Southland District Council

Winton WWTP Upgrade and Consent Renewal

Phase 1 Evaluation Report

July 2020

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1. Introduction

GHD has been commissioned by Southland District Council (SDC) to assist the renewal of the current resource consent of the Winton wastewater treatment plant (WWTP), which expires in June 2023.

1.1 Background

The primary objectives of the overall project are to deliver:

- Successful renewal of the discharge consent which Council currently holds through Environment Southland, and;
- An upgrade strategy for Council's existing wastewater treatment system in Winton (located as shown in Figure 1), identified from the supporting technical investigations.

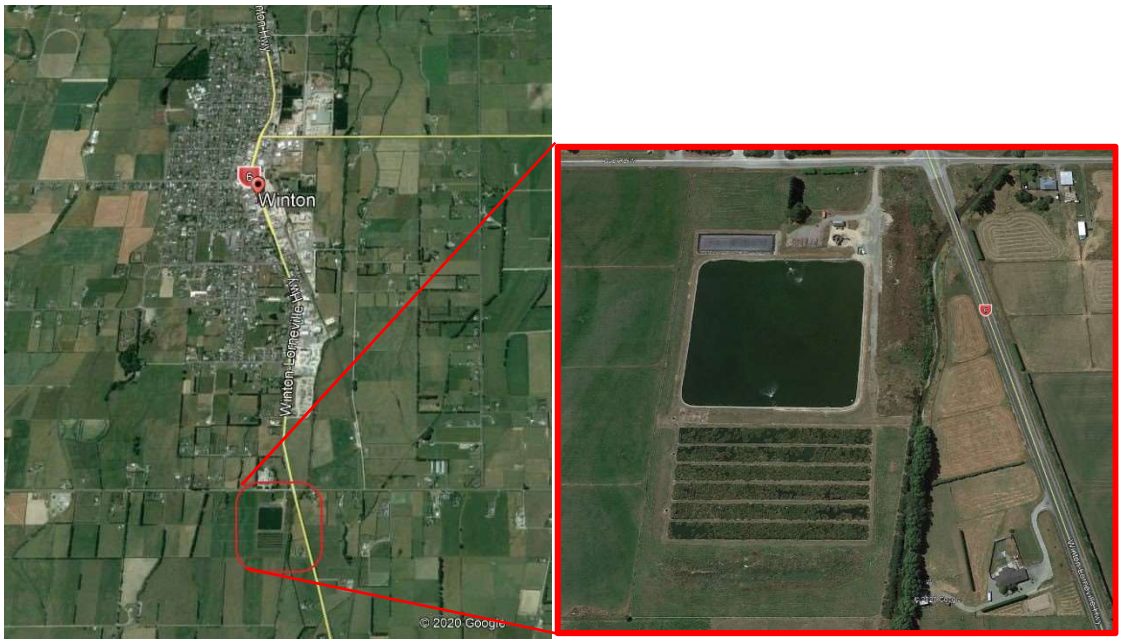

Figure 1: Winton WWTP

To achieve this, the project will be delivered through a phased approach, generally outlined as:

- **Phase 1**: Review of the existing system, and consent.
- **Phase 2**: Feasibility study and business case to identify the options to upgrade the system to meet future demands. Options and recommendation taken to Council and the Community for consultation, and ultimately a decision made on the preferred option.
- **Phase 3**: Complete concept design of the preferred option.
- **Phase 4**: Develop an assessment of environmental effects (AEE) for submission to Environment Southland as part of the consent renewal application.

1.2 Purpose of this report

The purpose of this report is to collate, and provide a high level summary of, the two aspects that have been assessed within Phase 1 of this project, namely the WWTP System Assessment, and the Planning Framework Assessment.

This report is the main deliverable for **Phase 1**, and acceptance of the content and recommendations is the trigger to initiate **Phase 2**. Refer to the Project Strategy and Quality Plan for a more-detailed description of the project phasing.

1.3 Scope and limitations

This report has been prepared by GHD for Southland District Council and *may only be used and relied on by Southland District Council for the purpose agreed between GHD and the Southland District Council as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Southland District Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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1.4 Assumptions

The following assumptions have been made in developing this Evaluation Report:

- Relevant documentation used as the basis of the contained reports has been provided by SDC and is assumed to be accurate.

2. WWTP System Assessment

This part of Phase 1 seeks to provide a baseline understanding of the performance observed at the Winton WWTP, identify specific existing issues and constraints, and develop a draft long list of options for the plant upgrade.

The WWTP System Assessment Report is included in Appendix A, and should be referred to for details. Below is a high level summary of the process, outcomes, and recommendations from the work.

2.1 Assessment Procedure

SDC provided GHD with various sources of information, which has formed the basis of the performance assessment. The information was supplied within the original Request for Proposal package, and through a Request for Information issued by GHD at the start of this phase. GHD has also sourced relevant information independently (e.g. rainfall data from NIWA).

Information used in this assessment includes:

- Catchment population predictions;
- Discharge wastewater flow and quality data (from historic sampling);
- Discharge consent limits (current and future predicted);
- As-built and O&M information for existing WWTP infrastructure.

The GHD Process Team has completed a desktop analysis to assess the efficacy of the current treatment plant to meet desired performance levels, and consider the potential options of plant upgrade or alternative servicing approach under the expectation of a tightening of discharge consent conditions.

The review included a high level commentary on the receiving environment, both the current discharge to the Winton Stream, and a potential change to land disposal.

2.2 Assessment Outcomes

A summary of the key outcomes from the performance assessment is included in Table 1.

Table 1: Plant Assessment Summary

Process Unit	Key Issues
Upstream wastewater network	• Infiltration issues reduces retention time in pond and wetlands, likely resulting deterioration in plant performance. • High inflow and infiltration issues lead to discharge permit non-compliances from high average inflows
Inlet screen	• No issue, the screen capacity seems to be sufficient for peak pumping rate to the plant.
Oxidation pond	• Pond has a shallower depth and shorter retention time compared with typical design guidelines. Surface aerators provide supplementary aeration to the pond to assist treatment performance.

Process Unit	Key Issues
	• Pond performance may also be impacted during storm flow events, e.g. retention time is reduced from 15 days to 9 days (at 1900m³/day, 90th percentile flow).
Wetland	• Wetland contact time is relatively short, approximately 2 days (assuming minimal sludge accumulation). It is likely to provide minor polishing of the pond effluent prior to discharge. • Wetland cells have not been desludged, and may require a sludge survey to quantify the current sludge accumulation level.
Sludge management	• No formal sludge management process in place. • Previous dewatering removed sludge using geobags.
Stream discharge	• Issues with mixing have been reported in 2017 WWTP review (Southland District Council, 2017)

A summary of the condition of the current receiving environment is:

- Environment Southland reporting confirms that Winton Stream has poor performance against E. Coli, nitrate, macroinvertables and slime algae;
- Ammoniacal nitrogen and dissolved reactive phosphorus concentrations are significantly elevated following the Winton WWTP discharge;
- A Land Air Water Aotearoa (LAWA) station monitoring the Winton Stream also confirms poor water quality.

2.2.1 Land Disposal

As is discussed in more details in the Planning Framework Assessment (refer to Section 3), there is a high likelihood that discharge of effluent to land will be preferred by Environment Southland when considering the consent renewal. To inform early discussions around the feasibility of disposal to land, an assessment was made of indicative land area required for disposal of wastewater from Winton WWTP.

Table 2: Indicative Land Disposal Area Requirements

Wastewater Flow Scenarios	Land Disposal Area (ha)	
	2 mm loading/day	5 mm loading/day
2 x Average Daily Wastewater Flow (~98%ile)	170	70
95%ile Wastewater Flow	150	60

The above information was provided for a preliminary discussion with SDC and Environment Southland (ES) regarding their position on effluent land disposal. The assumed application rates and the wastewater flow scenarios are pessimistic estimates to provide an “upper bound” land area requirements.

As such, a more detailed analysis will be necessary to quantify the hydraulic and nitrogen application rates from a desktop review of soil characteristics, potential land parcels and understanding of groundwater/surface water interactions, if this option is carried forward for further analysis.

The following assumptions were made in developing these indicative land disposal area estimates:

- Effluent application rates of 2 mm/day and 5 mm/day are conservative scenarios in terms of land area requirements, and the appropriate application rates will be determined through future field tests;
- The land area estimates do not include consideration of soil type or nutrient loading;
- Wastewater flows have been pro-rata'd up to account for 2043 population (2,680 people);
- Future wastewater flow estimation has no allowance of I&I reduction, as any I&I reduction will take some time to implement;
- Flow scenarios considered are: 2 x Average Daily Flow (~98%ile) and 95%ile Flow. Excess flows will either be stored in pond or storage tank, or as wet weather discharge to the stream;
- The scenario of land area sized for Maximum Daily Flow was also considered, but rejected as the required land area is excessive and impractical to manage;
- Land area includes additional 30% as reserve and buffer area;
- Land area rounded to nearest 10 ha.

2.3 Recommendations

The assessment has yielded a number of recommendations, which, subject to approval by SDC, will be progressed through the subsequent phases of the project. These include:

- A sampling and monitoring programme to gather updated condition data from the WWTP influent, discharge, and the Winton Stream;
- Suggested design basis for key parameters associated with the upgrade of the WWTP for options investigation (Phase 2);
- Initial proposed future discharge standards for the purpose of options investigation (Phase 2). This includes discharge limits for disposal to water and to land. These limits are included as a starting point for discussion, and will be refined through the subsequent phases of the project;
- Draft long list options for the plant upgrade. This list covers three themes: discharge to water; discharge to land; full system re-configuration (alternative plant or discharge location);
- Complete additional work to assess the availability of land that is suitable to accommodate an effluent disposal scheme.

Phase 2 will focus in on the long list of options, to prepare a short list and recommended option through the MCA business case approach. A more detailed desktop assessment of land disposal option will also be undertaken to identify potential land parcels suitable for land disposal. If the land disposal option is carried forward into the shortlisted option, a field investigation such as infiltration test will be recommended.

3. Planning Framework Assessment

GHD's Planning Team has completed a review of the overarching planning framework which will govern the renewal of the existing discharge consent; refer to report "High Level Summary of the Planning Framework" included in Appendix B. This review has considered a number of guidelines, including:

- National Policy Statement for Freshwater Management;
- Southland Regional Policy Statement 2017;
- Proposed Water and Land Plan;
- Regional Effluent Land Application Plan 1998;
- Regional Water Plan 2010;
- Te Tangi a Tauira – The Cry of the People;
- Southland District Plan.

A very high level preliminary assessment has been completed of the implications of continued discharge to water, versus a change to a land disposal option. This assessment will be updated as the design options and details are refined in the subsequent project phases.

As part of this assessment, an introductory pre-application discussion was held with Environment Southland (ES) on 5th June 2020. This discussion sought guidance from ES as to their expectations regarding discharge quality if discharge to land is not possible. ES did not provide any direct commentary on the required water quality parameters should the project proceed with a discharge to water, but did provide some comments by email following the meeting. These points are included in the appended Summary report.

3.1 Summary and Recommendations

The high level resource management planning framework provides a clear preference for discharges to land over water. **Discharges to water should only occur where the adverse effects of the discharge to water are lesser than those of a discharge to land**. There is also a move away from the maintenance of water quality, to requiring an **improvement in water quality**, where degradation of water quality has occurred.

The regional planning framework in terms of objectives, policies and rules, provides a strong preference for discharge to land.

On the basis of the comments from ES, and GHD's analysis of the objective and policy framework, a very robust alternatives assessment will need to be prepared in support of any application such as one for this scheme. The team has set up a spreadsheet to record dialogue and options throughout the project to provide an auditable record of how the design options and decisions have been progressed.

4. Next Steps

This report has been issued to collate and summarise the two key deliverables from the Phase 1 work. Both reports were provided in draft form to SDC, and discussed by the Project Team at the Phase 1 Workshop held on 18th June 2020.

The following summarises the next stage of the project.

Phase 2 – Feasibility Study, Business Case and Community Consultation

- Due to the identified preference for disposal to land over water, an assessment of the feasibility of establishing a land disposal system will be further investigated via a desktop assessment, as recommended in Section 2.2.1;
- In parallel to the land assessment, the project team will develop and agree the key criteria and drivers related to the treatment plant upgrade options, which will be fed into the MCA. SDC will take the lead on developing these key criteria in order to bring in the wider views of Council;
- Consultation with key stakeholders will commence, and be guided by the preparation of an Engagement Strategy. The SDC and GHD teams will jointly prepare this. Consultation will commence during the long list options assessment to maintain clarity of the decision processes;
- Critical appraisal of the proposed long list of options against the criteria to establish a short list of about three to four options to take forward. High-level risk assessments will be prepared to identify the pros and cons of each of the long list. This step will be concluded through evaluation and agreement at a workshop and the decisions and comments on options are recorded in a register jointly managed by SDC and GHD;
- Conceptual details will be prepared for the short list options to allow assessment via Multi-Criteria Analysis (MCA) to identify a preferred option. Criteria and weighting will be agreed with SDC, but are expected to include:
  - Consentability;
  - Plant performance efficiency;
  - Upgrade complexity;
  - Capital and operational cost;
  - Environmental impact;
  - Risks and constraints.
- Conclude the Phase 2 work through preparation of an **Options Assessment Report**, including a recommendation on the **preferred option** to take forward into **Phase 3 – Concept Design**.

Appendices

Appendix A – WWTP System Assessment Report

Winton WWTP System Assessment Report, July 2020

Southland District Council

Winton WWTP Upgrade and Consent Renewal

WWTP System Assessment Report

July 2020

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1. Introduction

Southland District Council (SDC) commissioned GHD to prepare a resource consent renewal application for the Winton wastewater scheme. This report is a review of the existing Winton wastewater treatment plant (WWTP), as part of Phase 1 Consent Strategy Development.

A Consent Scoping Assessment report is being prepared in parallel to this report to highlight the regional and district council planning issues and potential constraints applicable to this consent application and associated possible improvement options.

1.1 Purpose of this report

The purpose of this report is to provide a baseline understanding of the existing issues observed at the Winton WWTP, identification of existing issues, constraints and to develop a draft long list of options.

1.2 Scope and limitations

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1.3 Assumptions

The following assumptions have been used in developing this WWTP assessment:

- Relevant documentation in relation to the Winton WWTP, as per Table 1, has been provided by SDC and is assumed to be accurate.
- Typical influent loading rates have been used to develop the design basis for the options assessment.
- The WWTP assessment does not include an asset condition assessment.
- The WWTP assessment only includes a high-level desktop capacity assessment of the WWTP unit operations

2. Information Received

GHD submitted an RFI to SDC on 05/05/2020, requesting available documentation for Winton WWTP. The documentation provided by SDC is summarised in Table 1 below.

