Assessment of Environmental Effects for Treatment and Discharge of Municipal Wastewater: Cheviot Wastewater Treatment Plant

- Prepared for
  Hurunui District Council

- February 2014

PATTLE DELAMORE PARTNERS LTD
295 Blenheim Rd, Upper Riccarton, Christchurch
P O Box 389, Christchurch, New Zealand

Tel +3 345 7100 Fax +3 345 7101
Web Site http://www.pdp.co.nz
Auckland Wellington Christchurch

solutions for your environment

Quality Control Sheet

TITLE	Assessment of Environmental Effects for Treatment and Discharge of Municipal Wastewater: Cheviot Wastewater Treatment Plant
CLIENT	Hurunui District Council
VERSION	Final
ISSUE DATE	February 2014
JOB REFERENCE	C02863200
SOURCE FILE(S)	C02863200R002_AEE_Final_Feb 2014

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Taryn Wilks Lynn Torgerson Richard Brunton

Reviewed by Approved by

SIGNATURE

Eoghan O'Neill Andrew Brough

Limitations:

This report has been prepared on the basis of information provided by Hurunui District Council and others (not directly contracted by PDP for the work)], including Aquatic Ecology Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information. This report has been prepared by PDP on the specific instructions of Hurunui District Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Executive Summary

Hurunui District Council (HDC) currently holds resource consent for the discharge of treated wastewater to land (CRC091326) and via overland flows to water (CRC091327) from the Cheviot Wastewater Treatment Plant (WWTP). These consents are due to expire in September 2014 and therefore new consents are required. As a result Pattle Delamore Partners Limited (PDP) has been engaged by HDC to prepare the assessment of environmental effects and applications for the required consents.

HDC are seeking resource consent from Environment Canterbury (ECan) for the discharge of treated wastewater from the Cheviot WWTP to land, discharge of treated wastewater from the Cheviot WWTP via overland flow to surface water and use of land for community wastewater treatment system and for use of land from activities which may result in the discharge of nutrients.

The Cheviot WWTP consists of a primary oxidation pond and a secondary maturation pond operating in series followed by a storage buffer pond. Pond effluent is discharged from the buffer pond to land via spray irrigation over the drier months of the year. For the remainder of the time treated effluent is “polished” using an overland flow area before being discharged via a collector drain into the Crystal Brook, which is a tributary of the Jed River.

The proposed activities and the extent of their expected environmental effects has been described and assessed. Adverse effects of the discharge on groundwater quality, ecology, soil quality, odour, visual amenity, recreation and public health have been assessed and are considered to be minor. Surface water quality issues in the Crystal Brook are a catchment wide issue and on an annual basis the influence of WWTP discharge is considered minor. However, during winter, discharge to overland flow has been identified to be causing a localised increase in nutrients to the Crystal Brook. Based on available information an adverse effect on the Crystal Brook ecosystem has not been observed and the ecology is fairly similar above and below the discharge on the Crystal Brook.

HDC proposes to implement a monitoring management plan with the intent of identifying any adverse effects on the water quality of Crystal Brook arising from the overland flow discharge during winter. Should results of the continued monitoring programme demonstrate an adverse effect, appropriate recommendations to address the effect will be implemented. HDC has also proposed to fence out and plant a zone along the collector drain which will aid in reducing contaminant loading during this period.

Consultation has been undertaken with Te Rūnanga o Ngāi Tahu and Kaikōura Rūnanga representatives to discuss the proposed activity and to seek feedback. The key values of interest to the Rūnanga are continuing to be addressed by the applicant and consultation and discussions with Rūnanga will continue throughout the project process.

The proposed activities have been assessed against the relevant planning criteria including the regional policies NRRP, pLWRP and the HWRRP. Overall the evaluation of the objectives and policies has shown that the proposal is consistent and not contrary to the relevant objectives and policies in the relevant regional plans and therefore resource consent should be granted.

