PROJECT TECHNICAL MEMORANDUM FOR THE NELSON CITY COUNCIL

2877 Nelson Wastewater Treatment Plant (NWWTP)

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To: Nelson City Council

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For the Attention of: Warren Biggs and Lucy Clarke

Project Stage: Planning

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Subject: Considerations for Discharge Quantity Consent Limits

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Considerations for Discharge Quantity Consent Limits

1.1 Introduction

The Nelson Wastewater Treatment Plant (NWWTP) currently discharges treated wastewater to Tasman Bay under a resource consent, which expires in 2024. In preparing a new resource consent application for the treated wastewater discharge, an assessment of current (2022) and forecasted future (2059) inflows has been carried out as a surrogate for discharge flows to inform development of proposed draft consent conditions.

The purpose of this memo is to summarise the flow assessment and recommend potential discharge limits.

1.2 Previous assessments

An assessment of current and future inlet flow and loads to NWWTP was carried out in 2020 to inform the NWWTP consenting process. NWWTP inlet flow and loads from 2017-2019 were reviewed, with 2019 adopted as the typical 'base year'. 2017 and 2018 were both affected by extreme weather events – 2017 was generally a "wet" year and there were several summer cyclones in 2018. Projected flow and loads were then developed from the 'base year' assumptions and population projections provided by Nelson City Council (NCC).

As part of the NWWTP Process Capability Assessment (PCA) carried out in 2022, inlet flow and loads from 2020-2021 were reviewed to determine if the flow and load projections needed to be revised. The NZ response to managing the Covid-19 pandemic (ie lock-downs and alert-levels followed by traffic light settings) resulted in changes to the inlet flow and loads at NWWTP. Hence, 2019 was kept as the 'base year' for the PCA.

The Nelson region experienced extreme, consecutive rainfall events and associated flooding in August 2022, resulting in the highest recorded daily inflow (and discharge) at NWWTP, and 2022 being a "worst-case" wet year (see data presented in Appendix A). NCC requested Stantec use 2022 flows to provide a perspective on future flows in a "wet year" so that defensible draft discharge limits can be developed.

1.3 Inflow as a surrogate for discharge flow

Inflows to NWWTP are attenuated through the pond-based treatment system, comprising a facultative pond, maturation pond and wetland system, before being discharged via an ocean outfall to Tasman Bay. Two key mechanisms are used to attenuate wet-weather flows:

- Pond and wetland storage. Pond and wetland operating water levels are allowed to increase during periods of high inflows, limiting the daily discharge volume during the wet-weather event, and gradually returned to normal operating levels when inflows reduce.
- Flow buffer pond. Inflow over and above 33,000 m^3/day is bypassed to the buffer pond (up to a total of 16,000 m^3), with stored flow directed to the facultative pond when inflows reduce.

However, during periods of prolonged high inflows (due to extreme, prolonged wet-weather and/or consecutive significant wet-weather events), the NWWTP can reach flow buffering capacity, with average discharge flows essentially matching average inflows (see observed flows in August 2022 event in Figure A1) Rainfall on the surface of the ponds and wetlands (about 40 ha) can also contribute a significant volume. The existing discharge is via gravity; however, a pumped discharge may be required to accommodate future flows.

Hence historical inflows have been used as a surrogate for "worst-case" discharge flows.

1.4 Current and Future Inflow In a "Wet" Year

Observed inflows to NWWTP are presented in Appendix A as follows:

- Figure A1 - temporal variation in inflows from 1 January 2016 to 31 July 2023. This includes "wetter" years (2017, 2021 and 2022) and "drier" years (2020).
- Table A1 - annual and monthly average daily flows from 1 January 2020 to 1 July 2023.
- Table A2 - annual and monthly peak daily flows from 1 January 2020 to 1 July 2023.

2022 was used as the "base year" to provide a perspective on current (2022) and forecasted future (2059) flows in a "wet year", as summarised in Table 1. The future peak daily flow has been calculated in two ways.