Table 1: Summary of Winton WWTP Documentation Received

Documentation	Date	Key Summary / Findings	Relevance to GHD WWTP Assessment and Upcoming Options Investigations
Winton WWTP O&M manual	Assumed 2014 – not up to date	• Summary of plant operation, network plan, history of plant equipment, and operational issues • High inflows in storm events wash out oxidation pond, disrupting bacteria and algae communities and affecting performance of pond	• Important information for plant assessment • Effect of high inflow and infiltration noted.
Plant drawings	07/2004	• Drawings of wetland system	• Existing wetland dimensions, details of Winton stream discharge
Plant equipment information		• Product manuals and drawings for inlet screen, screw wash press and aerator	• Details of existing equipment on site
Wastewater compliance data	12/2019	• Lab results of compliance testing required in consent conditions • Data available from February 2015 to December 2019	• Recent performance of existing WWTP processes
Inflow and Infiltration Assessment report	03/2020	• Assessment of inflow and infiltration (I&I) in the Winton wastewater network • Report concludes that I&I is a significant contributor to wastewater flows in Winton • Estimated ADWF is 750 m^3/day	• Effect of high inflow and infiltration noted. • Impact on plant hydraulics and wet weather potential storage requirements
Winton Wastewater Study draft report	Assumed 2010	• Assessment of WWTP performance, in terms of effluent quality data and upstream and downstream measurements	• Performance of existing WWTP processes

Winton WWTP biological survey	03/2017	• Assessment of effect of WWTP discharge on aquatic ecosystem in Winton stream, concluded to be negligible / minor	• Performance of existing WWTP processes, impact on receiving waters
Winton Wastewater Treatment Plant 2017 Review	2017	• Summary of inflow volumes, discharge and receiving water sampling results, and plant issues	• Identification of key issues at Winton WWTP
Winton Wastewater Treatment Plant 1993 Review	1993	• Summary of plant equipment, water quality, improvement options	• Details of oxidation pond (area and depth)
Population estimates (provided in email from SDC)	05/2020	• Some population growth expected between 2013 to 2043	• Important information for options assessment / feasibility, forming the basis of design

3. Existing System Review

3.1 Winton Township and Population

The Winton WWTP catchment is understood to be primarily domestic, with little to no industrial contribution. The treatment plant receives and treats wastewater from the urban area, as shown in Figure 1 below.

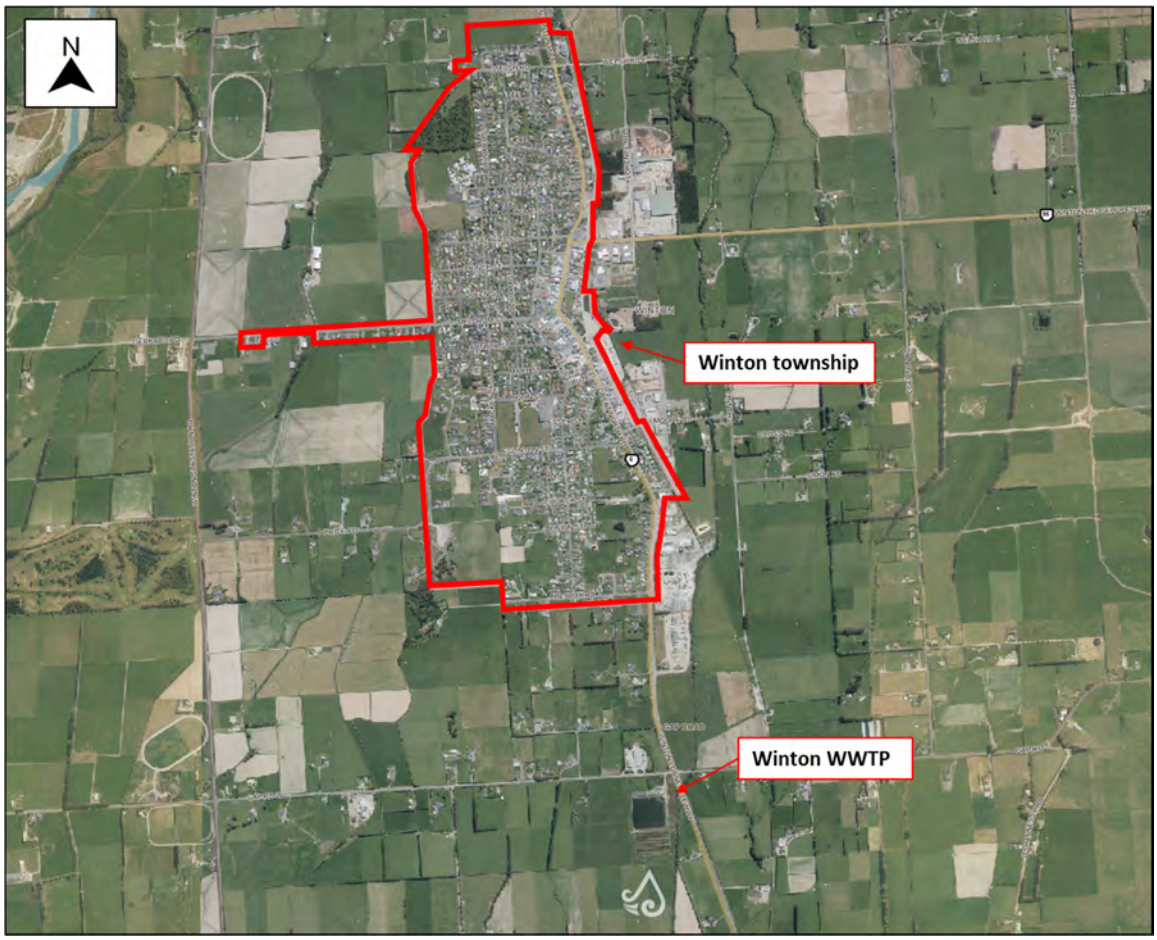

Figure 1: Winton Urban Area, from SDC GIS Maps

The wastewater network in Winton drains to a single pump station in Dejoux Road, where it passes through a 3mm bar screen before being pumped to the WWTP. The Winton wastewater network is shown in Figure 2, and is schematically represented in Figure 3.

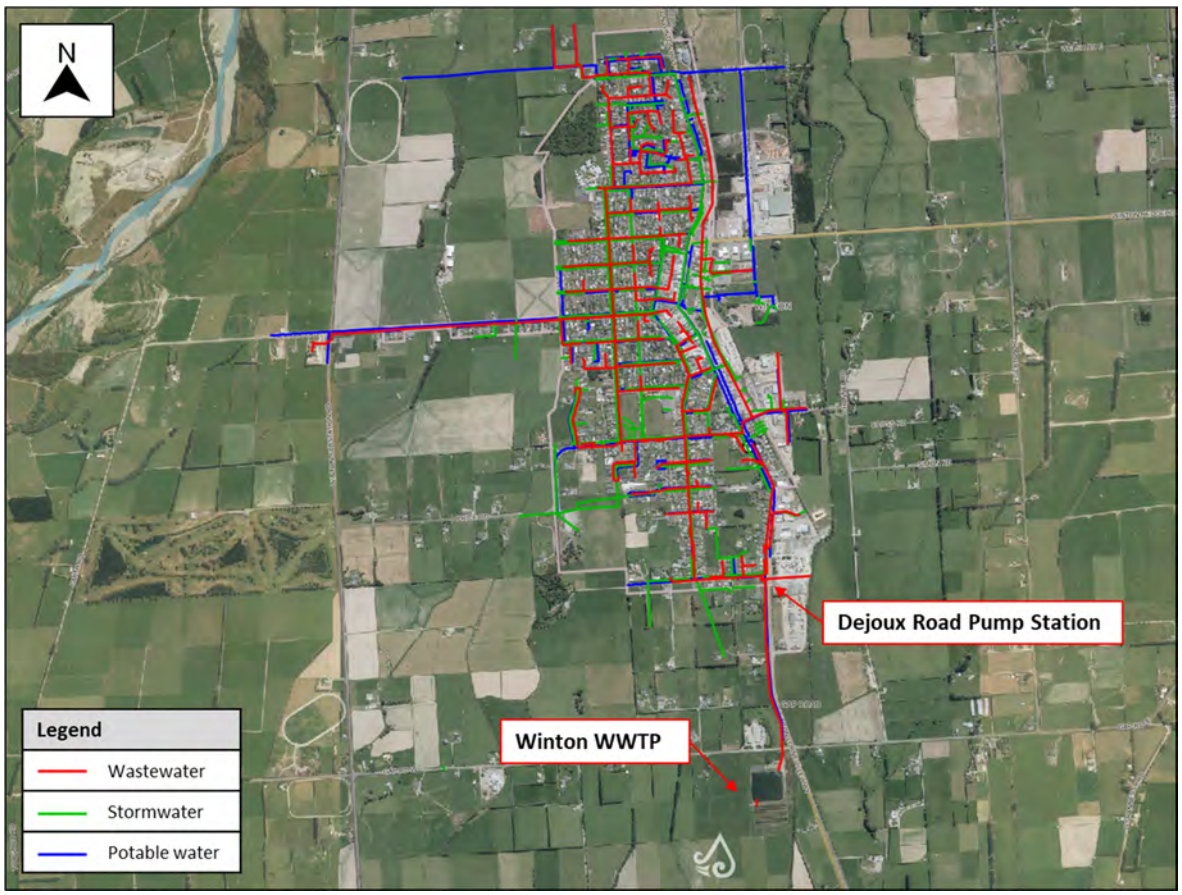

Figure 2: Winton Wastewater Network, from SDC GIS Maps

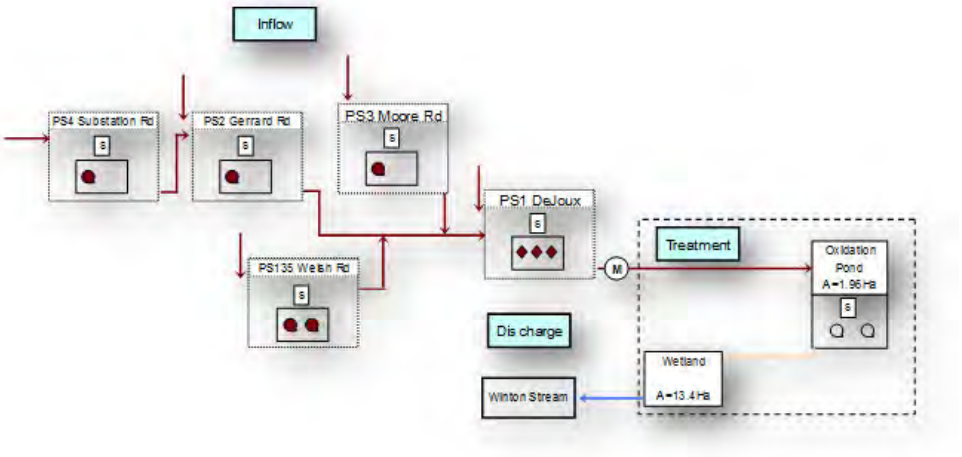

Figure 3: Winton Wastewater Network Schematic, from Winton WWTP O&M Manual

SDC has confirmed that the urban population of Winton, as of 2013, was 2,250 people. The population is estimated to grow to 2,680 people by 2043, by approximately 19%. The estimated population growth for Winton is shown in Figure 4, based on a linear growth assumption.

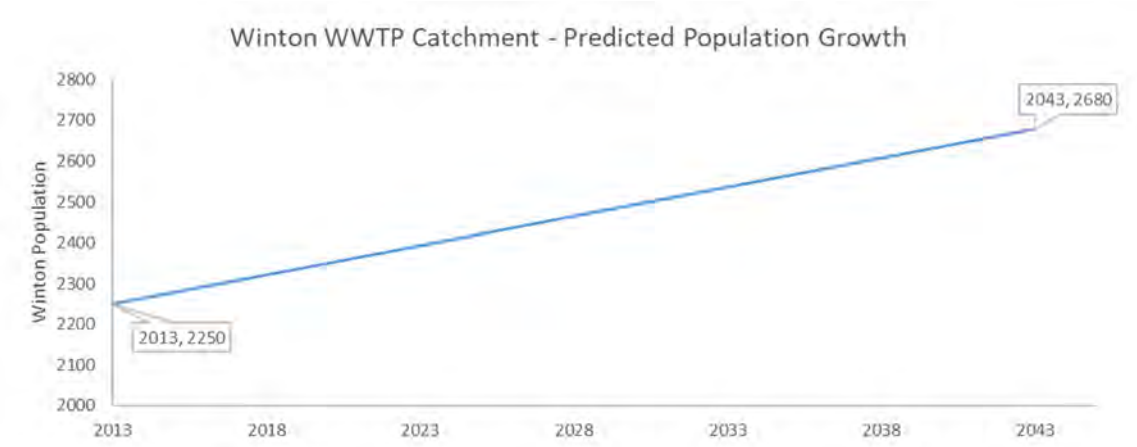

Figure 4: Predicted Winton WWTP Catchment Growth (assumed linear extrapolation), data from SDC

3.2 Current Wastewater Flows and Loads

3.2.1 Wastewater Flows

The Winton WWTP does not have a flowmeter at the inlet or outlet of the plant. However, there is a flowmeter on the combined discharge of the Dejoux Road pump station, directly upstream of the plant.

The daily wastewater inflow to Winton WWTP from 1st July 2016 to 16th February 2020 is shown in Figure 5 below. Peaks in the wastewater inflow to the plant correlate with peaks in daily rainfall, shown in Figure 6 below.

The inlet flow percentiles to the WWTP are shown in Figure 7. The majority of wet weather events appear to occur during the 90th percentile of wastewater inflows, ranging from 1,538 m^3/day to 6,393 m^3/day. SDC has advised that the extreme peak flow observed on 4th February 2020 is not representative of peak flows observed at the plant, as the region was subjected to wide-spread flooding on that day.

