system, however projection is difficult as there is little formal recording of visitor numbers and forecasting of future trends is highly speculative due to the many external factors that influence tourism.

Development West Coast has recently prepared a Glacier Country Destination Management Plan (GCDMP) issued in April 2009, which presents an assessment of tourism projections for the glacier towns of Franz Josef and Fox Glacier. The WDC has provided inputs to this report and considers that it reasonably represents the situation at present and the best information available. The findings of this report have been used to assist with the development of wastewater projections associated with visitors to Franz Josef.

A key conclusion of the GCDMP report is that the ***low*** visitor growth scenario of 1.3% per annum is considered most likely. This conclusion has been reinforced in the short-term due to the continuing world financial crisis and associated decline in tourism numbers. To account for the potential for tourism to rebound strongly and to sustain growth, an outcome that the New Zealand Government will be actively pursuing, it is considered prudent, in terms of assessing the wastewater infrastructure, to allow for a medium growth rate from 2016. A ***composite*** growth projection assuming ***low*** growth to 2016 and ***medium*** growth thereafter is proposed to provide a basis for assessing wastewater demands.

The average visitor projections for the peak month are presented in Table 2 and Table 3. The base figures of **1,309** overnight visitors and **515** day visitors are derived from supporting information provided with the GCDMP, which indicates that 13.7% of annual visitors arrive in the peak month. Note that the peak season comprises the months of January, February and March. The low season comprises June, July and August with each low month averaging 3.7% of annual visitors

- **Table 2 - Average Overnight Visitor Projections during the Peak Month**

Growth Scenario	2006	2011	2016	2021	2026	2031
Low growth – 1.3% p.a.	1,309	1,396	1,489	1,589	1,695	1,808
Medium growth – 3.4% p.a.	1,309	1,547	1,829	2,161	2,555	3,020
High growth – 6.9% p.a.	1,309	1,827	2,551	3,561	4,972	6,940
Composite growth –1.3% to 2016 then 3.4% to 2031	**1,309**	**1,396**	**1,489**	**1,761**	**2,081**	**2,459**

- **Table 3 - Average Day Visitor Projections during the Peak Month**

Growth Scenario	2006	2011	2016	2021	2026	2031
Low growth – 1.3% p.a.	515	549	586	625	667	711
Medium growth – 3.4% p.a.	515	609	719	850	1005	1188
High growth – 6.9% p.a.	515	719	1004	1401	1956	2731
Composite growth –1.3% to 2016 then 3.4% to 2031	**515**	**549**	**586**	**693**	**819**	**968**

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For the reasons described above, the composite growth projection is considered to apply an appropriate level of conservatism for wastewater planning.

Seasonal Worker Projections

Data to allow us to determine with accuracy the number of transient workers that live in and around Franz Josef during the peak tourism season is not available. We have made a broad assumption of one worker for every 4 visitors, and that 50% of workers in the tourism sector are seasonal. This assumption ties in relatively well with supporting information provided with the Glacier Country Destination Management Plan, which estimates that the 2006 peak season supported approximately 230 more jobs than the low season.

The estimated number of seasonal workers living in Franz Josef over the peak tourism season is summarised in Table 4.

- **Table 4 – Seasonal Worker Projections during the Peak Month**

Growth Scenario	2006	2011	2016	2021	2026	2031
Low growth – 1.3% p.a.	228	243	259	277	295	315
Medium growth – 3.4% p.a.	228	269	319	376	445	526
High growth – 6.9% p.a.	228	318	444	620	866	1209
Composite growth –1.3% to 2016 then 3.4% to 2031	**228**	**243**	**259**	**307**	**362**	**428**

Accommodation Availability and Projections

The Glacier Country Destination Management Plan also presents an assessment of the current and projected accommodation availability in Franz Josef up to 2015. This assessment identified the current capacity to be approximately 1700 bed-nights, which will increase to approximately 2140 bed-nights by 2010-2011 as currently proposed projects are constructed.

This assessment suggests that there will be sufficient accommodation for projected overnight visitor numbers for the period to 2021 for the *composite* growth scenario.

The accommodation availability provides an upper limit to the number of visitors. Construction of further accommodation provides a practical indicator when an increase in wastewater treatment will be required.

3.4. Population Projection Summary

The population projections considered appropriate for the wastewater planning for Franz Josef based on the assumptions stated in the preceding sections are summarised in Tables 5 & 6.

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Table 5 – Overnight Population Projections during the Peak Month – Composite Growth

Contribution	2006	2011	2016	2021	2026	2031
Normally Resident	340	350	360	370	380	380
Overnight Visitors	1,309	1,396	1,489	1,761	2,081	2,459
Seasonal Workers	228	243	259	307	362	428
TOTAL	**1,877**	**1,989**	**2,108**	**2,438**	**2,823**	**3,267**

Table 6 – Day Visitor Projections during the Peak Month – Composite Growth

Contribution	2006	2011	2016	2021	2026	2031
TOTAL	**515**	**549**	**586**	**693**	**819**	**968**

The following observations are made in respect to the tables above:

- The extended duration of the peak tourist season requires that the treatment system is designed to meet the average daily population over this period.
- The treatment capacity required for the normally resident population is approximately 15% of that required to satisfy peak wastewater treatment demands.
- There is an anomaly between the small resident population increase predicted by Statistics New Zealand and the larger projected increase in visitor numbers. This is not considered to be significant in the context of this report considering the overwhelming significance of the visitor population in determining treatment requirements.
- The census night population on Tuesday 07 March 2006 is given by Statistics New Zealand as 1,360 [provisional]. This compares to the 1,877 people derived in Table 5. This discrepancy could be explained by a lower number of overnight visitors on census night than the peak month average. It could also be an indication that the figures presented above, as derived from the Glacier Country Destination Management Plan, are conservative.

3.5. Wastewater Characteristics

WDC monitors influent wastewater characteristics. A statistical analysis of the sample data over the period 2005 to 2008, is summarised in Table 7.

- **Table 7 – Wastewater Characteristics from Influent Sampling, 2005 to 2008**

Contribution	BOD (mg/l)	SS (mg/l)	NH4-N (mg/l)	Faecal Coliforms (cfu/100ml)
Mean	169	168	26	5.5 x 10^6
Median	155	160	25	2.5 x 10^6
10%ile	83	101	12	0.4 x 10^6
90%ile	268	265	40	17.6 x 10^6

The mean and median values provide a good indication of the average concentrations. The 10%ile and 90%ile figures provide an indication of the typical range of concentration of the wastewater reaching the treatment plant.