Table 1 – Current and Future Inflow in a "wet" year

Parameter	Unit	2022[1]	2059	Comment
Population	People	27,540	37,230	35% population growth from 2022 to 2059 in NWWTP PCA report
Average daily flow	m^3/day	9,600	13,000	2022 - observed 365-day average 2059 - calculated from adopted flow generation rate and 2059 population
	m^3/person.day	0.349	0.349	Adopted flow generation rate based on 2022 average daily flow and population
Peak daily flow	m^3/day	55,300	74,800	2022 - observed peak daily flow 2059 – calculated from adopted ratio of peak to average daily flow and 2059 average daily flow. Note: future maximum NWWTP Inflow capacity not checked.
Ratio of peak daily flow to average daily flow	-	5.8	5.8	Adopted ratio of peak to average daily flow based on 2022 flows
Alternative Calculation:				
Average daily dry weather flow	m^3/day	8,000	10,800	2022 – adopted 2022 'drier summer' flow in NWWTP Virus Log Reduction memo 2059 - calculated from adopted 'dry' flow generation rate and 2059 population
	m^3/person.day	0.29	0.29	Adopted 'dry' flow generation rate based on 2022 'dry' flow and population
Peak daily inflow and infiltration (I&I) flow[2]	m^3/day	47,300	52,000	2022 – observed peak flow minus 'dry' flow 2059 – calculated from 2022 I&I flow and adopted I&I increase from 2022
Increase in I&I	%	n/a	10%	2059 – adopted I&I increase in NWWTP Virus Log Reduction memo
Peak daily flow	m^3/day	55,300	62,800	2022 – based on observed peak daily flow 2059 – sum of 2059 'dry' and I&I flows
Notes [1] 2022 is "base" year as well as "current" year. [2] Inflow and infiltration (I&I) due to stormwater inflow and ingress				

1.5 Potential Discharge Limits

The proposed consenting strategy is to offer two revised draft discharge volumetric conditions as follows:

- maximum daily flow limit. Note current limit is 38,000 m^3/day in a 2-year rainfall return period
- annual average flow limit instead of the existing 'peak 28-day average flow' condition. Note current limit is 21,000 m^3/day.

Based on indicative future (2059) flows for a "wet year" presented in Table 1, the following potential discharge volume limits are proposed for NCC's consideration:

- Maximum daily flow of 65,000 m^3/day. This is based on the lesser of the two peak daily flow calculations (62,800 m^3/day), rounded to nearest 5,000 m^3/day.
- 365-day average daily flow of 15,000 m^3/day. This is based on the calculated average daily flow (13,000 m^3/day), rounded to nearest 5,000 m^3/day.

1.6 Conclusion

2022 was used as the "base year" to provide a perspective on current (2022) and forecasted future (2059) flows in a "wet year". Observed NWWTP inflow and discharge flows from 2016 to mid-2023 are appended.

Based on future flows, a maximum daily flow limit of 65,000 m^3/day and 365-day average daily flow of 15,000 m^3/day is proposed for NCC's consideration.