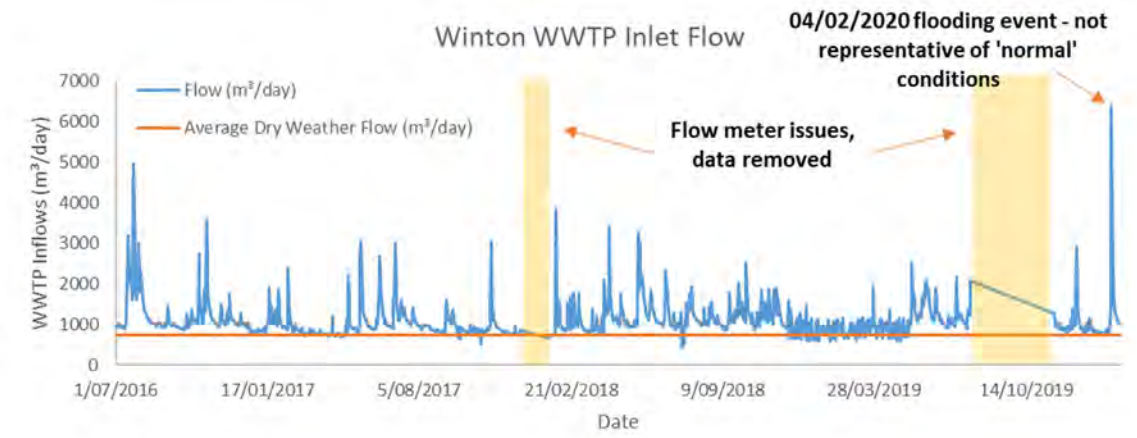

Figure 5: Winton WWTP Inlet Flow (July 2016 to February 2020)

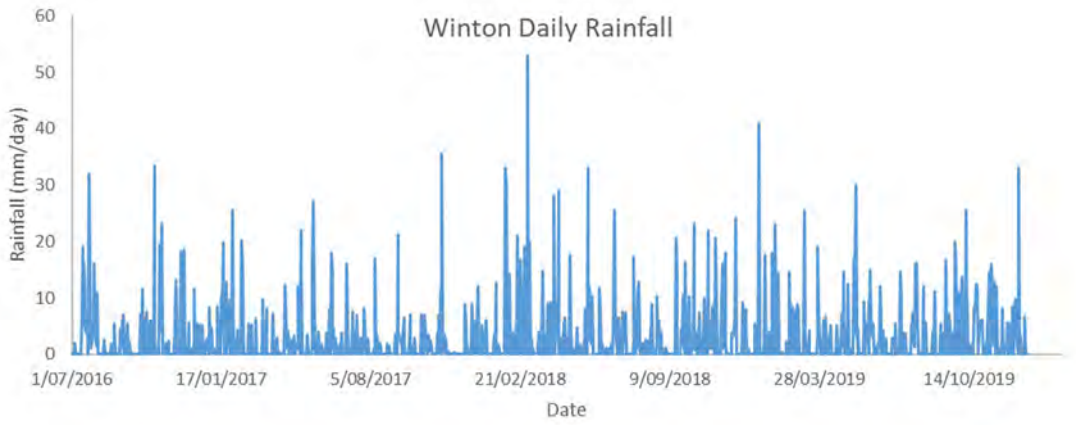

Figure 6: Winton Daily Rainfall (July 2016 to December 2019), sourced from the NIWA CliFlo system

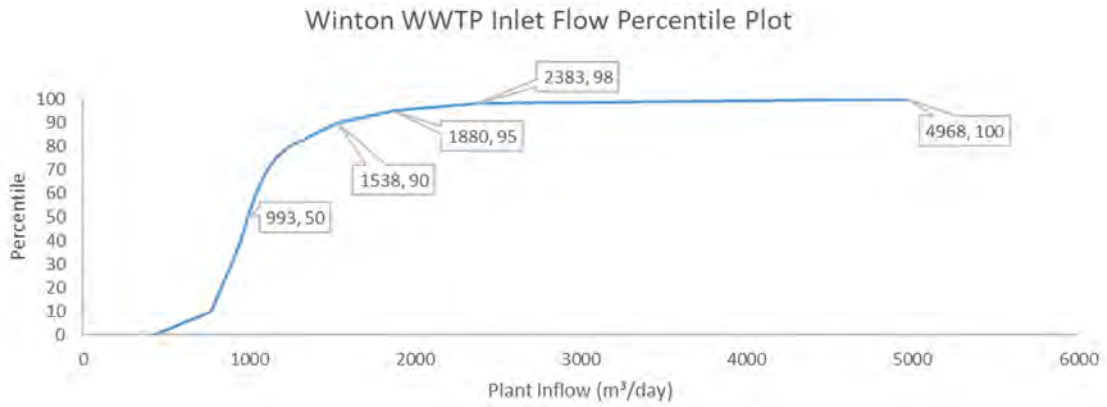

Figure 7: Winton WWTP Inlet Flow Percentiles

The characteristics of the wastewater inflow data is shown in Table 2 below.

Table 2: Winton WWTP Flow Parameters

Parameter	Value	Unit
# of Data Points	1180*	
Current Average Dry Weather Flow (ADWF)	750	m^3/day
Average Daily Wastewater Flow (AAF)	1102	m^3/day
Maximum Daily Wastewater Flow (MDF)	4968**	m^3/day
Peaking Factor (MDF/AAF)	5.8	

**Daily flow recordings from 01/07/2016 to 16/02/2020, excluding periods of flow meter issues*

***Largest inflow recorded was 6393 m³/day on 04/02/2020, however this was recorded during a time of significant flooding in Southland, and is not representative of 'normal' peak events, so has been removed from the data analysis.*

The resource consent for the plant authorises discharge of treated sewage into Winton Stream, at an average flow limit of 750 m^3/day. The average daily inflow to the plant is 1,102 m^3/day, and the consented limit covers less than 10% of the wastewater inflow scenarios.

The estimated wastewater flow per capita for Winton is as follows:

- Current ADWF per capita – 333 l/day per EP

- Current AAF per capita – 490 l/day per EP

SDC design guidelines recommend wastewater networks are designed for an ADWF of 180 – 250 l/day per EP (Southland District Council, 2012), which accounts for domestic wastewater, and acceptable levels of inflow and infiltration (I&I).

The wastewater flow per capita in Winton is significantly higher than this, indicating that I&I to the Winton network is significantly higher than acceptable levels. This aligns with an I&I assessment of the Winton wastewater network completed by ProjectMax (ProjectMax, 2020), which confirmed that I&I is a large contributor to wastewater inflows, with up to 50% additional flows on a dry day as a result of infiltration.

SDC has confirmed that ProjectMax are delivering a 12 week I&I assessment programme in the second half of 2020. The results from this assessment will be provided when available, to confirm the expected reduction in wastewater inflows to Winton WWTP.

3.2.2 Current Contaminant Loads

No influent sampling data has been provided for Winton WWTP. In the absence of data, typical per capita generation rates have been assumed, included in Table 3.

Table 3: WWTP Influent Loads (assumed)

Contaminant	Assumed Per Capita Rate (g/day)	Assumed Contaminant Load (kg/day)*	Assumed Average Load (mg/L)**
$cBOD_5$	70	158	143
TSS	70	158	143
TKN	15	34	31
TP	3	7	6

*Assuming a population of 2250 EP (2013)

**Assuming an average flow of 1102 m^3/day

High levels of I&I in the Winton wastewater network will result in dilution of contaminants, and the estimated concentrations provided in Table 3 are lower than typically observed in New Zealand municipal wastewater. The assumed influent loading rates need to be verified through sampling, as explained in Section 5 below.

3.2.3 Septic Tank Trucked Waste

SDC has confirmed that Winton WWTP currently does not accept waste from sludge trucks or septic tanks[1].

3.3 Discharge Standards and Final Effluent Quality

3.3.1 Current Resource Consent

The current discharge permit (CN: 202026) for the plant allows for discharge of treated sewage to the Winton Stream, from the 8th December 2003 to the 8th December 2023. There are no consent limits on wastewater discharge quality parameters, except for average wastewater flow into the Winton Stream, which is limited at 750 m^3/day.

[1] Email from Joe Findley (SDC) to Ian Ho (GHD) on 25/05/2020 (Subject: "RE: Winton WWTP – Additional Queries")

However, the discharge permit requires that minimum standards for Class D waters, as per Southland Regional Council's Transitional Southland Regional Plan (October 1991), are maintained beyond 100 metres downstream of the discharge point.

The permit also requires the total ammonia nitrogen in the Winton Stream, beyond the zone of the reasonable mixing, to be within Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines for Fresh and Marine Water Quality (October 2000).

A summary of consent requirements for water quality in the Winton Stream is provided in Table 4.

Table 4: Winton WWTP Discharge Permit Requirements

Determinand	Value
Average wastewater discharge to Winton Stream	750 m^3/day
Total Ammonia Nitrogen	180 – 2570 mg/m^3, dependent upon pH *(ANZECC Guidelines for Fresh and Marine Water Quality, October 2000)*
Maximum change in natural water temperature	± 3°C
pH Range	6 - 9
Quality	Water must not be unpalatable, unsafe for farm animal consumption, or emit objectionable odours
Toxicity	Natural aquatic life shall not be destroyed by concentration of toxic substances
Colour and clarity	Water colour and clarity must not be changed to a conspicuous extent, defined as a 20% reduction in black disc distance
DO	5 mg/l

The discharge permit requires monitoring of the treated sewage effluent at the discharge point, and of the receiving waters, 5 m upstream and 100 m downstream of the point of discharge. Monitoring is required to be completed at least twice during 1 November – 31 March, and one during 1 June to 31 August each year. The monitoring parameters are provided in Table 5.

Table 5: Winton WWTP Discharge Permit - Monitoring Parameters

WWTP Discharge	Receiving Waters – Upstream and Downstream
Temperature	pH
Electrical conductivity	Temperature
Dissolved oxygen concentration	Electrical conductivity
Carbonaceous Biochemical Oxygen Demand (BOD_5) concentration	Dissolved oxygen concentration
Total Suspended Solids concentration	Black disc distance
E. Coli concentration	E. Coli concentration
Nitrate Nitrogen concentration	Nitrate Nitrogen concentration
Total Ammonia Nitrogen concentration (NH_4^+-N and NH_3-N)	Total Ammonia Nitrogen concentration (NH_4^+-N and NH_3-N)
Total Nitrogen concentration	Total Nitrogen concentration
Total Phosphorus concentration	Dissolved Reactive Phosphorus concentration

The discharge permit for Winton WWTP also requires an Environmental Effects Review to be completed within 3 years of issue of the discharge permit, and every 5 years ongoing. The Environmental Effects Review requires intensive monitoring of the plant discharge and receiving waters, and a biomonitoring assessment to determine the effect of the plant discharge on aquatic life. The Environmental Effects Review is required to cover the following parameters:

- The operation and performance of the Winton WWTP;
- Results of monitoring data undertaken in accordance with the resource consent, and any other relevant data;
- Any significant adverse effect on the environment that can be “avoided, remedied or mitigated” by changes or upgrades to the Winton WWTP;
- The nature of any necessary improvements;
- The impacts of any changes to the resource consent conditions.

The 2010 and 2017 plant review reports (described in Section 2) are part of the Environment Effects Review, undertaken by SDC.

3.3.2 Current Final Effluent Quality

SDC has provided effluent monitoring data from 23 sampling occasions from 09/07/2012 to 10/12/2019 for the Winton WWTP discharge, and Winton Stream.

Monitoring Results – WWTP Performance

The plant performance against the requirements of the discharge permit is summarised in Table 6. Note, quality and toxicity performance have not been reported, as parameters for these determinands were not included in the monitoring data.

Table 6: Winton WWTP Performance against Discharge Permit Conditions

Determinand	Consent Limit	WWTP Performance (2012 – 2019)
Average wastewater discharge to Winton Stream	750 m^3/day	Non compliant: 1102 m^3/day *(Average flow from 01/07/2016 to 16/02/2019)*
Total Ammonia Nitrogen	Compliance with Ammonia Nitrogen limits in ANZECC Guidelines for Fresh and Marine Water Quality, October 2000	4 non compliances
Maximum change in natural water temperature	± 3°C	Compliant
pH Range	6 - 9	Compliant
Colour and clarity	Water colour and clarity must not be changed to a conspicuous extent, defined as a 20% reduction in black disc distance	Compliant
DO	5 mg/l	Compliant

Monitoring Results – WWTP Discharge

Key contaminant parameters from monitoring at the Winton WWTP discharge to the receiving waters are provided in Figure 8 and Figure 9.

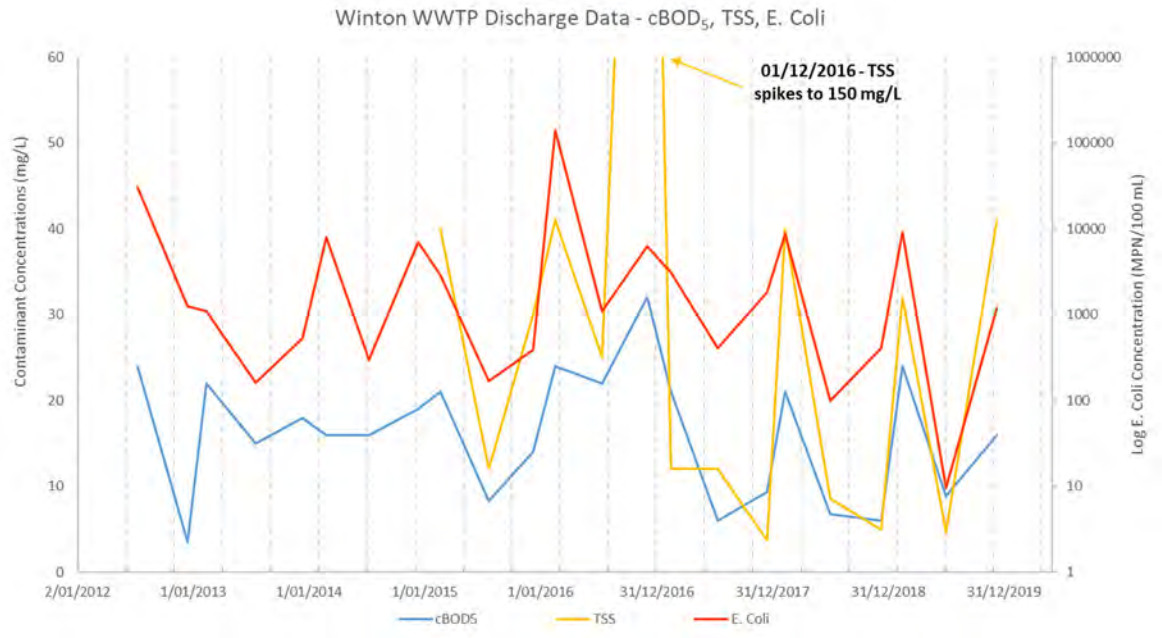

Figure 8: Winton WWTP Discharge – cBOD5, TSS and E. Coli

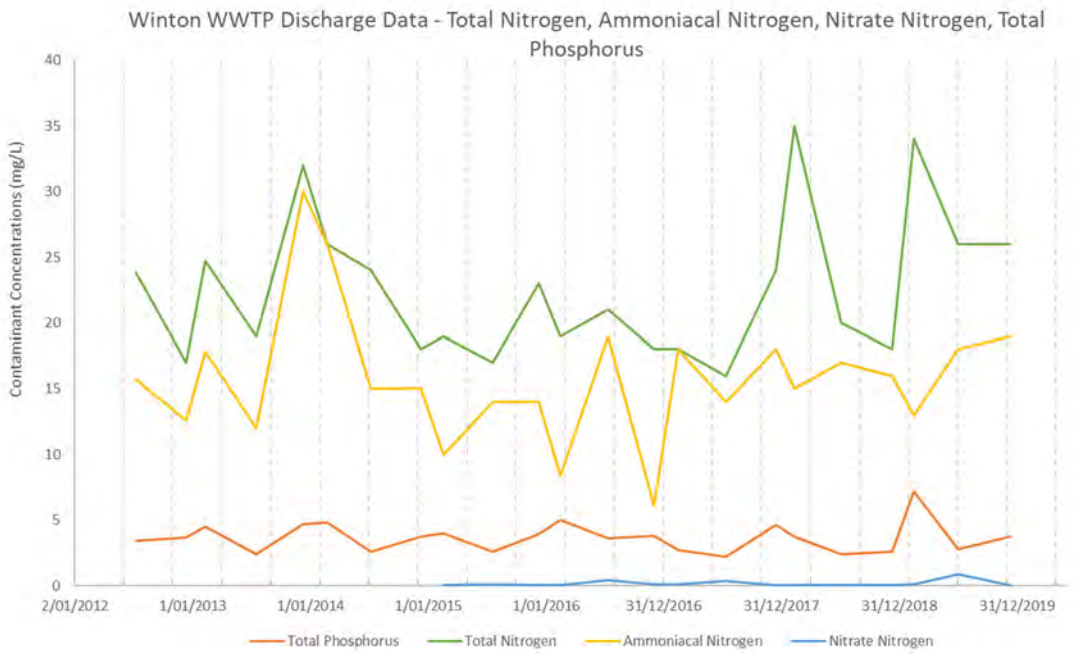

Figure 9: Winton WWTP Discharge - Total Nitrogen, Ammoniacal Nitrogen, Nitrate Nitrogen and Total Phosphorus

Observations noted:

- Discharge flow rates have not been recorded.
- There is no interstage data from the same period as the discharge data.
- $cBOD_5$ in the WWTP effluent fluctuates between 10 mg/L and 30 mg/L.
- E. Coli concentrations fluctuate between 100 MPN/100 mL, and 8,000 MPN/100 mL. There are two significant spikes in E. Coli, to 30,000 MPN/100 mL, and 140,000 MPN/100 mL. These spikes occurred during periods of mild wet weather, however similar spikes are not seen following periods of more extreme wet weather.
- TSS fluctuates between 10 mg/L and 40 mg/L. There is one significant spike in TSS concentration to 150 mg/L, likely to be attributed to algal solids.
- Total Phosphorus and Total Nitrogen are generally stable around 5 mg/L and 30 mg/L respectively.
- Ammoniacal nitrogen fluctuates between 5 mg/L and 20 mg/L, with one significant spike in concentration to 30 mg/L.
- Nitrate nitrogen is generally stable around 0.05 mg/L.
- There does not appear to be any downward or upward trend in contaminant concentration over the sampling period.