3.6. Wastewater Flows

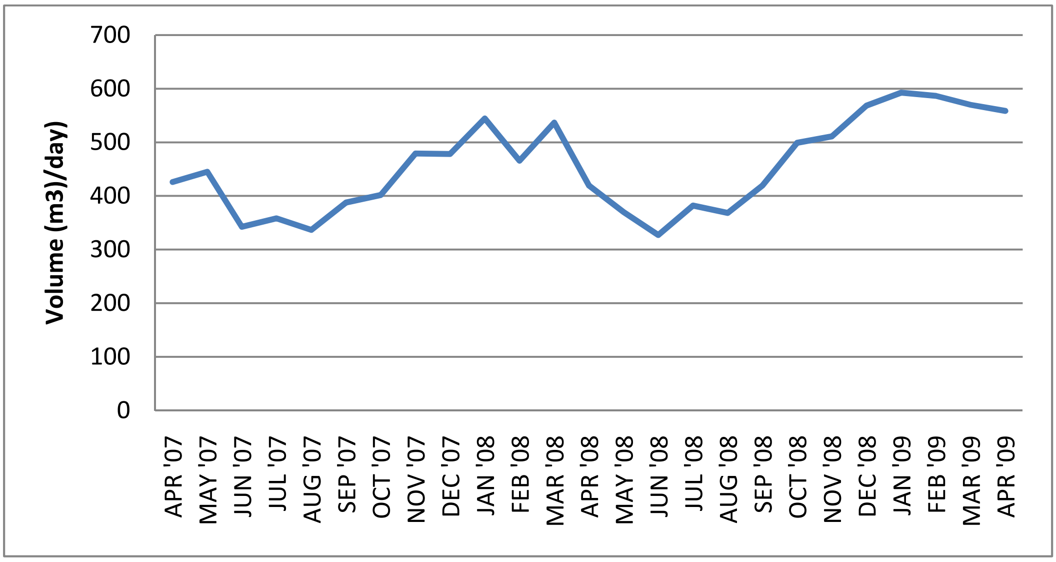
The influent wastewater characteristics in Table 7 are within a range considered typical for domestic wastewater. However, the values are indicative of a weak or diluted wastewater.

Limited accurate flow records are available, so the contaminant concentrations from sample data have been compared to published figures for per capita flows and load to allow broad assumptions to be made regarding inflow and infiltration.

Published figures suggest that one person typically produces approximately 75g per day of BOD and 200 litres of wastewater, which results in a BOD concentration of 375 mg/l. The average BOD concentration in Table 7 is approximately 160 mg/l with a typical range from approximately 80 mg/l to 270 mg/l. This suggests that the wastewater reticulation at Franz Joseph is subject to infiltration, with considerable inflow and infiltration in wet weather.

Per capita wastewater flows typically range from approximately 140 litres per person per day to 250 litres per person per day. Recorded water consumption at Franz Josef over the period 2007 to 2009 is presented in Figure 2. This indicates a peak demand in the order of 600m3/day over the peak tourism season. It is expected that a high percentage of this consumption, say 85% or 510m3/day, will be discharged to the wastewater system.

- **Figure 2 – Franz Josef Water Consumption – 2007 to 2009**



The peak demand occurred in early 2009. If we assume 535 day visitors [derived from Table 6] using 60 litres each [based on published typical usage data], then the wastewater produced by the resident population, overnight visitors and seasonal workers can be estimated as 478m3. Table 5 suggests a peak population of approximately 1950 people. 478m3 produced by 1950 people equates to approximately 240 litres per person per day (l/p/d). This is within the expected range and can be used to estimate dry weather flows.

Note that 75g of BOD and 240 litres per person equates to a concentration of 312 mg BOD/l. The average concentration of 169mg BOD/l determined from sampling results indicates that on average, the flow reaching the wastewater treatment plant is approximately 85% more dilute than typical. This implies there is also approximately 85% more flow than would be determined on a typical per capita basis, primarily as a result of inflow and filtration (I&I). I&I is therefore a significant component of the total flow to be treated.

For the purposes of determining future design flows, the 85% allowance for I&I is considered too conservative, as new developments will have good quality infrastructure with low I&I, and WDC has the ability to reduce I&I over time through investigation and management of the wastewater reticulation. An I&I allowance of 65% is considered more appropriate for determining future design flows.

The resulting predicted peak month design flows are summarised in Table 8.

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Table 8 – Projected Peak Month Design Flows

	2006	2011	2016	2021	2026	2031
Overnight Population	1,877	1,990	2,109	2,437	2,824	3,268
Day Visitors	515	549	586	693	819	968
Population Equivalent [Flow]	2,006	2,127	2,256	2,611	3,028	3,510
Average Dry Weather Flow (m3/day)	**481**	**510**	**541**	**627**	**727**	**842**
Average Inflow & Infiltration (m3/day)	263	272	277	297	319	339
Average Flow (m3/day)	**745**	**782**	**818**	**924**	**1045**	**1182**

The analysis outlined above is based upon a limited data set and necessarily contains assumptions and approximations. However, in the absence of flow monitoring information it is considered an appropriate basis for derivation of peak month average flows for assessment purposes.

3.7. Wastewater Loads

The traditional key parameter for the design of oxidation ponds is 5 day biological oxygen demand (BOD). Per capita BOD contribution is fairly uniform across most populations in the developed world, as it is related to food consumption, and in New Zealand is typically assumed to be in the range 70g to 80g per person per day. This report uses 75g for the overnight population and half this value for day visitors.

Based upon these BOD contributions and the population projections given in Table 5 and Table 6, the projected BOD loads are given in Table 9.

Table 9 – Projected Peak Month BOD Loads

Contribution	2006	2011	2016	2021	2026	2031
Overnight Population	1,877	1,990	2,109	2,437	2,824	3,268
Day Visitors	515	549	586	693	819	968
Population Equivalent [Load]	2,135	2,264	2,402	2,784	3,233	3,752
TOTAL - kg BOD/day	**160**	**170**	**180**	**209**	**242**	**281**

3.8. General Discussion

The assessment of population, wastewater character, flows and loads has identified the following:

- The tourism sector accounts for approximately 85% of the total demand
- A composite growth scenario with low growth to 2016 and moderate growth thereafter is considered appropriate given the recommendations of the Glacier Country Destination Management Plan and current Statistics NZ data.

- The peak demand occurs during January, February and March
- Increases in bed numbers and occupancy rates provide a direct and practical indication of increasing wastewater demand
- The wastewater arriving at the wastewater treatment plant is relatively weak and this is indicative of high levels of infiltration and inflow to the reticulation network

4. Treatment Plant Performance Review

4.1. Description of Treatment Plant

The existing wastewater treatment plant consists of two oxidation ponds operated in series, without screening, but including an outlet baffle to prevent the carry through of floatables in the discharge to the River Waiho.

Based on WDC drawing No. 2292/15 the pond sizes are as follows:

- Pond 1 has an area at water level of approximately 6000m2, is 1.5m deep and has an area of approximately 4700m2 at bed level. The volume of Pond 1 is approximately 8000m3.
- Pond 2 has an area at water level of approximately 3800m2, is 1.5m deep and has an area of approximately 2800m2 at bed level. The volume of Pond 2 is approximately 5000m3.

The site is shown in Figure 3.

- **Figure 3 – Plan of the Franz Josef Wastewater Treatment Plant**

Pond 2 normally discharges directly to the Waiho River, however due to the fluctuating river channels and aggrading river bed, there is often no river channel adjacent to the site and the discharge can pond before slow infiltration to ground.

There is public access close to the discharge location via the stop-bank between the treatment plant and the Waiho River.

4.2. Treatment Plant Performance

In order to assess how the treatment plant is performing, the theoretical performance has been determined based on the influent flows and loads derived in Section 3 and published design equations, assuming a range of sludge accumulation scenarios.

An assessment of theoretical and measured performance based on *median annual performance* has been undertaken for BOD and faecal coliforms [considered the two key performance parameters] and is summarised in Table 10 below.