Table of Contents

Table of Tables

Appendices

Abbreviations

BOD_5 :	5 day Biochemical oxygen demand is the standard test for determining the oxygen demand in water. Only the carbonaceous BOD (cBOD) is reported as the Nitrogenous demand does not reflect the oxygen demand from organic matter
DIN:	Dissolved Inorganic Nitrogen
DRP:	Dissolved Reactive Phosphorus
E. Coli:	*Escherichia coli*
HWRRP:	Hurunui Waiau River Regional Plan (operative 20 December 2013)
MCI:	Macro-invertebrate community index
N	Nitrogen
NA	Not available
N/A	Not appliable
NH_3N:	Ammonia-Nitrogen
Nitrate N:	Nitrate Nitrogen
NNN:	Nitrate Nitrite Nitrogen
NO_2:	Nitrite
NO_3:	Nitrate
NRRP:	Canterbury Natural Resources Regional Plan
P	Phosphorus
pHWRRP:	Proposed Hurunui Waiau River Regional Plan
pLWRP:	Proposed Canterbury Land and Water Plan
QMCI:	Quantitative macro-invertebrate community index (QMCI)
TN:	Total Nitrogen
TP:	Total Phosphorus
TSS:	Total Suspended Solids
WWTP:	Wastewater Treatment Plant

1.0 Introduction

1.1 Overview

Hurunui District Council (HDC) currently holds resource consent for the discharge of treated wastewater to land (CRC091326) and via overland flow to water (CRC91327) from the Cheviot WWTP. These resource consents were granted in 2009 for a duration of 5 years and are due to expire in September 2014. Therefore new consents are required.

Pattle Delamore Partners Limited (PDP) has been engaged by HDC to prepare an application for resource consent for the consents identified below. This report provides all relevant information including an Assessment of Environmental Effects in support of applications for resource consents to Canterbury Regional Council (ECan).

1.2 Consents Sought

HDC are seeking resource consent from ECan for the following activities:

- Discharge of treated wastewater from the Cheviot WWTP to land;
- Discharge of treated wastewater from the Cheviot WWTP via overland flow to surface water;
- Use of land for community wastewater treatment system and for use of land from activities which may result in the discharge of nutrients.

HDC seeks a consent duration of 35 years for these activities.

2.0 Background

2.1 Overview

The Cheviot WWTP and small flood irrigation wastewater disposal area was commissioned in 1964. The plant was upgraded in 1999, with maturation ponds, a storage buffer pond, overland flow area and land application area. New consents were then granted based on the upgraded design. These consents expired in 2008 requiring council to secure new consents. Consents to discharge treated effluent to land via a land application system and to water via an overland flow system were obtained in 2009 with a five year term being imposed. The shortened duration of the consents was to allow sufficient time, through increased monitoring and ecological assessment to properly assess the effects of the discharges on the receiving environment. Figure 1, Appendix A shows the location of the Cheviot WWTP.

Part of the conditions of the consents was a requirement to investigate options for upgrade of the WWTP. These investigations have been carried out and concluded that any preferred option would involve continuing in the most part the operation of the existing WWTP. A number of mitigation actions are proposed to improve treatment performance of the overland flow component of the discharge.

3.0 Description of Proposed Activity

3.1 Overview

The Cheviot WWTP consists of a primary oxidation pond and a secondary maturation pond operating in series followed by a storage buffer pond. Pond effluent is discharged from the buffer pond to land via spray irrigation over the drier months (6 - 7 months) of the year. For the remainder of the time treated effluent is "polished" using an overland flow area before being discharged via a collector drain into the Crystal Brook, which is a tributary of the Jed River. Figure 2, Appendix A shows the location of the WWTP and discharge areas.

According to the 2009 consent officers report (Holland, 2009) the secondary and buffer ponds are lined with a 300 mm thick clay material liner. This liner can be expected to have a permeability of less than 10^{-7} m/s. The report also states that the primary pond is largely impermeable due to years of sludge accumulation. The ponds are raised with embankment crests above known flood levels.

Table 1 shows the dimensions and capacities of each of the three ponds based on an investigation by Global Environmental Engineering Ltd (g2e) in 2013.