A comparison of the Winton WWTP effluent quality to typical wetland effluent quality is shown in Table 7. The parameters of potential concern are highlighted in red.

Table 7: Winton WWTP Effluent Quality vs Typical Wetland Effluent Quality

Contaminant	Winton WWTP Discharge – Median Concentration (2012 to 2019)	Typical Effluent Quality from Wetlands – Median Concentration (Walmsley, 2018)
cBOD5 (mg/L)	16	15
TSS (mg/L)	25	15*
Total Nitrogen (mg/L)	21	25
Ammoniacal Nitrogen (mg/L)	15	5*
Total Phosphorus (mg/L)	4	6
E. Coli (MPN/100 mL)	1200	2000

** Low levels of ammoniacal nitrogen and suspended solids are achieved by a wetland designed for treatment and polishing, requiring reasonable contact time.*

TSS and ammoniacal nitrogen concentrations in the Winton WWTP effluent appear to be higher than expected, based on typical wetland treatment performance of municipal wastewater.

Elevated TSS level in the discharge may be attributed to wetland cells have not been desludged since its operation.

Elevated ammoniacal nitrogen level in the discharge may be attributed to the cooler temperature in Winton, and lower biological activities within the pond and wetland cells.

Monitoring Results – WWTP Receiving Waters

Key contaminant parameters from monitoring of the Winton Stream, upstream and downstream of the Winton WWTP discharge point are provided in Figure 10 to Figure 13 below.

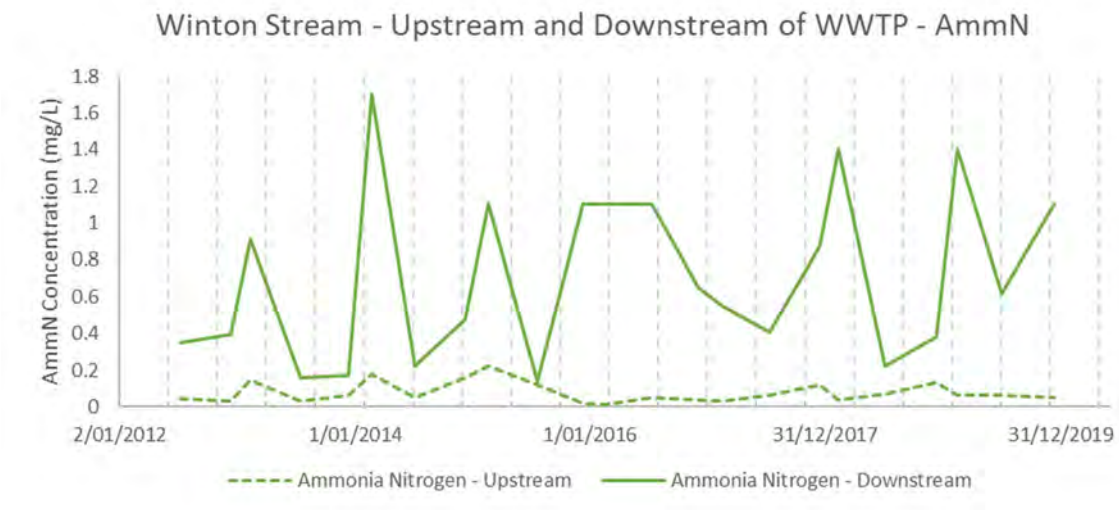

Figure 10: Winton Stream – Ammoniacal Nitrogen Concentration

The NPS for Freshwater Management 2014 (updated 2017) National Bottom Line for ammoniacal nitrogen in freshwater rivers is an annual median of 1.3 mg/L, and an annual maximum of 2.2 mg/L.

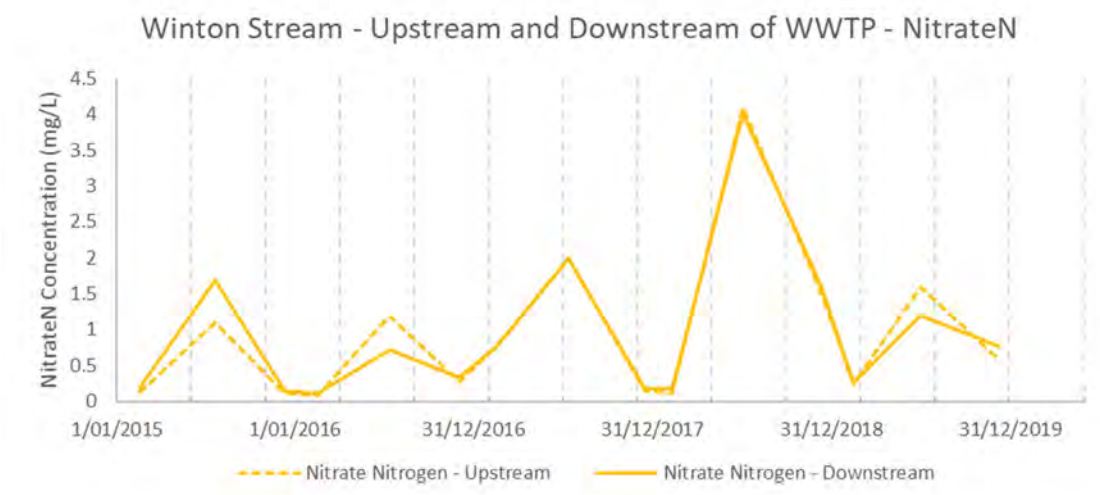

Figure 11: Winton Stream - Nitrate Nitrogen Concentration

The NPS for Freshwater Management 2014 (updated 2017) National Bottom Line for nitrate nitrogen in freshwater rivers is an annual median of 6.9 mg/L, and an annual maximum of 9.8 mg/L.

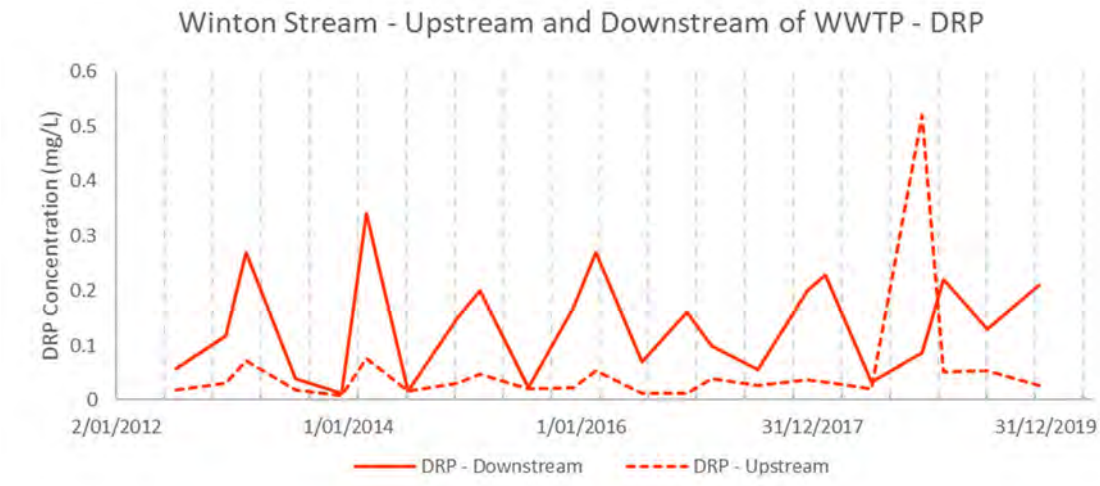

Figure 12: Winton Stream – Dissolved Reactive Phosphorus (DRP) Concentration

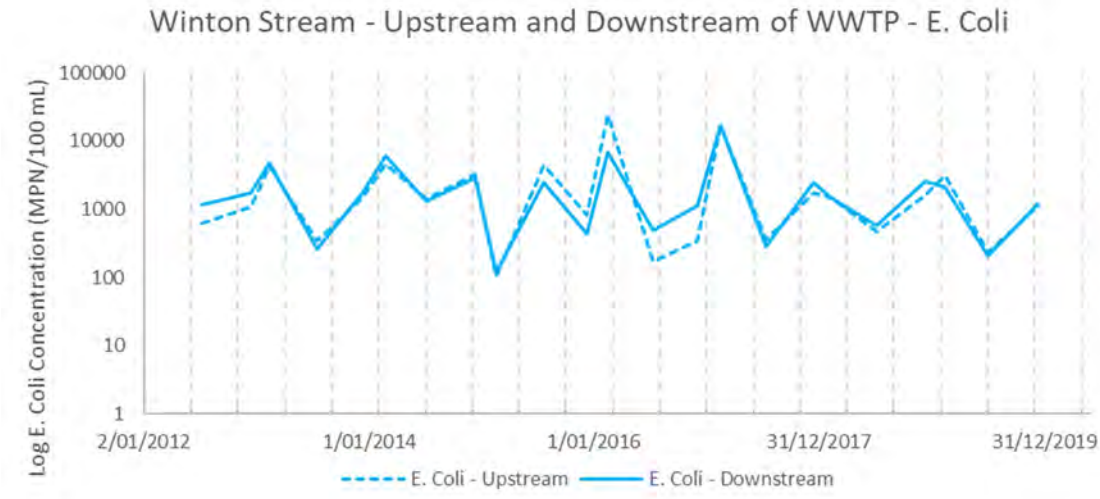

Figure 13: Winton Stream - E. Coli Concentration

Observations noted:

- Ammoniacal-nitrogen (AmmN) concentrations are generally stable around 0.1 mg/L upstream of the WWTP, and fluctuate between 0.2 mg/L and 1.8 mg/L downstream of the WWTP
- Dissolved reactive phosphorus (DRP) concentrations are generally stable around 0.05 mg/L upstream of the WWTP, and fluctuate between 0.1 mg/L and 0.3 mg/L downstream of the WWTP
- E. Coli concentrations fluctuate between 100 MPN/100 mL to 5000 MPN/100 mL upstream and downstream of the WWTP
- AmmN and DRP concentrations are generally significantly higher downstream of the WWTP
- AmmN, DRP and E. Coli concentrations upstream and downstream of the WWTP spike in summer months (February)
- There are a few significant spikes in upstream DRP and E. Coli concentrations.
- Flow record of the Winton Stream have not been provided in the dataset.

Environmental Effects Review

The most recent Environment Effects Review completed under the discharge permit was undertaken in 2017. 10 samples of the WWTP discharge and receiving waters were taken between 20/01/2017 and 24/03/2017.

The contaminant concentrations recorded as part of the Environmental Effects Review at the Winton WWTP discharge, and in the receiving waters upstream and downstream of the plant, were found to be similar to the concentrations identified in the discharge permit monitoring. The contaminant concentrations are shown in Figure 14 to Figure 18.

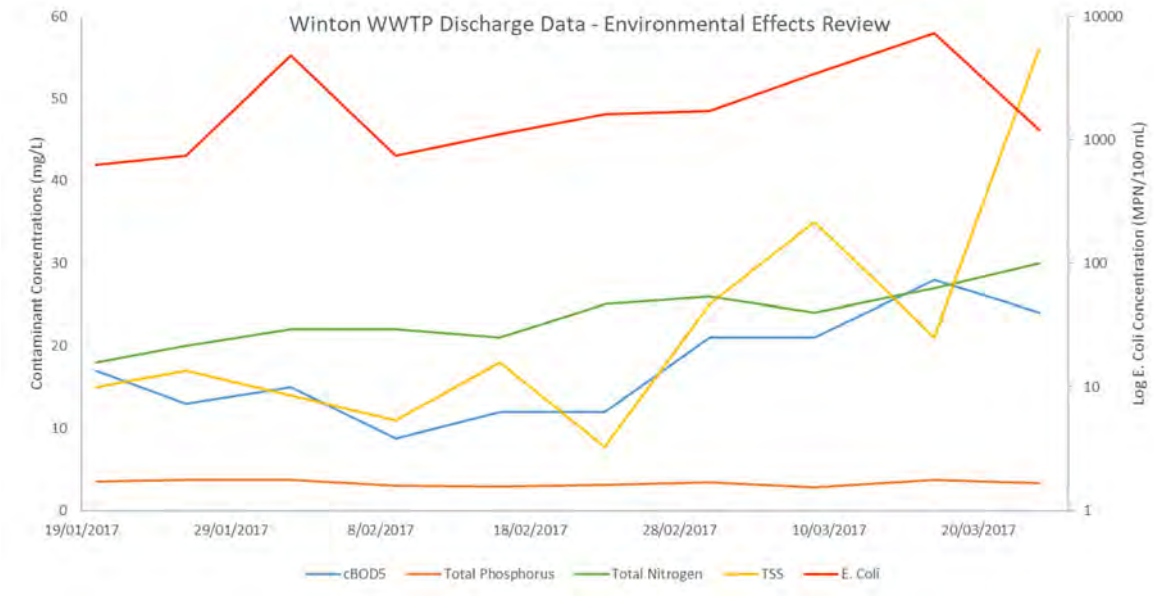

Figure 14: Winton WWTP Discharge – Environmental Effects Review - Key Quality Parameters (Southland District Council, 2017)