- **Table 10 – Median Annual Performance of Existing Treatment Plant**

	BOD (mg/l)	Faecal Coliforms (cfu/100ml)
Scenario 1 – 0% sludge	34	1.2 x 10^5
Scenario 2 – 50% sludge	62	3.4 x 10^5
Actual Performance (2008)	43	4.9 x 10^4

Scenario 1 assumes there is no significant build up of sludge in the two treatment ponds. Scenario 2 assumes the ponds are half full with sludge. No reliable data on sludge depth is available, but Scenario 2 is likely to be more representative.

The actual performance is better than the theoretical Scenario 2 performance. This could be explained by a number of reasons including:

- The sludge depth is less than assumed for Scenario 2
- The number of samples, on which actual performance is based, is small given the highly variable performance of oxidation ponds.
- The influent flows and loads used in the theoretical performance calculations are overestimated

An assessment comparing seasonal performance has been undertaken and is summarised in Table 11 below.

- **Table 11 – Seasonal Median Performance from Sample Data**

	BOD (mg/l)		Faecal Coliforms (cfu/100ml)	
	Jan/Feb/Mar	Jun/Jul/Aug	Jan/Feb/Mar	Jun/Jul/Aug
2007	44	No data	9.0 x 10^4	2.1 x 10^4
2008	40	27	6.6 x 10^4	4.0 x 10^3

This suggests that performance over the summer and peak tourism season is poorer than over the winter and low tourism season, although note this is based on a statistically small number of samples. This is contrary to normal design scenarios in New Zealand where the colder winter season becomes the critical period for treatment performance. This is due to the significantly increased wastewater treatment demand over the summer period.

4.3. Current Resource Consents

Resource consents RC00387/1-4 are held for the discharge of:

1) Wastewater to land from oxidation ponds (seepage from base)
2) Wastewater to water from oxidation pond discharge
3) Wastewater to air
4) Installation and maintenance of a discharge infiltration trench

These were granted in 2001 and run for a period of 35 years, with expiry on 21st September 2036.

Of note, these consents are structured to capture treatment performance over the peak tourism period and employ a discharge quality monitoring methodology, as opposed to receiving environment effects monitoring. Sampling is to be undertaken 4 times per year, with 3 of the 4 samples to be taken during the summer months.

Compliance limits on the discharge are annual **median** concentrations not to exceed:

▪ Biochemical Oxygen Demand	30mg/L
▪ Suspended Solids	30mg/L
▪ Ammonia Nitrogen	15mg/L
▪ Faecal Coliforms	10,000 cfu/100mL

Other key conditions of note are:

- The total daily volume of wastewater shall not exceed 600 m^3.
- Warning notice should be in place as close as practical to the point of discharge.
- Stability assessments of the river bank need to be undertaken every 5 years.
- Additional sampling is required if visitor bed number in Franz Josef township exceed 1800.
- The discharge is required to be subsurface in the infiltration trench at all times.
- It is required that there is no objectionable odour beyond the boundary of the site.

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We consider that the discharge quality limits are relatively stringent and note that the Assessment of Effects on the Environment (BECA, 2000) made in support of the application for the current consents did not justify the compliance limits from an environmental effects perspective.

4.4. Compliance History

Observation of the monitoring results for sampling undertaken in accordance with the consent conditions indicates a relatively low level of compliance with the discharge limits since 2006. These are presented in Table 12.

- **Table 12 Franz Josef Annual Median Discharge Quality – Compliance Data**

Parameter	2002[1]	2003	2004	2005	2006	2007	2008	Limit[2]
BOD_5 (mg/L)	26 (3)	19 (2)	7 (3)	21 (4)	37.5 (4)	60 (3)	49 (3)	30
SS (mg/L)	48 (3)	48 (2)	5 (3)	72 (4)	82 (4)	110 (3)	96 (3)	30
NH_4-N (mg/L)	11 (3)	8 (2)	2 (3)	14 (4)	14.5 (4)	21 (3)	17 (3)	15
Faecal Coliforms (cfu/100mL)	3600(3)	575(2)	5700(3)	8850(4)	23900(4)	48800(4)	94500(4)	10,000

Note: [1]Data is a median of the 4 compliance samples only (Nov, Jan, Mar and Aug) with the number of samples in brackets.
[2]Data highlighted in orange is above compliance limits

Of critical note, all parameters sampled in 2007 and 2008 were above compliance limits.

Other key results include:

- Prior to 2006 most parameters were compliant with the consent, with the exception of suspended solids
- BOD concentrations have been out of compliance since 2006
- Suspended solid concentrations have been at least double the compliance limits since 2005 and have generally been out of compliance
- Ammonia concentrations have been out of compliance in 2007 and 2008
- Faecal coliform counts have been well above compliance limits since 2006

WDC undertakes additional monthly monitoring. Review of the performance of all monthly results is presented in Table 13.

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- **Table 13 Franz Josef Annual Median Discharge Quality – All Data**

Parameter	2002[1]	2003	2004	2005	2006	2007	2008	Limit[2]
BOD_5 (mg/L)	26 (9)	19 (8)	7 (9)	22 (12)	37 (11)	54.5 (8)	43 (11)	30
SS (mg/L)	50 (9)	37 (8)	29 (10)	60 (12)	80 (11)	120 (8)	96 (11)	30
NH_4-N (mg/L)	10 (9)	7 (8)	2 (10)	14 (12)	15 (11)	18(8)	15 (11)	15
Faecal Coliforms (cfu/100mL)	3600 (9)	1550 (8)	2800 (11)	5700 (11)	45000 (11)	29000 (11)	49000 (11)	10,000

Note: [1]Data is a median of all available data for that year with the number of samples in brackets.
[2]Data highlighted in orange is above compliance limits

While the monthly data is not required to be analysed for consent compliance it gives a better picture of overall annual performance and shows a broadly similar picture of compliance/non-compliance with consented discharge concentrations.

Appendix A contains a plot of the monthly monitoring data from 2000 to 2008. The suspended solids and BOD results appear to be trending upwards (i.e. performance worsening). Ammonia concentrations appear relatively stable and there is a high degree of variability in faecal coliform results, especially since 2006

In summary from this data there is a need for WDC to address the performance of the system as it relates to all four compliance parameters, with the main focus on BOD, SS and faecal coliforms.

Consent RC00387/4, to install and discharge to an infiltration gallery, was applied for part way through the processing of the consents in response to WCRC and public concerns regarding wastewater flowing overland for 1km to the Waiho River. This aimed to reduce the possibility of human contact and reduce odour concerns. From our site visit the discharge was direct to water so either this structure is no longer working or was not installed. Therefore the consented discharge point is not currently being utilised.

In summary the data gathered to date indicates that for all compliance monitoring parameters the treatment system is not performing in accordance with the consent compliance limits. This non-compliance with the consent requires addressing to the satisfaction of the WCRC and to give WDC certainty over their long term consent obligations and treatment plant strategy for Franz Josef.

We note that it is not clear whether the non-compliance with the discharge limits is actually giving rise to an adverse effect on the environment

4.5. Other Issues

A site visit to the treatment plant indicates other issues that should be noted including the following:

- Long grass
- Inorganic waste removed from the ponds disposed on pond bunds
- Build-up of floatable inorganic waste within the ponds
- Sludge flocs and gas emmittance generally indicative of pond overloading and significant sludge depth

These are indicative of insufficient site management.