Appendix A: Supporting Information

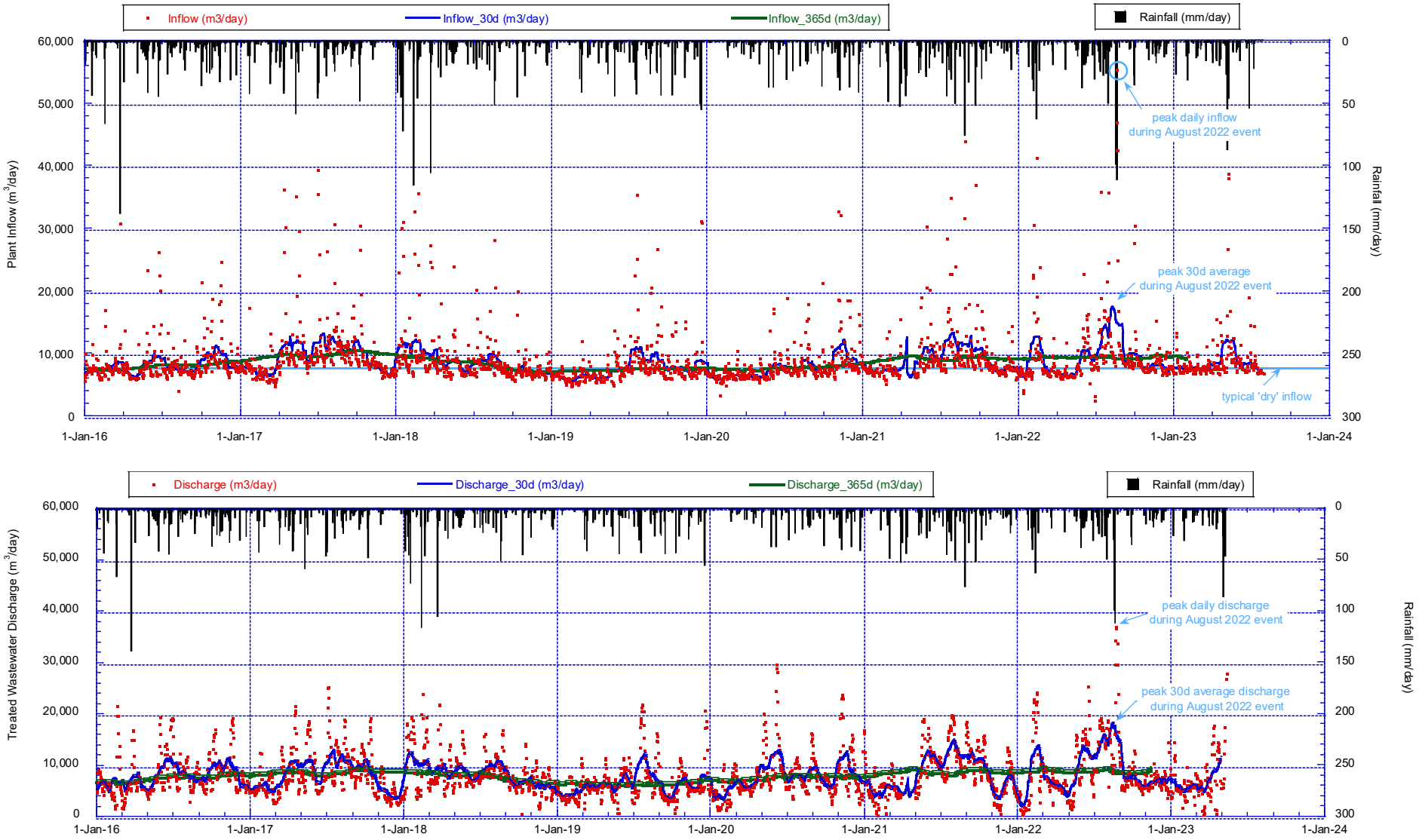


Figure A1 – Variation in NWWTP Daily Inflow (upper graph), Discharge (lower graph) and Rainfall (both graphs)

[1] Total daily flow – red dots; 30day rolling average flow – blue line; 365day rolling average flow – green line; rainfall – black bars.

[2] Rainfall from Nelson Airport Weather Station (#4241)

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Table A1 – NWWTP Average Annual and Monthly Inflow by Year

Average of Plant Inflow, m3	Column Labels												
Row Labels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2020	6,364	6,332	6,657	6,509	6,870	8,402	8,006	9,033	7,789	7,402	11,805	9,287	7,871
2021	7,242	7,105	7,819		9,575	9,951	12,262	11,863	10,780	9,331	7,191	8,025	9,213
2022	6,702	13,488	7,332	6,767	7,041	10,621	12,679	16,468	9,198	9,132	8,455	7,593	9,601
2023	7,817	7,911	7,596	8,793	12,178	8,604	7,640						8,658
Grand Total	**7,031**	**8,688**	**7,351**	**7,356**	**8,916**	**9,394**	**10,147**	**12,454**	**9,256**	**8,622**	**9,151**	**8,302**	**8,847**

Notes: 2021 and 2022 considered ‘wet’ years, while 2020 considered ‘drier’ year.