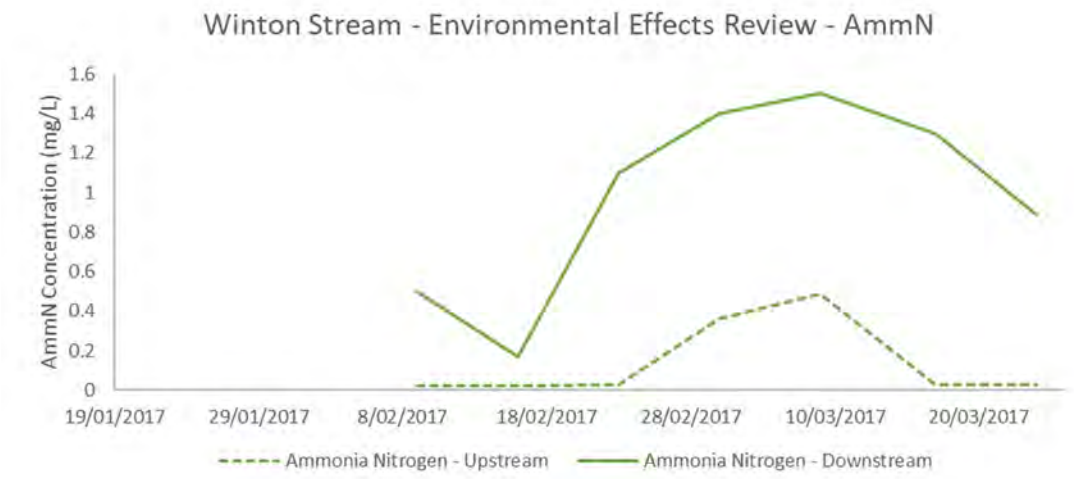

Figure 15: Winton Stream – Environmental Effects Review – AmmN Concentration (Southland District Council, 2017)

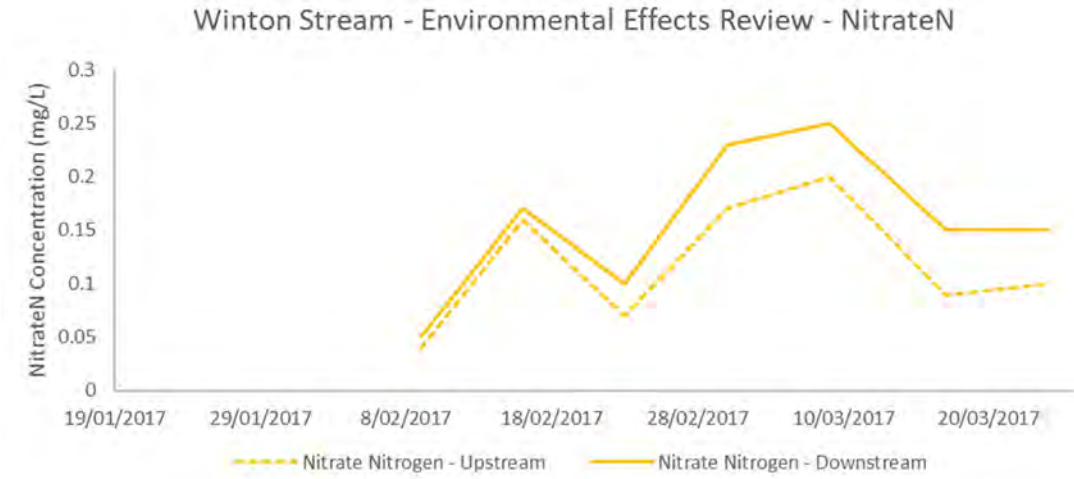

Figure 16: Winton Stream - Environmental Effects Review - NitrateN Concentration (Southland District Council, 2017)

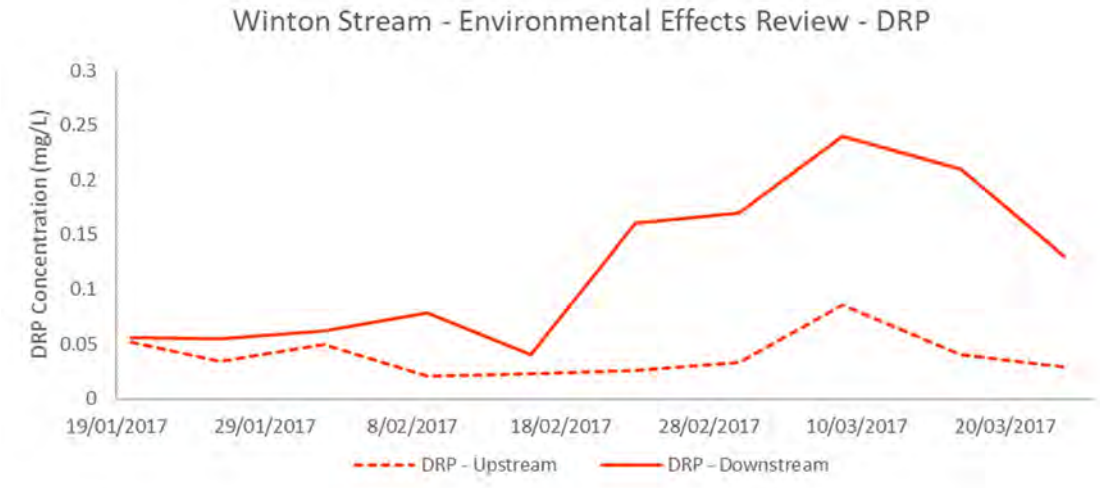

Figure 17: Winton Stream - Environmental Effects Review - DRP Concentration (Southland District Council, 2017)

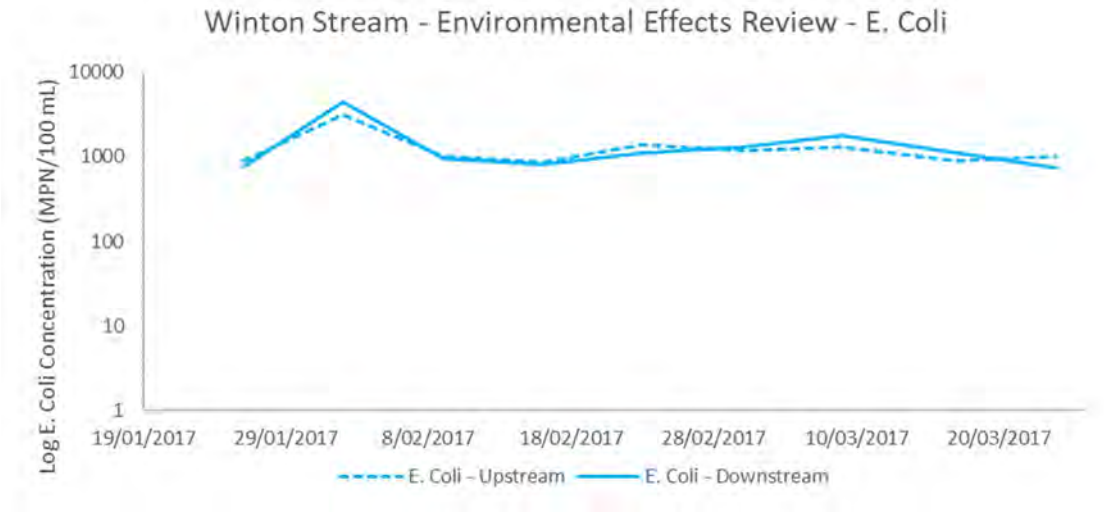

Figure 18: Winton Stream - Environmental Effects Review - E. Coli Concentration (Southland District Council, 2017)

The Environmental Effects Review confirmed the following about the performance of the WWTP (Southland District Council, 2017):

- There is significant infiltration to the wastewater network in rain events.
- There is elevated Ammonia Nitrogen concentrations in the WWTP discharge, and in the Winton Stream, which is occasionally non-compliant with discharge permit conditions.
- There is insufficient mixing in the Winton Stream before the downstream measurement point, 100 m downstream of the discharge.

A biomonitoring assessment completed by Ryder Consulting Ltd included in the 2017 Environmental Effects Review concluded that the discharge from the WWTP was not affecting biological communities in Winton Stream, except for minor effects on periphyton communities, and that in general, the water quality in the Winton Stream was compliant with 'lowland hard bed' standards specified by Environment Southland (Ryder Consulting Ltd, 2017).

3.4 Existing Treatment Plant

3.4.1 Overall Description

Winton WWTP is located on the outskirts of the Winton township. Wastewater from the primarily gravity network drains to a pump station in Dejoux Road, where it passes through a bar screen, before being pumped to the WWTP. The existing treatment processes at the plant include:

- Inlet screen and screenings compactor
- Oxidation pond, with two 3kW Reliant Lagoon Masters mechanical aerators
- Wetland with 6 cells
- Buried discharge pipes from each wetland cell to the Winton Stream

There is also a decommissioned clarifier and drying beds on site.

The layout of the Winton WWTP is shown in Figure 19.

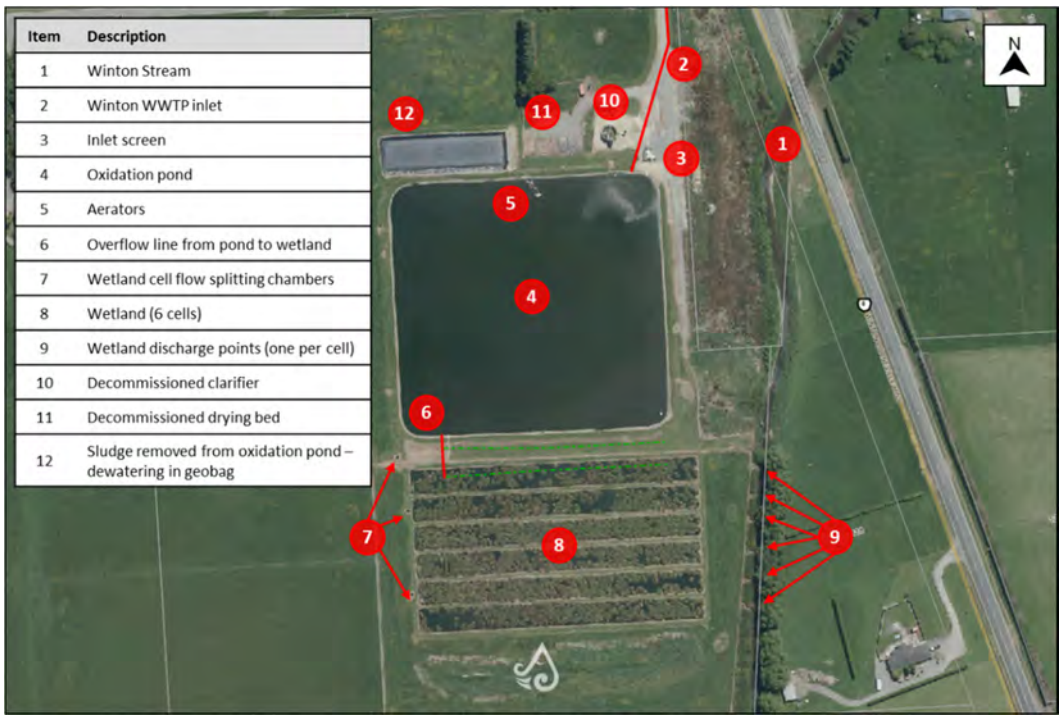

Figure 19: Winton WWTP Layout

3.4.2 Desktop Assessment

Inlet Screen

Influent to the Winton WWTP is screened through a *Johnson Screens* SC7T Screen Compactor. Solids from the influent wastewater build up on the screen, raising the water level in the inlet channel.

The inlet screen was installed in 2015, and has an expected design life of approximately 20 years. The screen mesh has 3mm dia perforations. Brickhouse Technologies, who supplied the screen, have confirmed that the maximum rated capacity of the screen is 100 l/s.

SDC has confirmed that the Dejoux Road pump station has three fixed speed pumps installed, delivering a peak flow of approximately 75 l/s.

Screenings Management

Solids removed by the inlet screen are further dewatered using a *NOGGERATH* Nogwash 250/650E screw wash press. This press can increase the dry matter content of screenings by up to 50%, and reduce the screenings weight and volume and can process up to 3.8 m³/hr of screenings.

Oxidation Pond

Following screening, wastewater enters the oxidation pond, through an inlet pipe in the northeastern corner of the pond, as shown in Figure 20. The oxidation pond inlet is “T” shaped to help reducing flow short circuiting.

Figure 20 : Winton WWTP Oxidation Pond

The oxidation pond was constructed in 1962. The pond is a conventional clay-lined aerobic pond, fitted with a concrete wave band. Pond dimensions are provided in Table 8.

Table 8: Winton WWTP Oxidation Pond Dimensions

Dimension	Value	Source
Width (m)	135	Winton WWTP O&M Manual
Length (m)	145	Winton WWTP O&M Manual
Surface area (ha)	1.96	Winton WWTP O&M Manual
Depth (m)	1.15	Review of Winton Sewage Treatment (SDC, 1993)
Top Water Level (TWL) (m RL)	45.30	New Winton Wetland System tender drawing set

No as-built drawings have been provided for the oxidation pond. Assuming the pond batters are sloped at a grade of 1 in 3, and the depth value provided in the 1993 Review of Winton Sewage Treatment refers to the depth of the pond from the base to the design TWL, the total pond volume is around 22,000 m³.

In the absence of a current sludge survey, a sludge depth of 0.3 metre has been assumed. The hydraulic retention time of the pond is approximately 15 days, which is at the lower end of typical oxidation pond retention time of 20 to 30 days. The oxidation pond was last de-sludged in 2016.

Two 3kW Reliant Lagoon Master mechanical aerators are installed in the pond to assist with aerobic digestion. The aerators are located on opposite sides of the pond from each other. These aerators were installed in 2015.

Table 9: Winton WWTP Oxidation Pond Capacity

Parameter	Value	Assumptions
Influent $cBOD_5$ (kg/day)	158	See Table 3
Oxidation pond mid-depth area (ha)	1.91	Assuming sludge depth of 0.3, and pond batter grade of 1 in 3
Current pond loading rate (kg/ha/day)	83	Excluding effect of surface aerators
Typical Design loading rate (kg/ha/day as $cBOD_5$)	84 60	Ministry of Works 1974 design guideline – conservative US EPA 2011 guideline for cooler temperature
Loading Rate Assessment	Current loading seems to be within typical design guidelines, applicable for cooler climate.	
Effect of Surface Aerators		
Oxidation pond treatment capacity (kg $cBOD_5$/day) – MoW guideline	160	Estimated by MoW design guideline and pond surface area
Oxidation pond treatment capacity (kg $cBOD_5$/day) – USEPA guideline	114	Estimated by MoW design guideline and pond surface area
Aerators installed (kW)	6	2 x 3kW aerators installed in pond
Aerator efficiency (kg O_2/kW-hr)	1.5	Assumed aerator efficiency
Additional capacity by surface aerators (kgO_2/day)	216	Two units running 24/7
Oxygen requirements (kg O_2/kg $cBOD_5$)	1.3	
Equivalent additional cBOD5 capacity by aerators (kg $cBOD_5$/day)	166	
Mixing Energy by aerators (W/m^3)	0.27	<1W/m^3, not highly turbulent to affect pond natural operation

As per Table 9 above, the Winton WWTP oxidation pond should be of sufficient capacity in summer, and require moderate use of aerators to assist capacity in winter.