4.6. Discussion

There is a poor recent history of compliance with resource consent conditions, however it is highlighted that the non-compliance does not necessarily indicate an adverse effect on the receiving environment.

The discharge consent limits are considered to be optimistic for a two pond system and without significant upgrading, the WDC is unlikely to achieve compliance with the present conditions.

It is also considered that, based upon observations on site, the discharge is unlikely to be having a significant effect on the receiving environment. This suggests that the discharge conditions may be more stringent than required to provide the necessary environmental protection. We note that no specific environmental assessment has been undertaken to validate this observation to date.

5. Environmental Characteristics

The 2000 Assessment of Effects on the Environment (AEE) (BECA, 2000) has been used to make a preliminary assessment of the receiving environment along with obvious changes since that date observed from our site visit of 17 March 2009. Extracts of the original AEE are inserted below with our comments of any observed changes.

5.1. General Setting

BECA 2000:

The Franz Josef area experiences high rainfall, typically 5 000 mm or more per year. Rainfall intensity is high during rainfall events. Temperatures generally are reasonably consistent, with extremes not generally experienced. The glacier up-valley has permanent snowfields associated with it.

The total catchment area of 162 km^2, above the SH6 bridge, comprises the Franz Josef Glacier/Waiho subcatchment of 70km^2 and the Callery subcatchment of 92 km^2, of which 17 km^2 and 13 km^2 respectively, are ice-covered.

The Franz Josef Glacier wastewater treatment system is located on the alluvial fan of the Waiho River. The system discharges treated wastewater into the riverbed of the Waiho River, downstream of the Franz Josef Glacier township. The location of the wastewater treatment system is shown in Figure 3.1[12]. A scale drawing showing the WWTP layout is included in Appendix A.

The WWTP is located several hundred metres off the main road into the Franz Josef Glacier township. A track runs along the top of a stopbank providing access to the river (and the WWTP) from the main road as well as an adjacent motel.

SKM Comments:

The general setting of the area does not appear to have changed significantly.

Surrounding land use is a mix of native bush and rough agricultural grassland with the braided river to the South West. The nearest residential/commercial activity is the scenic circle motel approximately 300 to 400m to the East.

Access to and use of the river bank is easy for both locals and tourists for informal recreation. Fishing and other recreation uses are likely to be limited due to the high glacial sediment load and discoloration of the water in the Waiho River.

SKM

5.2. Groundwater

BECA 2000:

WCRC records contain no groundwater data for the Franz Josef Glacier area. However, in general, groundwater in this area is characterised by thin aquifers which have never been exploited commercially, due to the abundance of surface fresh water available, as well as the low yields expected (making it non-viable from a commercial viewpoint). The surrounding topography would suggest that groundwater in the immediate area flows towards the Waiho River, following the land contours.

Our Comments:

From the WCRC GIS system (April 8th 2009) there are no consented takes for using groundwater or consents to install bores within at least a kilometre around the Franz Josef oxidation ponds area. Therefore it appears that groundwater is still not utilised in the area.

5.3. Water Quality and Ecology

BECA 2000:

(a) Existing in-stream water quality

Existing water quality in the Waiho River is low. High sediment loading, sourced from glacial melt and direct deposition of material by landslides, results in high suspended solids and high turbidity in-flow. Catchment organic loading levels are likely to be relatively low, given that the catchment is dominated by mature and regenerating native vegetation.

(b) Benthic Communities

The nature of the in-stream flow (high silt loads, poor visibility, and frequent high-intensity freshes) means that the environment in the tributary of the Waiho River is unsuitable for flora and fauna typical of other West Coast waterways. Water temperatures are typically in the range 3-6°C, making the waterway unattractive for most freshwater benthic species found elsewhere.

Recent investigations suggest that the Waiho River has few macroinvertebrate species present[15, 16]. Species found include chronomid midge larvae, *Deleatidium* mayflies and occasionally stoneflies. Midge larvae have also been associated with the presence of periphyton cover.

(c) Fisheries

Fish and Game West Coast[17] have advised that it is unlikely that either exotic or native fish will be present in the Waiho River, in the area under examination. The high turbidity and frequent freshes would result in unsuitable habitat for these species. The level of natural food available to fish would also be low as a result of the unstable environment.

However, DoC have indicated that fish may use the Waiho River whilst in transit to clearer tributary streams upstream.

Our Comments:

We are not aware of any likely changes to the aquatic receiving environment that would significantly change this assessment. According to the WCRC GIS system (8th April 2009), there were no new consented discharges in the vicinity of the oxidation ponds, or within a kilometre upstream. The WCRC assessed surface water quality across the region in 2008 but the Waiho River was not part of the monitoring schedule.

However of note the river channels have moved. In 2000 the discharge flowed onto the gravels and then flowed as a wastewater only derived channel for ~1000m prior to entering the main braid of the Waiho River. When visited on 17 March 2009 the discharge was direct into a small side braid of the Waiho River. Of note is that according to consent RC00387/4, the discharge should have been to an infiltration gallery, not to the land surface or water.

5.4. Climate

NIWA records indicate mean monthly temperature and rainfall at Franz as follows:

Table 14 – Mean Monthly Air Temperature and Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (*C)	14.9	15.3	14.2	12.0	9.6	7.4	6.8	7.6	9.1	10.4	11.7	13.8
Rainfall (mm)	492	412	443	411	419	354	324	380	449	516	485	495

This is a total mean annual rainfall of approximately 5200mm. Monthly rainfall has been recorded from under 100mm to almost 1500mm.

SKM

5.5. Public access

BECA 2000 stated in their AEE that:

The Franz Josef Glacier WWTP is located in an area easily accessible to the public, near a motel and a stopbank access track. A lockable gate will be installed on the track to prevent vehicular traffic (apart from WDC staff) from accessing the WWTP.

As the ponds are not fenced and discharged treated wastewater stream flows to an open channel prior to incorporation into the full river flow, signage in the area warning the public of potential health risks (in several languages, given that tourists are present in the area) will be erected.

Our Comment:

Public access to the area and specifically the riverbank receiving environment is similarly easy today as it was in 2000. However the ponds are now fenced and warning signs have been erected. In 2000 Crown Public Health did raise concerns regarding public access to overland wastewater flows. Visitor numbers have increased in the last 9 years so it is probably more people may use the area for informal recreation. We are not aware of any activities such as contact recreation or food gathering that may have a health risk as a result of the discharge. However it is known that kayaking does occur on the Waiho River, generally from the glacier down to the road bridge.

5.6. Visual Effects

BECA 2000 stated in their AEE that:

High sediment loading, sourced from glacial melt and direct deposition of material by landslides, results in high suspended solids and high turbidity in the Waiho River. This will tend to mask other flows discharged into the river. The small discoloured flow from the secondary pond at Franz Josef Glacier has no impacts on the visual quality of the Waiho River.

Our Comment:

During the consent process concern over a surface discharge (probably primarily due to the health risk of this) required a modification to the proposals and new application for an infiltration gallery. During our site visit of 17 March 2009 it was evident that the discharge was still to water. However this was not visible for more than 10m downstream as it quickly mixed with the milky glacial water. If the discharge is made in a subsurface manner as consented we consider there should be no effects of the visual impact of the discharge. However with continued surface discharge there is potential for more community concerns.