Table A2 – NWWTP Peak Annual and Monthly Inflow by Year

Max of Plant Inflow, m3/d	Column Labels												
Row Labels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2020	7,610	8,300	10,310	8,030	13,590	17,070	18,770	17,860	21,140	11,030	32,710	18,360	32,710
2021	8,130	12,410	15,360		30,150	20,140	34,790	43,750	36,780	16,680	8,480	14,260	43,750
2022	10,460	41,130	12,440	11,570	12,620	22,540	35,730	55,270	27,510	30,300	15,130	10,260	55,270
2023	13,100	10,070	11,040	15,290	38,610	18,830	14,180						38,610
Grand Total	**13,100**	**41,130**	**15,360**	**15,290**	**38,610**	**22,540**	**35,730**	**55,270**	**36,780**	**30,300**	**32,710**	**18,360**	**55,270**

Notes: 2021 and 2022 considered ‘wet’ years, while 2020 considered ‘drier’ year.

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Table A3 – NWWTP Average Annual and Monthly Discharge Flow by Year

Average of Plant Discharge, m3	Column Labels												
Row Labels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2020	3,758	5,639	6,036	6,505	9,675	12,518	8,031	7,964	7,974	5,945	12,041	7,894	7,821
2021	5,621	4,527	5,749		9,024	11,938	12,068	11,717	12,122	9,703	3,623	7,669	8,565
2022	2,520	13,899	7,050	5,666	6,514	13,247	13,772	18,089	7,153	6,876	6,656	7,101	9,019
2023	5,870	5,463	5,437	9,131	11,674	8,046	6,269						7,429
Grand Total	**4,442**	**7,392**	**6,068**	**7,117**	**9,222**	**11,437**	**10,035**	**12,590**	**9,112**	**7,508**	**7,440**	**7,555**	**8,294**

Notes: 2021 and 2022 considered ‘wet’ years, while 2020 considered ‘drier’ year.

Table A4 – NWWTP Peak Annual and Monthly Discharge Flow by Year

Max of Plant Discharge, m3/d	Column Labels												
Row Labels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2020	9,010	10,390	8,950	9,620	19,950	29,620	11,370	16,280	12,440	10,400	23,700	16,820	29,620
2021	12,320	7,490	10,230		18,900	17,240	19,630	18,310	18,360	15,610	6,310	13,450	19,630
2022	8,370	23,990	10,050	7,100	15,790	25,150	19,120	36,870	11,430	12,810	10,320	14,280	36,870
2023	14,230	9,500	10,150	17,500	27,720	13,740	10,230						27,720
Grand Total	**14,230**	**23,990**	**10,230**	**17,500**	**27,720**	**29,620**	**19,630**	**36,870**	**18,360**	**15,610**	**23,700**	**16,820**	**36,870**

Notes: 2021 and 2022 considered ‘wet’ years, while 2020 considered ‘drier’ year.

Table A5 – Comparison of NWWTP Inflow and Discharge Flows in 2022 ('base year')

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Average Daily Inflow (m^3/day)	6,702	13,488	7,332	6,767	7,041	10,621	12,679	16,468	9,198	9,132	8,455	7,593	9,601
Average Daily Discharge (m^3/day)	2,520	13,899	7,050	5,666	6,514	13,247	13,772	18,089	7,153	6,876	6,656	7,101	9,019
Average flow reduction across plant (%)	62%	-3%	4%	16%	7%	-25%	-9%	-10%	22%	25%	21%	6%	6%
Maximum Daily Inflow (m^3/day)	10,460	41,130	12,440	11,570	12,620	22,540	35,730	55,270	27,510	30,300	15,130	10,260	55,270
Maximum Daily Discharge (m^3/day)	8,370	23,990	10,050	7,100	15,790	25,150	19,120	36,870	11,430	12,810	10,320	14,280	36,870
Average flow reduction across plant (%)	20%	42%	19%	39%	-25%	-12%	46%	33%	58%	58%	32%	-39%	33%

Notes: Values shown in red indicate that average (or maximum) monthly discharge is larger than inflow (eg due to rainfall on ponds and wetlands).