During normal operation, the treatment capacity of the oxidation pond is not sufficient to reduce ammoniacal nitrogen to consistently compliant levels. Ammoniacal nitrogen is typically reduced to concentrations of around 15 mg/L in a facultative pond, and 5 mg/L following wetland treatment (Walmsley, 2018). The median ammoniacal nitrogen concentration in the Winton WWTP discharge is 25 mg/L which is significantly higher, and likely to be attributed to the cooler temperature, lower biological activity in the pond and the relatively short retention time in wetland.

The pond is shallower than typical facultative ponds (~1.3 to 1.5 metres), and may be more prone to surface “freeze-over” during winter, further reducing its capacity. The high inflow and infiltration can also impact the pond and wetland performance by significantly reducing its retention time, for instance, the estimated pond retention time is reduced from 15 to 9 days at 95%tile flow of 1900 m^3/day.

Wetland Cells

The final treatment process at Winton WWTP is the wetland. The wetland comprises of 6 cells, which are installed in parallel. Effluent from the oxidation pond is drained to the wetland through a submerged outlet. There are three flow splitting chambers to divide inflows equally between the cells. Each cell discharges to the Winton Stream through a separate outlet manhole and discharge pipe, as shown in Figure 21.

Figure 21: Winton WWTP Wetland

The wetland was constructed in 2004/2005. Each cell is shallow, and planted with rush species to promote settling, and support biofilm growth. Wetland cell dimensions are provided in Table 10.

Table 10: Winton WWTP Wetland Dimensions

Dimension	Value	Source
Cell length (m)	155*	Winton WWTP O&M Manual
Cell width (m)	10*	Winton WWTP O&M Manual
Wetland TWL (m RL)	44.4	New Winton Wetland System tender drawing set
Wetland Base Level (m RL)	44.1	New Winton Wetland System tender drawing set
Wetland Top of Bund Level (m RL)	44.75	New Winton Wetland System tender drawing set
Cell depth (m)	0.3	New Winton Wetland System tender drawing set
Freeboard depth (m)	0.35	New Winton Wetland System tender drawing set

*Note: the wetland tender drawing set provided by SDC notes the dimensions of each wetland cell as 160 m x 14 m.

Based on the tender design drawings, the cell batters are approximately sloped at a grade of 1 in 3, resulting in a total wetland volume of around 2,700 m³. The hydraulic retention time in the wetland cells is approximately 2 days, excluding any provision of sludge accumulation.

The shallow wetland depth, and short hydraulic retention time of effluent means the wetland cells will provide less treatment than the oxidation pond.

The wetland has similar operational issues to the oxidation pond in storm events. High inflows during those periods will significantly shorten contact time hence reducing any polishing effect by the wetland plantation.

Sludge Management

There is no formal sludge management or treatment process at the WWTP. Sludge was removed from the oxidation pond during the last desludging operation in 2016 and is currently being dewatered on site, through storage in a large geobag.

It is understood that the wetland cells have not been de-sludged since its first operation in 2004/5.

3.5 Plant Assessment Summary

A summary table of the process units and key issues is provided in Table 11.

Table 11: Plant Assessment Summary

Process Unit	Key Issues
Upstream wastewater network	• Infiltration issues reduces retention time in pond and wetlands, likely resulting deterioration in plant performance. • High inflow and infiltration issues lead to discharge permit non-compliances from high average inflows (ProjectMax undertaking I&I assessment programme in 2020)
Inlet screen	• No issue, the screen capacity seems to be sufficient for peak pumping rate to the plant.
Oxidation pond	• Pond has a shallower depth and shorter retention time compared with typical design guidelines. Surface aerators provide supplementary aeration to the pond to assist treatment performance. • Pond performance may also be impacted during storm flow events, e.g. retention time is reduced from 15 days to 9 days (at 1900m³/day, 90th percentile flow).
Wetland	• Wetland contact time is relatively short, approximately 2 days (assuming minimal sludge accumulation). It is likely to provide minor polishing of the pond effluent prior to discharge. • Wetland cells have not been desludged, and may require a sludge survey to quantify the current sludge accumulation level.
Sludge management	• No formal sludge management process • Dewatering removed sludge using geobags.
Stream discharge	• Issues with mixing have been reported in 2017 WWTP review (Southland District Council, 2017)

4. Receiving Environment

4.1 Water Quality – Winton Stream

Winton WWTP discharges treated effluent to Winton stream, downstream of the Winton township. There is an individual effluent discharge point to the stream from each wetland cell (refer Figure 21).

Winton stream is a major tributary to the Oreti river, which drains a catchment of around 1,102 km². The stream flows south from Benmore to Winton, and joins the Oreti river downstream of Winton, by Northope. The Winton stream catchment is predominantly agricultural and urban areas, with minor industry. The Winton stream and Oreti river catchment is shown in Figure 22.

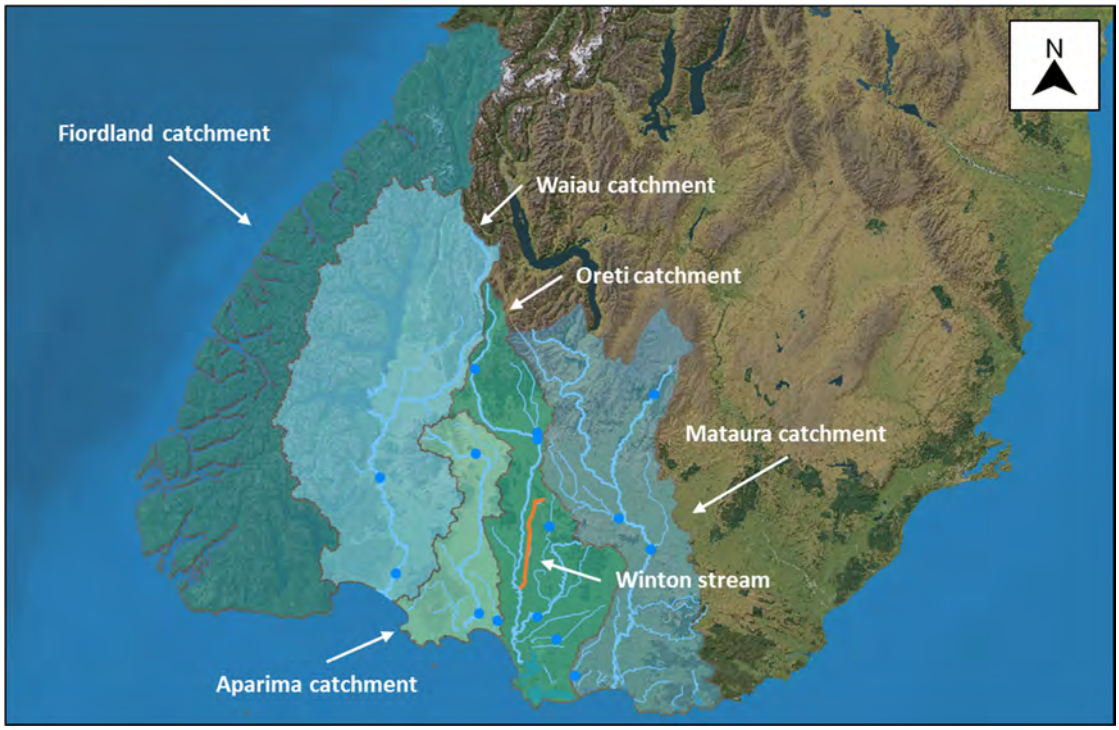

Figure 22: Southland rivers and catchments, from Environment Southland

There is a Land Air Water Aotearoa (LAWA) station, monitoring the water quality of Winton stream at Lochiel, downstream of the Winton WWTP. Monitoring data from the LAWA station indicates that the water quality in the Winton stream is very poor. Winton stream is in the worst 25% of all LAWA sites nationwide for the following parameters:

- E. Coli
- Clarity (black disc and turbidity)
- Nitrogen (total nitrogen, total oxidised nitrogen and ammoniacal nitrogen)
- Phosphorus (dissolved reactive phosphorus and total phosphorous)

LAWA monitoring data over the previous 5 years indicates that E. Coli and clarity median values are likely improving, and that nitrogen and phosphorous median concentrations are likely degrading (Land Air Water Aotearoa, 2020).

Sampling completed by Environment Southland confirms that the Winton stream has poor performance against E. Coli, nitrate toxicity, macroinvertebrates and slime algae (periphyton) performance measures (Environment Southland, 2015). Winton stream was also reported by Environment Southland as having the worst water quality index in the Southland region, based

on nitrate-nitrite-nitrogen, dissolved reactive phosphorus, faecal coliforms concentrations, and clarity (Environment Southland and Te Ao Marama Inc, 2010).

As outlined in Section 3.3.2, a biomonitoring assessment completed by Ryder Consulting Ltd concluded that the discharge from the WWTP was not significantly affecting biological communities in Winton Stream, and that in general, the water quality in the Winton Stream was compliant with 'lowland hard bed' standards specified by Environment Southland (Ryder Consulting Ltd, 2017).

4.2 Climate

Winton has a temperate climate, with a mean annual temperature of 9.9°C. The warmest month is January with an average daily temperature of 14.5°C. The coldest month is July, with an average daily temperature of 4.8°C.

The average annual rainfall in Winton is 959 mm. Winton receives more rainfall in summer than in winter, with the driest month being July, with an average rainfall of 63 mm, and the wettest month being January, with an average rainfall of 101 mm. On average, there are 175 days per year in Winton with over 1 mm of rainfall is recorded (NIWA, 2013).

4.3 Land Use

Winton WWTP is located within two land parcels, designated as a public utility within the Southland District Plan. The underlying zone of the WWTP and surrounding parcels is rural.

Winton township, WWTP and the surrounding rural area is designated as subject to potential flooding, as per Figure 23.

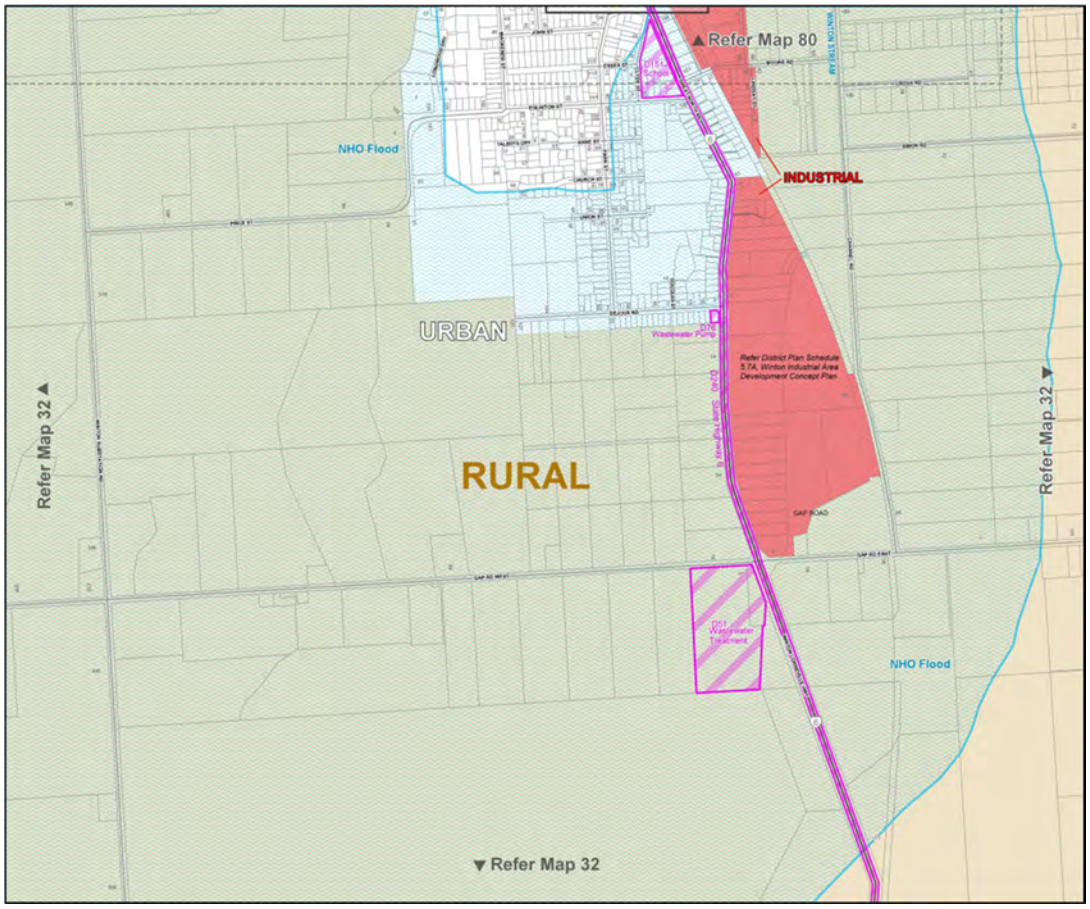

Figure 23: Winton Urban Zone, Southland District Plan

5. Information Gaps

5.1 WWTP Information Gaps

The current information gaps in the Winton WWTP assessment are provided in Table 12.

Table 12: Information Gaps in WWTP Assessment

Information Gap Identified	Recommended Action
Upstream pump station pump hours and instantaneous / hourly flow rates	O&M manual notes that Magflow meter in upstream PS records hourly flow, SDC to provide data to confirm screen capacity. SDC to confirm calibration of upstream pump station flowmeter
Influent and interstage sampling data, including flow, contaminant concentrations	Small domestic catchment, influent concentration parameters can be assumed, then verified during spring/summer when infiltration issue is less.
Sludge depth in oxidation pond and wetland	SDC to confirm, for future planning of pond/wetland decommissioning
WWTP discharge flow data	To be verified at site visit to see if a weir or a magflow meter can be installed to measure plant outflow.
Winton Stream flow data	Part of ongoing liaison with ES about this data
As-built drawings for plant, including full dimensions of oxidation pond and wetland, and details of stream discharge	SDC to confirm if available

5.2 Proposed Sampling Regime

Additional sampling is proposed to be undertaken to provide more detailed information on the WWTP effluent quality, and impact on receiving environment. The sampling is proposed to be undertaken at the WWTP discharge point, and upstream and downstream of the discharge point, at the same locations as the resource consent monitoring. Collection of pond outlet samples at a lower frequency is suggested to establish any correlation between pond effluent and wetland outlet samples, particularly for suspended solids and nutrients.

Recent communication with ES indicated that metal sampling in the receiving water is to be included.