5.7. Cultural

In their 2000 AEE BECA noted consultation with Te Runanga o Makawhio. Their summary of consultation was that each of the community schemes appeared to be operating satisfactorily, or their effects appeared to be minor. Further details are provided in the AEE.

Our comment:

Given the poor consent compliance performance of all the systems in recent years it is possible this view could have changed. Consideration of consultation regarding the actual effects, versus non compliance with consent may be worthwhile.

5.8. Preliminary Assessment of Sensitivity

Our preliminary assessment of the sensitivity of the receiving environment indicates that the Waiho River is low sensitivity due to the glacial nature of the river and limited ecological values. Ground water appears again to be low sensitivity due to limited water availability and limited (if any) use.

The most sensitive receptor would appear to be with respect to public access/amenity and potentially public health risk. This relates to the ease of public (and tourist) access to the site of the ponds and the discharge location. The overland discharge flow (which does not comply with the consent) especially contributes to this sensitivity.

We have not attempted to identify whether the cultural sensitivity to the discharge has changed.

6. Treatment Plant Upgrade

6.1. General

There are several treatment upgrading options available to WDC, ranging from continued use of ponds with appropriate upgrading through to implementation of mechanical treatment plant.

Key factors that influence the selection of an appropriate treatment strategy include:

- Consent conditions
- Process suitability for high I&I and variable demands
- Technical complexity and operational requirements
- Capital, operational and overall life-cycle costs
- Community affordability

WDC has identified a preference for a least cost and lowest technology approach and to utilise existing infrastructure where possible and appropriate. In line with this preference we have focused on oxidation pond options.

6.2. Consent Conditions

The AEE supporting the application for the current consents provided evidence of plant performance based only on three discharge samples taken on one day. The day was in June so during the winter with low visitor numbers. No discussion was entered into in the AEE regarding whether this performance was typical either for this system or for systems of this type. Additionally no comment was made as to what the performance might be in summer during higher loading.

The application proposed the compliance limits that are given on the granted consents as follows:

- Biochemical Oxygen Demand 30mg/l
- Suspended Solids 30mg/l
- Ammonia Nitrogen 15mg/l
- Faecal Coliforms 10,000 cfu/100ml

No explanation was given for the proposal of these specific limits, but we note that they are all above the performance identified on the one day of sampling. No justification for these limits was provided on a control of adverse effects basis.

While we are not able to access all discussions and considerations in the granting of the consents we have reviewed the West Coast Regional Council (WCRC) Officer Report. This was a very basic document and provided no further clarification on the suitability of the limits proposed. A number of key questions arise and these are asked and answered below:

1. What would typical performance and end of pipe compliance limits for two pond systems be?

   The [draft] Oxidation Pond Guidelines 2005 suggest that "typical performance" from a two pond system is as follows:

   - Biochemical Oxygen Demand 30mg/l
   - Suspended Solids 40mg/l
   - Ammonia Nitrogen 13mg/l
   - Faecal Coliforms 10,000 cfu/100ml

   We interpret typical performance to mean that an appropriately designed 2 pond system operating within its design parameters should perform at or about these median values. An appropriate consent basis for a two pond system should therefore use values higher than these figures, but within a relatively close range. On that basis appropriate compliance limits for a two pond system would be:

   - Biochemical Oxygen Demand 40mg/l
   - Suspended Solids 60mg/l
   - Ammonia Nitrogen 20mg/l
   - Faecal Coliforms 75,000 cfu/100ml

   This would ensure that the consent holder maintains an efficient treatment system, but is not punished for a minor exceedence of typical performance. To put it another way, real performance is variable and minor exceedences of typical valves are in fact also typical, and shouldn't result in non-compliance.

2. What would be expected of these particular systems during higher loading in summer?

   Our calculations suggest that a two pond system for Franz Joseph, designed using the standard procedures, would achieve a median annual BOD concentration in excess of 30 mg/l, with monthly median performance ranging from approximately 20mg/l to 40mg/l. The lower values are expected in winter with the higher values in summer. This is primarily because the summer increase in population due to tourism outweighs the improvement in treatment performance due to the higher summer temperatures.

3. Are these compliance limits overly restrictive, could they be relaxed and how do the compliance limits relate to actual and potential environmental effects?

   The current compliance limits do not appear to be based on environmental effects and neither are they consistent with appropriate compliance limits for two pond performance. This indicates that relaxing the compliance limits may be an appropriate starting point for an upgrade assessment.

   There is no available data on receiving environment (water quality and or aquatic ecology) impacts from the current discharges. Therefore we cannot say in confidence whether any environmental impact is occurring. However from visual inspection of the site there appears to be little impact on the receiving environment at present due to the relatively small scale of the discharge and the high suspended solids content of the Waiho River. This opinion would require further assessment (e.g. receiving environment monitoring) to present a robust argument in an AEE to support relaxing the consent conditions.

The selection of upgrade options has been based on assumed future compliance limits of:

- Biochemical Oxygen Demand 40mg/l
- Suspended Solids 60mg/l
- Ammonia Nitrogen 20mg/l
- Faecal Coliforms 75,000 cfu/100ml

These limits are less stringent than the current consent, are potentially more stringent than required for receiving environment protection, but represent what we believe at this stage may be realistically achievable in a consent process.

6.3. Upgrade Requirements

The assumed future consent conditions given above are based on performance from a two pond system operating to typical design standards. The treatment process is currently overloaded and an upgrade will be required to achieve these performance levels. Section 6.4 discusses the generic treatment process options, Section 6.5 outlines specific upgrade options, Section 6.6 sets out a preferred option.

6.4. Process Options

Oxidation ponds, although an old technology, remain an effective treatment option and have a number of advantages including:

- A robust treatment process

- A low technology treatment process
- A low maintenance treatment process
- Wind and algal induced aeration [rather than electrical/mechanical]
- Solar powered disinfection
- Integral sludge storage and digestion

The primary disadvantages of oxidation ponds are:

- Variable treatment performance
- Large land area required

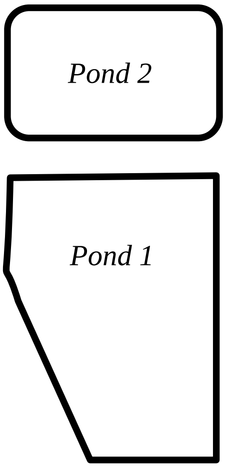
At Franz Joseph the variable treatment performance from an oxidation pond system is unlikely to have a more than minor impact on the receiving environment and land is available.

The existing oxidation ponds therefore provide a good starting point around which to base the design of an upgraded oxidation pond treatment plant. There do not appear to be any drivers for looking at alternative, more intensive and more mechanically complicated treatment processes.

The oxidation ponds at Franz Joseph are facultative ponds. This means they change from aerobic (with oxygen) processes to anaerobic (without oxygen) processes over the depth of the pond. Fully anaerobic ponds offer a more concentrated form of treatment and improved sludge digestion. However, an anaerobic process is better targeted at concentrated wastewater. Municipal sewage is relatively weak and at Franz the influent is weaker than typical municipal sewage due to high levels of inflow and infiltration. We do not therefore recommend anaerobic ponds for Franz Joseph.

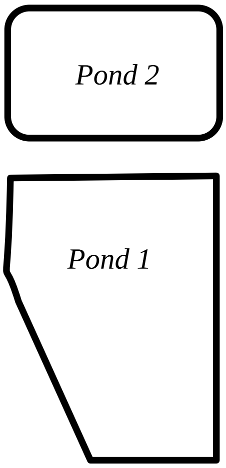
6.5. Upgrade Options

A set of upgrade options is presented below. The options are discussed in relation to the predicted flows and loads set out in Section 3.



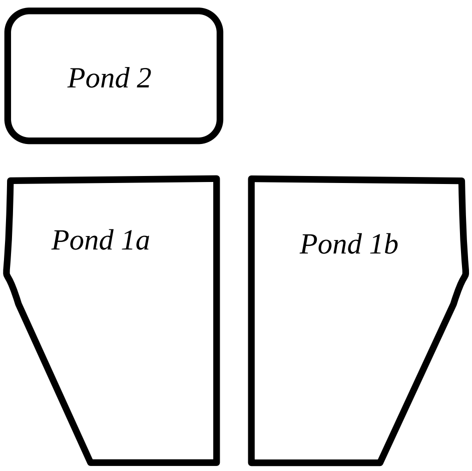
Option 1 – Do Nothing

This is not a realistic option due to the current treatment issues, consent non-compliance, continuing sludge build up and the trend for deteriorating performance.



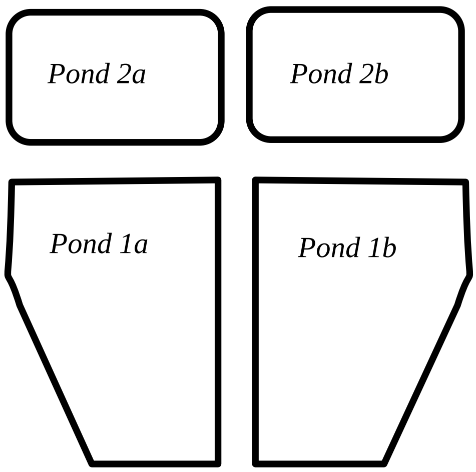
Option 2 – Do Minimum - Desludge

Pond 1 is overloaded and Pond 2 is working as a secondary pond to polish the poor performance from Pond 1. Desludging would not change these fundamentals but would improve performance. Calculations suggest that the two ponds may be able to achieve the proposed consent limit for BOD of 40mg/l when desludged. However, this would be at best borderline compliance in the short term with guaranteed failures as the population grows. The other effluent quality parameters are also predicted to be borderline. This option does not represent an effective solution to the treatment problems at Franz Joseph.



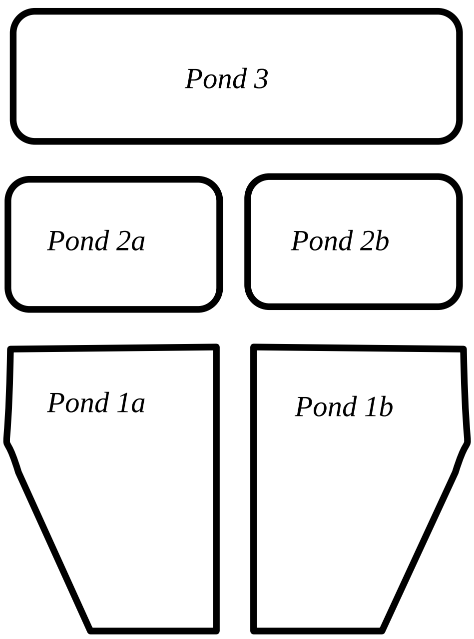
Option 3 – Double Pond 1

By year 2011 the required size for the first pond, based on the standard equations for BOD removal, is approximately 1.1Ha. This is nearly twice the size of the current Pond 1. This option therefore involves construction of Pond 1b to double the capacity of the first treatment stage. Pond 1a and Pond 2 would also be desludged. This option should be effective at meeting the proposed consent limits for approximately 10 years



Option 4 – Double Pond 1 and Double Pond 2

Option 3 is effective for approximately 10 years. The addition of Pond 2b, to complete the doubling of the current treatment capacity, would extend the effectiveness of the upgrade to a 20 year timeframe. Pond 2a and Pond 2b could be configured to work in series, rather than in parallel, which would bring a further minor improvement in performance.



Option 5 – Double + Maturation Pond

Options 3 and 4 are expected to result in minor overloading of Pond 1a and Pond 1b from year 2021. This is not a problem as Pond 2a and Pond 2b will provide a polishing function. The addition of Pond 3 is not required to achieve the proposed consent parameters over the 20 year time period (to year 2031) that has been assessed. However, this option is a future upgrade that would provide an enhanced effluent quality. Pond 3 would be shallow to assist disinfection, would be divided internally to avoid short circuiting, and could be designed with additional features such as fixed media and a covered final cell, or as a hybrid/advanced pond system, to further improve performance. This option may also be required if the outcome of the re-consenting process is not favourable.

The expected treated effluent quality from these options is shown in Table 15.

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▪ **Table 15 Expected Treated Effluent Quality**

Option		BOD (mg/l) 2011	BOD (mg/l) 2021	BOD (mg/l) 2031	Faecal Coliforms (cfu/100ml) 2011	Faecal Coliforms (cfu/100ml) 2021	Faecal Coliforms (cfu/100ml) 2031
Option 1	Do Nothing	63	74	91	3.6 x 10^5	4.6 x 10^5	6.4 x 10^5
Option 2	Do minimum	34	42	55	1.2 x 10^5	1.6 x 10^5	2.4 x 10^5
Option 3	Double Pond 1	20	25	34	6.6 x 10^4	8.8 x 10^4	1.4 x 10^5
Option 4	Double Ponds1&2	15	19	27	3.6. x 10^4	4.9 x 10^4	7.5 x 10^4
Option 5	Double + Mat. Pond	10	13	19	1.9 x 10^4	2.6 x 10^4	4.0 x 10^4

The orange shading in Table 15 indicates performance that will not meet the proposed compliance limits. The blue shading indicates performance that comfortably meets the limits and this indicates excessive treatment capacity. The green shading indicates a desirable balance between capacity and performance.

6.6. Preferred Option

The conclusion from Table 15 is that Option 3 should be implemented as soon as reasonably possible with an upgrade to Option 4 scheduled for year 2021. In reality the timing of the Option 4 upgrade will depend on the actual growth rate of the township and the performance of the treatment plant over time. This conclusion is predicated on obtaining the relaxed conditions proposed in Section 6.2.

Option 3 involves construction of an additional treatment pond in parallel to Pond 1. The additional pond has been termed Pond 1b with the original Pond 1 renamed as Pond 1a. Ponds 1a and 1b would operate in parallel with the effluent from both ponds receiving further treatment in Pond 2.