Table 13: Information Gaps in WWTP Assessment

Parameters	Pond outlet	Wetland outlet	Discharge upstream	Discharge downstream
TSS	✓	✓	✓	✓
$cBOD_5$	✓	✓	✓	✓
Ammoniacal nitrogen	✓	✓	✓	✓
Nitrate-nitrogen	✓	✓	✓	✓
Nitrite-nitrogen	✓	✓	✓	✓
Total Kjeldahl nitrogen	✓	✓	✓	✓
Dissolved reactive phosphorus	✓	✓	✓	✓
Total phosphorus	✓	✓	✓	✓
E. Coli	✓	✓	✓	✓
Conductivity	--	✓	✓	✓
pH	--	✓	✓	✓
Temperature	--	✓	✓	✓
Dissolved oxygen	--	✓	✓	✓
Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg	--	✓	✓	✓
Flows	✓ (plant flow)		✓ (stream flow)	
Sampling Period	20 weeks			
Sampling Frequency	Monthly	Fortnightly		
Number of samples	5	10	10	10

6. Draft Design Basis for Options Assessment

This section describes the proposed basis of design to be adopted for the next phase of options assessment (Phase 2).

6.1 Design Wastewater Flows and Loads

The proposed design wastewater flow and loads for the Winton WWTP are summarised in Table 14.

Table 14: Winton WWTP Design Basis

Design Wastewater Parameter	Current Load*	Future Load*
Population	2250	2680
AAF (m^3/day)	1102	1313***
MDF (m^3/day)	4968	5918***
$cBOD_5$ (kg/day)**	158	188
TSS (kg/day)**	158	188
TKN (kg/day)**	34	40
TP (kg/day)**	7	8

*Current load is based on Winton population in 2013 of 2,250 people. Future load is based on 2043 population of 2,680 people.

**Contaminant loadings based on assumed influent concentrations, as per Table 3.

***Wastewater flow estimates are based on linear extrapolation of population figures.

It is understood that SDC may consider permitting septic tank trucks to discharge in the upgraded Winton WWTP. The potential impact on specific upgrade options will be investigated during Phase 2.

6.2 Proposed Discharge Standards

A summary of the proposed discharge standards for Winton WWTP is provided in Table 15 and Table 16. The proposed discharge standards have been split into standards for disposal to water (Winton Stream) and disposal to land. The disposal to land may include a mechanism to permit excess flows to be discharged to the Winton Stream, when the land irrigation system is unavailable and pond/irrigation storage is exhausted.

The proposed limits have been developed based on recent WWTP consenting projects, and are subject to revision by detailed environmental and ecological assessments.

Table 15: Proposed Discharge Standards - Disposal to Water

Parameter	Current consent	Proposed discharge limit			Current WWTP Performance		
		Median	95%ile	Range	Median	95%ile	Range
pH	6 - 9	-	-	6 - 9	-	-	Not measured
$cBOD_5$ (mg/L)	-	5	15	-	16	24	-
TSS (mg/L)	-	5	25	-	25	74	-
TP (mg/L)	-	2	5	-	4	5	-
TN (mg/L)	-	10	20	-	21	34	-
Ammoniacal nitrogen (mg/L)	-	3	10	-	15	25	-
E. coli (cfu/100 mL)	-	150	2000	-	1,150	28,593	-

*Based on effluent monitoring data from 09/07/2012 to 10/12/2019, completed as part of resource consent

Table 16: Proposed Discharge Standards - Disposal to Land

Parameter	Current consent	Proposed discharge limit			Current WWTP Performance to Water		
		Median	95%ile	Range	Median	95%ile	Range
pH	6 - 9	-	-	6 - 9	-	-	Not measured
$cBOD_5$ (mg/L)	-	20	30	-	16	24	-
TSS (mg/L)	-	20	30	-	25	74	-
TP (mg/L)	-	4*	5*	-	4*	5	-
TN (mg/L)	-	20*	35*	-	21*	34	-
Ammoniacal nitrogen (mg/L)	-	15*	25*	-	15*	25	-
E. coli (cfu/100 mL)	-	150	2000	-	1,150	28,593	-
Nitrogen loading rate on land (kg/ha/year)		150					

** Additional samples to be collected to understand the correlation between pond effluent quality and the wetland outlet (the current plant discharge sample point).*

It is expected that the current processes at the Winton WWTP will not produce effluent of a sufficient quality to meet future discharge standards, for either water or land disposal.

7. Draft Long List Options

A draft long list of options for upgrades to the Winton WWTP is provided in Table 17, Table 18 and Table 19. The upgrade options have been split into disposal to water, disposal to land, and system reconfiguration.

Table 17: Upgrade options long list - disposal to water

Option Theme (to water)	Option Description
Optimisation	• Treatment performance of existing WWTP is enhanced through additional aeration, desludging regime, addition of chemicals or baffle curtain to oxidation pond • Retain existing stream disposal
Add-on treatment	• Additional treatment processes for ammonia and DRP removal (activated sludge treatment, extended aeration) • Retain existing stream disposal
Tertiary treatment	• Additional disinfection process after wetland (UV, membrane filtration) • Retain existing stream disposal
New WWTP at the current location	• Winton pond is replaced with a new treatment process, likely high rate process

Table 18: Upgrade options long list - disposal to land

Option Theme (to land)	Description
Status quo	• Minimal change to treatment process at Winton WWTP • Liquid effluent from wetland pumped to irrigation system
Tertiary treatment	• Additional disinfection process after wetland (UV, membrane filtration) • Liquid effluent from wetland pumped through disinfection unit, then to irrigation system

Table 19: Upgrade options long list - system reconfiguration

Option Theme (system reconfiguration)	Description
Plant relocation and discharge to land	• Winton WWTP is decommissioned and relocated to area in close proximity to suitable land disposal fields
Pump wastewater to Invercargill	• Wastewater from Winton is pumped to the Invercargill WWTP for treatment (approx. 35 km pipeline length)
Pump wastewater to Alliance Lorneville	• Wastewater from Winton is pumped to the Alliance Group plant in Lorneville for treatment (approx. 25 km pipeline length)

8. Summary and Conclusion

Winton WWTP is a small plant serving a predominantly domestic catchment in Southland, New Zealand. The treatment processes at the plant include an inlet screen, oxidation pond and a wetland. The plant discharges treated effluent to the Winton stream.

Data recorded from 2012 to 2019 as part of the existing resource consent requirements confirms that the performance of the WWTP is mostly compliant with the resource consent conditions, with occasional non-compliances in ammoniacal nitrogen concentrations (Table 6).

Flowmeter data from the terminal pump station to the WWTP (Dejoux Road) indicates that the average discharge from the plant is higher than the resource consent requirements. This is caused by significant inflow and infiltration issues in the wastewater network.

From the desktop capacity assessment, the oxidation pond requires the use of surface aerators to supplement treatment capacity particularly during winter months. Elevated ammoniacal nitrogen in the final effluent can be attributed to cooler climate (lower biological activity), shallow pond depth and relatively short retention time in pond and wetland cells. It is understood that the wetland cells have not been desludged since its initial operation in 2004/5, and sludge accumulation may impact the polishing effect by the wetlands.

Monitoring of the receiving waters also indicates that ammoniacal nitrogen concentrations and DRP concentrations in Winton stream are consistently higher downstream of the WWTP discharge. Additional sampling plan has been proposed to collect more information about the discharge and the impact on the receiving environment.

A draft long list of potential upgrade options has been presented, and the key option themes include continue with stream discharge, conversion into land disposal and relocation/pump to an external facility for treatment.

9. Next Steps

The draft long list has been presented at the Phase 1 workshop on 18th June, for discussion. The long list option has been accepted.

Following the workshop, the proposed next step is for GHD to confirm the long list of options for the WWTP upgrades, and facilitate a short list workshop to feed into a feasibility study and MCA for the upgrade options. The first step is to undertake a desktop identification of suitable land parcels for irrigation.

10. References

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GHD

Level 3, 138 Victoria Street
Christchurch Central, Canterbury, 8012
T: (03) 378 0900

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Appendix B – Planning Framework

High Level Summary of the Planning Framework, 15 June 2020

15 June 2020

Joe Findley
Project Manager
Southland District Council
15 Forth Street
Invercargill 9810

Our ref: 1252/8505/

Dear Joe,

Winton Wastewater Treatment Plant Upgrade
High Level Summary of the Planning Framework

This document provides a high level summary of the resource management planning framework that applies to the upgrade and consent renewal of the Winton Wastewater Treatment Plant.

1 Our understanding

Southland District Council (SDC) are seeking to upgrade the Winton Wastewater Treatment Plan (WWTP) and renew the associated discharge consent which is due to expire in June 2023 (Ref: 202026). Both options for discharge to water and to land are being explored. Phase 1 of the project involves a review of the existing system, network and consent.

2 Planning framework

Below is a summary of the overarching planning framework which will govern the renewal of the existing discharge consent. Both options of discharge to land and water have been considered. It is important to note that this is a very high level preliminary assessment that will need to be readdressed and updated as decisions are made about the design and method of the discharge.

2.1 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management (Freshwater NPS) applies to the management of fresh water through a framework that considers and recognises Te Mana o te Wai as an integral part of freshwater management. It directs the content that regional councils, in consultation with their communities, must include in their regional plans.

The Freshwater NPS is currently under review, with the new Freshwater NPS 2020 coming into force later this year. The new requirements will include:

- Managing freshwater in a way that 'gives effect' to Te Mana o te Wai through involvement of tangata whenua and communities to set long-term visions, and prioritising the health and wellbeing of waterbodies, then the essential needs of people, followed by other uses.
- A requirement to improve degraded water bodies, and maintain or improve all others using baselines defined in the NPS.

GHD Limited
Level 3 138 Victoria Street Christchurch Central 8013 PO Box 13468 Christchurch 8141 New Zealand
T 64 3 378 0900 **F** 64 9 370 8001 **E** chcmail@ghd.com **W** www.ghd.com

- Avoid any further loss or degradation of wetlands and streams, map existing wetlands and encourage their restoration.
- Identify and work towards target outcomes for fish abundance, diversity and passage and address in-stream barriers to fish passage over time.
- Set an aquatic life objective for fish and address in-stream barriers to fish passage over time.

The Freshwater NPS must be given effect to in regional policy statements, regional plans and district plans.

2.2 Southland Regional Policy Statement 2017

The Southland Regional Policy Statement 2017 (RPS) guides resource management policy and practice in Southland. It provides a framework on which to base decisions regarding the management of the region's natural and physical resources, gives an overview of the significant resource management issues facing Southland, including issues of significance to tangata whenua, and includes objectives, policies and methods to resolve any identified issues.

Policy WQUAL.2 seeks to maintain or improve water quality, having particular regard to nitrogen, phosphorus, sediment and microbiological contaminants.

Policy WQUAL.7 recognises the social, economic and cultural benefits that may be derived from the use, development or protection of water resources.

Policy WQUAL.8 provides a preference for the discharge of contaminants to land over discharges to water where a discharge to land is practicable and the adverse effects associated with a discharge to land are **less** than a discharge to water.

Policy WQUAL.9 seeks to **avoid** the direct discharge of sewage, wastewater, industrial and trade waste and agricultural effluent to water unless these discharges have undergone treatment.

Policy RURAL.4 seeks to avoid the irreversible loss of high value soils from productive use, through inappropriate subdivision, use and development.

2.3 Proposed Water and Land Plan

The Proposed Water and Land Plan (PWLP) provides direction and guidance regarding the sustainable use, development and protection of water and land resources in the Southland region.

Once fully operative, the PWLP will replace both the Regional Effluent Land Application Plan 1998 (RELAP) and Regional Water Plan (RWP). It is noted that several of the objectives and policies, and rules relating to discharges to water and land are **currently under appeal.** The relevant objectives, policies and rules within the PWLP are detailed in **Attachment 1**.

In summary, the objective and policy framework presents a strong preference for discharges to land over discharges to water**, unless adverse effects associated with a discharge to land are greater than a discharge to water**. **If discharging to surface water where water quality outcomes are not currently met, water quality beyond the zone of reasonable mixing must be improved, rather than just maintained, to assist with meeting those standards or sediment guidelines.**

Consent duration for discharges to water may also pose a barrier due to the proposed establishment of freshwater objectives and limits under Freshwater Management Units, which seek to improve water quality where it is degraded to the point where freshwater objectives are not being met and otherwise maintain water quality where freshwater objectives are being met. Council will have to consider whether granting a shorter or longer duration will better enable implementation of the revised frameworks established in those sections.

In terms of consenting requirements, discharge to land is a discretionary activity provided that:

- The discharge is not within 20 metres of a river, lake, artificial watercourse, modified watercourse, natural wetland or the coastal marine area;
- The discharge is not within 200 metres of any place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding; and
- The discharge is not within 100 metres of any authorised water abstraction point.

Any discharge to a surface waterbody is a non-complying activity, thus being held to a higher standard of scrutiny as it is subject to the s104D gateway test.

2.4 Regional Effluent Land Application Plan 1998

The Regional Effluent Land Application Plan 1998 (RELAP) controls the treatment and discharge of effluent and sludge within the Southland Region.

The objectives, policies and rules within the RELAP will be replaced by the Proposed Southland Water and Land Plan (PSWLP) once operative. The relevant objectives, policies and rules within the RELAP are detailed in **Attachment 2**.

Generally, the RELAP seeks to utilise land treatment of effluent and sludge where this can be undertaken in a sustainable manner and without significant adverse effects. The policy framework also requires recognition and provision for takata whenua concerns related to the discharge to land. Under the RELAP the discharge of effluent onto or into land from a community sewage scheme is a discretionary activity.

2.5 Regional Plan Water 2010

The purpose of the RWP is to promote the sustainable management of Southland's rivers, lakes, groundwater, surface water, and wetland resources. The plan is aimed at enabling the use and development of fresh water where this can be undertaken in a sustainable way, providing a framework for activities, such as discharges to water, taking and using water, and structures and bed disturbance activities in river beds.

The objectives, policies and rules within the RWP will be replaced by the PSWLP once operative. The relevant objectives, policies and rules of the RWP are detailed in **Attachment 3**.

In summary the objectives and policies of the RWP show a preference for discharges to land over discharges to water where this is practicable and the effects are less adverse. Discharges to water shall not result in a reduction in water quality, unless consistent with Part 2 of the Act. When discharging to water there is a preference for discharges to water at times of high flow over discharges at normal or low flows. Where discharging to land, the level of management required should be equivalent to the level of environmental risk.

In terms of consenting requirements, discharges to surface water bodies that meet water quality standards are a discretionary activity, and where water quality standards are not met (see Appendix G “Water Quality Standards), the discharge is a non-complying activity thus being held to a higher standard of scrutiny as it is subject to the s104D gateway test.

2.6 Te Tangi a Tauira – The Cry of the People

The Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan 2008 reflects the attitudes and values of the four Rūnanga Papatipu o Murihiku – Awarua, Hokonui, Oraka/Aparima and Waihōpai. This Iwi Management Plan (IMP) is written as a statement that consolidates Ngāi Tahu ki

Murihiku values, knowledge and perspectives on natural resource and environmental management issues. It is an expression of kaitiakitanga.

The IMP provides a strong framework for avoiding discharges of wastewater to water due to adverse effects on cultural values. Where it is not feasible to avoid discharge to water, then adverse effects must mitigated through treatment to a very high standard and robust monitoring programs. This is summarised as follows:

"Our bottom line is to avoid discharge of wastewater (e.g. sewage and stormwater) to water, as such activities have adverse effects on cultural values such as mauri, wairua, mahinga kai and wāhi tapu. Our preference is for wastewater to be treated to remove contaminants, and then discharged to land via wetlands and riparian areas, to allow Papatūānuku to provide a natural filter for waste. Where this is not practical or feasible, and discharge to water is proposed, then adverse effects must be mitigated through treatment to a very high standard and robust monitoring programs. Ngāi Tahu ki Murihiku will always look for the most culturally, environmentally, socially and economically appropriate option for a particular site".

It is recommended that engagement with iwi occurs early in the process and that a cultural impact assessment is undertaken.

2.7 Southland District Plan

The Southland District Plan ('District Plan') outlines how Council will manage land use in the Southland District. The site is designated under the District Plan (ref D51) for public utility purposes and there are no conditions attached to the designation. The surrounding area is zoned Rural and subject to a Flood Hazard Overlay.

If land disposal is required there are two options to be considered. The first is to designate the land via a Notice of Requirement process, and the second is to seek resource consent for the activity, which is likely to be a discretionary activity.

3 Pre Application Discussion with Environment Southland

A high level pre application discussion was held with Environment Southland (ES) on Friday 5 June 2020. This was followed up via email on 10 June 2020. As part of this discussion we sought guidance from ES as to their expectations regarding discharge quality if discharge to land is not possible. ES did not provide any direct commentary on the required water quality but did provide the following comments:

- *"I consider the receiving environment to be the biggest limiting factor.*
- *Land disposal in this locality would be challenging, noting much of the periphery of Winton is flood prone and the water table is quite high in this area.*
- *The dilution available in the Winton Stream during summer is small. I haven't seen the monitoring data, but I would suspect that any tightening of conditions would be difficult.*
- *There is growth around the margins of Winton Township. I don't know how much capacity there is, during summer conditions, for increases in volume and contaminant load.*
- *Due to the physical nature of the Winton Stream (shallow, dark bed), it tends to heat up during summer, particularly at Thomsons Crossing a few km downstream of the discharge. Warm water can hold less oxygen. So BOD load and downstream DO sag may be significant issues for the wastewater discharge if it is to continue. They may need to think of measures to mitigate the effects that involve direct manipulation of the stream (e.g. riparian plantings, enhancement of low flows with groundwater)*
- *The Winton Stream is upstream of the Invercargill City water supply take. So emerging contaminants, such as antibiotics and hormones, from medication use may be an issue.*

- *Like all the SDCs sewage systems, there will be flow fluctuations during rainfall events due to increased drainage and stormwater inflows to the sewerage network.*
- *There is light industry in Winton, so I would expect the AEE to look at metals and organics in addition to the usual (BOD, pH, TSS, E.coli and nutrients)*
- *If the wastewater is piped to the Oreti River to achieve greater dilution it will directly affect a statutory acknowledgement area, and it will still be upstream of the Invercargill City and Alliance Group Ltd's water takes, so there may be more opposition to it.*
- *The land in the vicinity is high value, so land discharge will be expensive.*
- *It will be difficult to site a land disposal system without considering effects on groundwater users in the vicinity. Possibly issues with amenity values also.*
- *The current wastewater treatment system is primarily designed to reduce BOD, E. coli, suspended solids (via the pond treatment) and spiritual concerns (via the wetland treatment). Other contaminants, such as some forms of nutrients, are incidentally removed to a degree with the sediment reduction. Some will pass through, but maybe in a different form. For example ammoniacal nitrogen will tend to be oxidised to nitrate nitrogen, going from a potentially toxic form for fish to one that will increase instream weed growth."*

On the basis of these comments and our analysis of the objective and policy framework above, a very robust alternatives assessment will need to be prepared in support of any application. We recommend setting up a spreadsheet that can record dialogue and options from this early stage through to confirmation of a preferred option.

4 Summary

The high level resource management planning framework provides a clear preference for discharges to land over water. **Discharges to water should only occur where the adverse effects of the discharge to water are lesser than those of a discharge to land**. There is also a move away from the maintenance of water quality, to requiring an **improvement in water quality**, where degradation of water quality has occurred.

The regional planning framework in terms of objectives, policies and rules, provides a strong preference for discharge to land.

Kind regards
GHD Limited

Sarah White
Environmental Planner
03 363 0825

Amy Callaghan
Technical Lead - Planning

Attachment 1 – Relevant objectives, policies and rules of the PWLP

Table 1. Relevant objectives and policies of the PWLP

Note all of the policies listed below are currently under appeal

Objectives and policies
Policy 13 - Management of land use activities and discharges 1. Recognise that the use and development of Southland's land and water resources, including for primary production, enables people and communities to provide for their social, economic and cultural wellbeing. 2. Manage land use activities and discharges (point source and non-point source) to enable the achievement of Policies 15A, 15B and 15C.
Policy 14 – Preference for discharges to land Prefer discharges of contaminants to land over discharges of contaminants to water, unless adverse effects associated with a discharge to land are greater than a discharge to water. Particular regard shall be given to any adverse effects on cultural values associated with a discharge to water.
Policy 15A – Maintain water quality where standards are met Where existing water quality meets the Appendix E Water Quality Standards or bed sediments meet the Appendix C ANZECC sediment guidelines, maintain water quality including by: 1. Avoiding, remedying or mitigating the adverse effects of new discharges, so that beyond the zone of reasonable mixing, those standards or sediment guidelines will continue to be met; and 2. Requiring any application for replacement of an expiring discharge permit to demonstrate how the adverse effects of the discharge are avoided, remedied or mitigated, so that beyond the zone of reasonable mixing those standards or sediment guidelines will continue to be met.
Policy 15B – Improve water quality where standards are not met Where existing water quality does not meet the Appendix E Water Quality Standards or bed sediments do not meet the Appendix C ANZECC sediment guidelines, improve water quality including by: 1. Avoiding where practicable and otherwise remedying or mitigating any adverse effects of new discharges on water quality or sediment quality that would exacerbate the exceedance of those standards or sediment guidelines beyond the zone of reasonable mixing; and 2. Requiring any application for replacement of an expiring discharge permit to demonstrate how and by when adverse effects will be avoided where practicable and otherwise remedied or mitigated, so that beyond the zone of reasonable mixing water quality will be improved to assist with meeting those standards or sediment guidelines.
Policy 15C – Maintaining and improving water quality after FMU processes Following the establishment of freshwater objectives and limits under Freshwater Management Unit processes, and including through implementation of non-regulatory methods, improve water quality where it is degraded to the point where freshwater objectives are not being met and otherwise maintain water quality where freshwater objectives are being met.
Policy 17A – Community sewerage schemes and on-site wastewater systems 1. Minimise adverse effects on water quality, and avoid, remedy, or mitigate other adverse effects of the operation of, and discharges from, community sewerage schemes by:

a) designing, operating and maintaining community sewerage schemes in accordance with recognised industry standards; and

b) implementing measures to progressively reduce the frequency and volume of wet weather overflows from community sewerage schemes; and

c) ensuring community sewerage schemes are operated and maintained to minimise the likelihood of dry weather overflows occurring.

2. Avoid the discharge of untreated domestic wastewater to water or onto or into land; and avoid, remedy, or mitigate the adverse effects of discharges from on-site wastewater systems; by:

a) avoiding any surface run-off or overland flow, ponding, or contamination of water from the application of domestic wastewater to land; and

b) designing, locating and maintaining on-site wastewater systems in accordance with Sections 5 and 6 of the New Zealand Standard AS/NZS 1547:2012 On-site Domestic Wastewater Management.

Policy 40 – Determining the term of resource consents

When determining the term of a resource consent consideration will be given, but not limited, to:

1. granting a shorter duration than that sought by the applicant when there is uncertainty regarding the nature, scale, duration and frequency of adverse effects from the activity or the capacity of the resource;
2. relevant tangata whenua values and Ngāi Tahu indicators of health;
3. the duration sought by the applicant and reasons for the duration sought;
4. the permanence and economic life of any capital investment;
5. the desirability of applying a common expiry date for water permits that allocate water from the same resource or land use and discharges that may affect the quality of the same resource;
6. the applicant's compliance with the conditions of any previous resource consent, and the applicant's adoption, particularly voluntarily, of good management practices; and
7. the timing of development of FMU sections of this Plan, and whether granting a shorter or longer duration will better enable implementation of the revised frameworks established in those sections.

Table 2. Relevant rules of the PWLP

Note both rules are currently under appeal

Reference	Rule
Rule 33 – Community sewerage schemes (discharge to land)	*Under appeal* a) The discharge of effluent or bio-solids onto or into land, in circumstances where contaminants may enter water, from a community sewerage scheme is a **discretionary activity**, provided the following conditions are met: i) the discharge is not within 20 metres of a river, lake, artificial watercourse, modified watercourse, natural wetland or the coastal marine area; and

	ii) the discharge is not within 200 metres of any place of assembly or dwelling not on the same landholding, or 20 metres of the boundary of any other landholding; and iii) the discharge is not within 100 metres of any authorised water abstraction point. b) The discharge of effluent or bio-solids onto or into land, in circumstances where contaminants may enter water, from a community sewerage scheme that does not meet the conditions of Rule 33(a) is **a non-complying activity**.
Rule 33A – Community sewerage schemes (discharge to water)	*Under appeal* a) The discharge of effluent or bio-solids from a community sewerage scheme into water in a river, lake, artificial watercourse, modified watercourse or natural wetland is a **non-complying activity**.

Attachment 2 – Relevant objectives, policies and rule of the RELAP

Table 3. Relevant objectives and policies of the RELAP

Objectives and policies
Policy 4.2.2 - Discharge to land Utilise land treatment of effluent and sludge where this can be undertaken in a sustainable manner and without significant adverse effects.
Policy 4.2.3 - Avoid where practicable, remedy or mitigate adverse effects on water Avoid where practicable, remedy or mitigate adverse effects on water quality, water ecosystems and water potability from effluent and sludge discharges onto or into land
Policy 4.2.8 - Takata whenua Recognise and provide for takata whenua concerns related to the discharge of effluent and sludge onto or into land.

Table 4. Relevant rules under the RELAP

Number	Rule
Rule 5.2.1	The discharge of effluent onto or into land from a community sewage scheme is a **discretionary activity**.
Rule 5.3.2	The discharge of sludges onto or into land, other than those permitted under Rule 5.3.1 or non-complying under Rule 5.3.3 is a **discretionary activity**.
Rule 5.3.3	The discharge of sludge onto or into land is a **non complying activity** where the discharge takes place within: a) 100 metres of a residential dwelling other than residential dwellings on the property; b) 100 metres of any potable water abstraction point; c) 20 metres of any water body or wetlands listed in Appendix F, excluding aquifers; d) 20 metres of any coastal marine area.

Attachment 3 – Relevant objectives, policies and rule of the RWP

Table 5. Relevant objectives and policies of the RWP

Objectives and policies
Policy 3 – No reduction in water quality Notwithstanding any other policy or objective in this plan, allow no discharges to surface water bodies that will result in a reduction of water quality beyond the zone of reasonable mixing, unless it is consistent with the promotion of the sustainable management of natural and physical resources, as set out in Part 2 of the Resource Management Act 1991, to do so.
Policy 4 – Surface waterbodies outside Natural State Waters For surface water bodies outside Natural State Waters, manage point source and non-point source discharges to meet or exceed the water quality standards referred to in Rule 1 and specified in Appendix G "Water Quality Standards", unless it is consistent with the promotion of the sustainable management of natural and physical resources, as set out in Part 2 of the Resource Management Act 1991, to do so and so avoid levels of contaminants in water and sediments that could harm the health of humans, domestic animals including stock and/or aquatic life.
Policy 7 – Prefer discharges to land Prefer discharges to land over discharges to water where this is practicable and the effects are less adverse.
Policy 8 – Discharges to water Prefer point source discharges of contaminants to water at times of high flow over discharges at normal or low flows, and ensure that where discharging does take place at low flows, the effects that could not be practically avoided are minimised.
Policy 13 – Discharge of untreated effluent Avoid the point source discharge of raw sewage, foul water and untreated agricultural effluent to water.
Policy 25 – Adverse effects arising from point source and non-point source discharges To avoid, remedy or mitigate the adverse effects arising from point source and non-point source discharges so that there is no deterioration in groundwater quality after reasonable mixing, unless it is consistent with the promotion of the sustainable management of natural and physical resources, as set out in Part 2 of the Resource Management Act 1991, to do so.
Policy 31A – Matching discharges onto or into land to risk Match the level of management that is required for discharges of contaminants onto or into land to the level of environmental risk posed by the following risk factors: a) Nature and quantity of contaminants in the discharge b) Sloping land c) Soils with artificial drainage or coarse structures d) Soils with impeded drainage or low infiltration rates e) Well drained soils f) Climate

g) Proximity to groundwater h) Proximity to surface water i) Soil's current physical, chemical and biological characteristics and its potential to leach nutrients j) Natural hazards (for example, flooding and erosion).
Policy 31C – Manage discharges of contaminants onto or into land Manage discharges of contaminants onto or into land to avoid, remedy or mitigate adverse effects, including on: a) soil quality; b) amenity values; c) habitats, ecosystems and indigenous biological diversity; d) historic heritage, cultural and traditional values; e) natural character; f) outstanding natural features.

Table 6. Relevant rules of the RWP

Number	Rule
Rule 1 – Discharges to surface water bodies that meet water quality standards	Except as provided for elsewhere in this Plan or in any other Southland Regional Council regional plan, the discharge of any: a) contaminant or water into a surface water body; or b) contaminant onto or into land in circumstances where it may enter a surface water body is a **discretionary activity** provided the following condition is met: i) the discharge does not reduce the water quality below any standards set for the relevant water body in Appendix G "Water Quality Standards" after reasonable mixing.
Rule 2 – Discharges to surface water bodies that do not meet water quality standards	a) Except as provided for elsewhere in this Plan or in any other Southland Regional Council regional plan, the discharge of any: i) contaminant or water into a surface water body; or ii) contaminant onto or into land in circumstances where it may enter a surface water body that cannot meet the conditions in Rule 1 is a **non-complying activity**. b) Notwithstanding the provisions of Rules 1 and 2(a) of this Plan or any other Southland Regional Council regional plan, the discharge of biologically treated wastewater, treated to a minimum of secondary standard: i) into the main stem of the Makarewa River; or ii) onto or into land in circumstances where it may enter the main stem of the Makarewa River at any point downstream of the sheep bridge at or about Map Reference NZMS 260 E46:483:191 is a **discretionary activity**.

Rule 14 – Discharge of raw sewage, foul water or untreated agricultural effluent	The discharge of raw sewage, foul water or untreated agricultural effluent into water is a **prohibited activity**.

GHD

Level 3
138 Victoria Street
T: 64 3 378 0900 F: E: chcmail@ghd.com

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