Although the major element of construction work is the new pond, the overall scheme would comprise the following elements:

- New 0.6 hectare, 1.5m deep pond to be known as Pond 1b
- Flow split chamber to divide the flow equally between Pond 1a and Pond 1b
- Isolation valves to enable either Pond 1a or Pond 1b to be taken out of service
- Interconnecting pipework to:
  - Link Pond 1a to the flow split chamber
  - Link Pond 1b to the flow split chamber

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  - Link Pond 1b to Pond 2
- Desludging of Pond 1a and Pond 2
- Reconfiguration of some of the existing design details (TBC)
  - Pipework linking Pond 1a to Pond 2
  - Inlet and outlet arrangements in Pond 1a
  - Inlet and outlet arrangement in Pond 2

The expected effluent quality is as follows:

- **Table 16 – Median Annual Effluent Quality**

	2011	2016	2021	2026	2031
BOD (mg/l)	20	22	25	30	34
Faecal Coliforms (cfu/100ml)	6.6 x 10^4	7.1 x 10^4	8.8 x 10^4	1.1 x 10^5	1.4 x 10^5

The proposed effluent quality compliance limits are as follows:

- Biochemical Oxygen Demand 40mg/l
- Suspended Solids 60mg/l
- Ammonia Nitrogen 20mg/l
- Faecal Coliforms 75,000 cfu/100ml

Note that the current actual performance of the treatment plant in terms of faecal coliforms is better than the performance as derived from theoretical calculations, refer to Table 10 in Section 4.2. We therefore expect the faecal coliform performance of the preferred option to meet the proposed compliance limits in 2021. This is the year when the upgrade to Option 4 is provisionally scheduled, although as stated in Section 6.6 the timing of the Option 4 upgrade will depend on the actual growth rate of the township.

This report has focused on performance in terms of BOD and faecal coliforms. The upgrade is also expected to bring SS and ammonia concentrations to within the proposed compliance limits. We suggest that calculations to confirm this expectation are made at the start of the design phase.

6.7. Cost Estimate

The cost of the preferred option is heavily influenced by the type of construction. The existing ponds were not designed with an impermeable liner and WDC hold a consent allowing for seepage through the base of the ponds. It is expected that the insitu materials have a low permeability and that the permeability will decrease over time as fine particles in the ponds block pore spaces. This unlined approach may be consentable for the new pond, although this would likely require further research into the receiving environment. The advantage of the unlined approach is that it keeps construction costs to a minimum and contributes to community affordability.

Capital cost estimates for an unlined pond and a lined pond are given in Appendix B and are summarised as follows:

Table 17 – Preferred Option Capital Cost Estimates

	Unlined	Lined
General	$134k	$134k
Pond construction	$173k	$352k
Ancillaries	$71k	$71k
On costs	$214k	$315k
Total	**$591k**	**$872k**

These estimates are preliminary and should be refined as design progresses, they do not include GST.

7. Conclusions & Recommendations

7.1. Conclusions

Key conclusions are as follows:

- Franz Joseph Wastewater Treatment plant is overloaded with the first pond receiving, in the peak month, nearly twice the load that it should ideally receive according to usual design practice. The second pond is acting as a polishing pond to enhance the quality of the poor effluent from the overloaded first pond.
- The treatment plant is regularly failing to meet its consent compliance limits, in particular suspended solids, biological oxygen demand and faecal coliforms. The performance is deteriorating over time.
- It is not clear that the non-compliance is actually giving rise to an adverse effect on the receiving environment. This is mainly due to the relatively small scale of the discharge and the discoloured and high suspended solids content of the receiving waters of the Waiho River.
- There is very little justification in previous documentation for the compliance limits, which appear to have been based on samples taken on only one day during the winter low demand period and do not appear to have accounted for peak summer demand or variability in pond performance. The limits are also strict for a two pond treatment system. We recommend that WDC seek a variation to the compliance limits to better reflect normal performance of a two pond system and an appropriate standard for the receiving environment.
- The first 0.60 hectare pond is undersized and the expected long-term increase in wastewater demands indicates that treatment upgrading will be required. The recommended upgrade is to double the capacity of the first pond by constructing another 0.60 hectare pond in parallel. Pond 1a (existing) and Pond 1b (new) would each treat half of the incoming flow which would then be further treated in the existing Pond 2.
- The estimated capital cost of this upgrade is **$590k** and it is projected to provide sufficient treatment capacity through to year 2021 when additional secondary [disinfection] pond capacity may be required. The design of this upgrade is predicated on achieving the relaxation in effluent quality compliance limits through a re-consenting process.
- The $590k estimate is based on an unlined pond. The existing ponds were not designed with an impermeable liner and WDC hold a consent allowing for seepage through the base of the ponds. It is expected that the insitu materials have a low permeability and that the permeability will decrease over time when the pond is in use as fine particles infiltrate and block pore spaces. If an impermeable liner is required then the cost estimate would rise to approximately **$870k**.

- Note that these cost estimates are preliminary and should be refined as design progresses. The estimates do not include for desludging which we recommend should be carried out as part of a district wide desludging programme

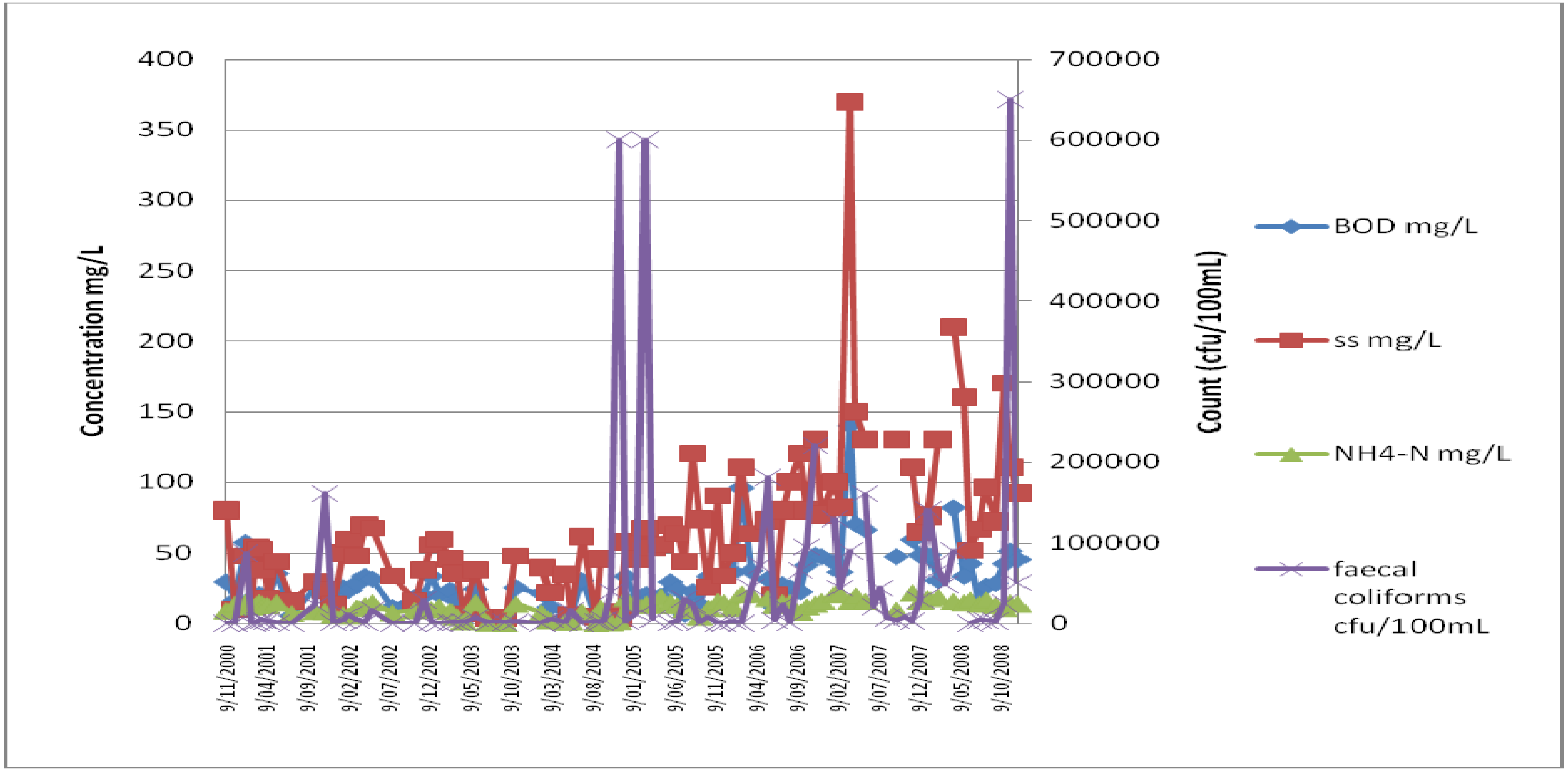
7.2. Recommendations

We recommend that:

- Due to the significant cost of this upgrade a structured review of flows, sludge depth, discharge quality and a receiving environment assessment is undertaken. This would allow a factual and reasoned argument for relaxed consent conditions to be developed if appropriate. At that stage the preferred upgrade option can be confirmed.
- If a new pond is accepted by WDC as the preferred upgrade option, then an unlined pond should be considered. The receiving environment assessment will need to take this into account.
- Desludging of the ponds at Franz Joseph should be carried out as part of a district wide desludging programme.
- A meeting with the Regional Council, to outline and discuss the approach and programme, should be arranged as a priority.

Appendix A Discharge Monitoring Results

The following figure plots monthly discharge monitoring results for the Franz Josef treatment plant.



Appendix B Capital Cost Estimate

FRANZ JOSEPH - TREATMENT PLANT UPGRADE - CAPITAL EXPENDITURE

LINED POND

ELEMENT	NO	UNIT	RATE	COST	SUM	NOTES
General						
Site preparation	14000	m2	8	112000		Rawlinsons comparative
General reinstatement	4000	m2	4	16000		Rawlinsons detailed
Fencing	300	m	20	6000		From internet search
					$134,000	
Pond 1b						
Excavate & fill	8500	m3	15	127500		Rawlinsons comparative
Trim	10000	m2	1	10000		Rawlinsons detailed
100mm levelling layer	700	m3	35	24500		Rawlinsons detailed, 100mm sand layer
GCL liner	7000	m2	17	119000		Based on Butlers, Elcoseal X3000
300mm confining layer	2000	m3	25	50000		Rawlinsons detailed, site derived
Wave bands	320	m2	50	16000		Provisional rate
Inlet arrangement	1	Sum	2500	2500		Provisional sum
Outlet arrangement	1	Sum	2500	2500		Provisional sum
					$352,000	
Miscellaneous						
Flow split chamber	1	Sum	10000	10000		Provisional sum
Isolation valves	1	Sum	5000	5000		Provisional sum
Pipework - flow split to Pond 1a	75	m	200	15000		Rawlinsons comparative/provisional rate
Pipework - flow split to Pond 1b	75	m	200	15000		Rawlinsons comparative/provisional rate
Pipework - Pond 1b to Pond 2	30	m	200	6000		Rawlinsons comparative/provisional rate
Modify inlet arrangement Pond 1a	1	Sum	5000	5000		Provisional sum
Modify outlet arrangement Pond 1a	1	Sum	5000	5000		Provisional sum
Modify inlet arrangement Pond 2	1	Sum	5000	5000		Provisional sum
Modify outlet arrangement Pond 2	1	Sum	5000	5000		Provisional sum
					$71,000	
SUBTOTAL - DIRECT COSTS					$557,000	
On Costs						
Preliminary and general items	15%	Sum	557000	83550		15% of direct costs
Commissioning	1%	Sum	557000	5570		2% of direct costs
Engineering & management	20%	Sum	646120	129224		20% of all costs
Contingency	15%	Sum	646120	96918		15% of all costs
					$315,262	
SUBTOTAL - ON COSTS					$315,262	
TOTAL (excluding GST)					**$872,262**	
GST @12.5%					$109,033	
TOTAL (including GST)					**$981,295**	

NOTES:
1. These costs are indicative and have been prepared for preliminary budgeting purposes
2. Doesn't include for tree felling and associated wood sale/disposal
3. Doesn't include for desludging the existing ponds as it is assumed that desludging will be carried out as part of a district wide programme

FRANZ JOSEPH - TREATMENT PLANT UPGRADE - CAPITAL EXPENDITURE

UNLINED POND

ELEMENT	NO	UNIT	RATE	COST	SUM	NOTES
General						
Site preparation	14000	m2	8	112000		Rawlinsons comparative
General reinstatement	4000	m2	4	16000		Rawlinsons detailed
Fencing	300	m	20	6000		From internet search
					$134,000	
Pond 1b						
Excavate & fill	7800	m3	15	117000		Rawlinsons comparative
Trim	10000	m2	1	10000		Rawlinsons detailed
100mm levelling layer	700	m3	35	24500		Rawlinsons detailed, 100mm sand layer
GCL liner	0	m2	17	0		Based on Butlers, Elcoseal X3000
300mm confining layer	0	m3	25	0		Rawlinsons detailed, site derived
Wave bands	320	m2	50	16000		Provisional rate
Inlet arrangement	1	Sum	2500	2500		Provisional sum
Outlet arrangement	1	Sum	2500	2500		Provisional sum
					$172,500	
Miscellaneous						
Flow split chamber	1	Sum	10000	10000		Provisional sum
Isolation valves	1	Sum	5000	5000		Provisional sum
Pipework - flow split to Pond 1a	75	m	200	15000		Rawlinsons comparative/provisional rate
Pipework - flow split to Pond 1b	75	m	200	15000		Rawlinsons comparative/provisional rate
Pipework - Pond 1b to Pond 2	30	m	200	6000		Rawlinsons comparative/provisional rate
Modify inlet arrangement Pond 1a	1	Sum	5000	5000		Provisional sum
Modify outlet arrangement Pond 1a	1	Sum	5000	5000		Provisional sum
Modify inlet arrangement Pond 2	1	Sum	5000	5000		Provisional sum
Modify outlet arrangement Pond 2	1	Sum	5000	5000		Provisional sum
					$71,000	
SUBTOTAL - DIRECT COSTS					$377,500	
On Costs						
Preliminary and general items	15%	Sum	377500	56625		15% of direct costs
Commissioning	1%	Sum	377500	3775		2% of direct costs
Engineering & management	20%	Sum	437900	87580		20% of all costs
Contingency	15%	Sum	437900	65685		15% of all costs
					$213,665	
SUBTOTAL - ON COSTS					$213,665	
TOTAL (excluding GST)					**$591,165**	
GST @12.5%					$73,896	
TOTAL (including GST)					**$665,061**	

NOTES:
1. These costs are indicative and have been prepared for preliminary budgeting purposes
2. Doesn't include for tree felling and associated wood sale/disposal
3. Doesn't include for desludging the existing ponds as it is assumed that desludging will be carried out as part of a district wide programme