Table 1: Cheviot Wastewater Treatment Pond Capacities

Pond	Surface Area (m^2)	Depth (m)	Volume (m^3)
Primary Pond	5,200	1.3	5,700
Secondary Pond	5,200	0.8 – 0.9	4,000
Storage pond	1,400	-	-

Notes: Pond dimensions and capacities obtained from g2e plant desludging investigation 2013 (g2e 2013)

The primary oxidation pond is fitted with two surface aerators. The secondary maturation pond relies on algae growth and wind mixing. Baffles are installed through the length of the maturation pond. These baffles aid in increasing the retention time of the effluent within the two ponds.

3.2 Land Application Area

Treated effluent from the WWTP is discharged to land via spray irrigation over the drier months of the year, typically, between November and April. The land application area is located to the east of the WWTP and has a total effective area of approximately 5.9 ha. Treated effluent is applied to the land via a low pressure K-line irrigation system. The land application system utilises K-line sprinklers with an instantaneous application rate of 6.6 mm/hr. Discussions with the WWTP operator indicate that the K-line run for up to 6 hours on any one area. This gives a gross application of around 40 mm per day. This depth is reduced to 20 mm per day early and late in the season (or after rainfall), to minimise the risk of ponding. The total effective irrigation area is approximately 5.9 ha, however only a fraction of this is irrigated at one time. The K-lines are moved between applications to ensure that excessive application does not occur in any single location. Figure 2, Appendix A shows the land application area.

3.3 Overland Flow Area

When the amount of treated effluent to be discharged exceeds the capacity of the land application system, treated effluent is diverted to an overland flow area. This typically occurs in the winter months between May and October. Effluent is discharged via above ground low pressure nozzles to the overland flow area. The overland flow area is located to the south of the WWTP and has a total effective area of approximately 1.7 ha. The treatment area is formed into narrow borders, approximately 6 m wide and planted with grass species. Treated effluent from the overland flow area is collected in a collector drain and is conveyed south-east approximately 460 m to the Crystal Brook. Figure 2, Appendix A shows the overland flow area, collector drain and discharge point into the Crystal Brook.

3.4 Wastewater Quantity

3.4.1 Overview

The Cheviot WWTP has around 217 equivalent discharge connections to the town's reticulated sewage network. WWTP inlet, land application and overland flows are measured and data is collected and transmitted to HDC via telemetry.

HDC have provided PDP with recorded daily wastewater inflow series from October 2004 to October 2012. Over the recorded period, the WWTP inflow is variable. The average WWTP inflow over the monitoring period is approximately 119 m^3/day. The maximum inflow is 1,498 m^3/day. Figure 3, Appendix A shows the time series of inflow data for the WWTP.

3.4.2 Land Application and Overland Flow Discharges

HDC have provided PDP with recorded daily land application discharge series from January 2009 to August 2013. The average discharge to the land application system is approximately 210 m^3/day. The maximum discharge to occur in the monitoring period is 1,140 m^3/day. The average discharge to the overland flow path is approximately 260 m^3/day. The maximum discharge is 1,145 m^3/day (excluding a pond repair event). Figures 4 and 5, Appendix A shows a time series of land application discharge and overland flow discharge since over the recorded period.

3.4.3 Population and Quantity Projection

Currently the Cheviot WWTP has around 217 equivalent discharge connections. There is no expected increase in population within Cheviot and hence the number of WWTP connections is not expected to rise. There is also not expected to be a significant change in water use patterns within Cheviot.

3.4.4 Seasonal Effects on Wastewater Quantity

Wastewater inflows to the WWTP vary significantly due to the influence of direct inflow of stormwater and infiltration of groundwater into the sewer network (I&I). Table 2 shows statistics for dry and wet weather flows for the recorded inflow period from October 2004 to October 2012.

Table 2: Cheviot Wastewater Treatment WWTP Inflows

Pond	**Average (m^3/day)**	**Median (m^3/day)**	**Peak (m^3/day)**
Whole record[1]	119	103	1498
Annual[2]	113	103	479
Dry Weather	103	98	238
Wet Weather[3]	136	110	1498

1. *Oct 2004 – Sep 2012*
2. *For year 2012*
3. *It is assumed that wet weather inflows are inflows during and for 4 days after a rainfall event greater than 5 mm*

Table 2 shows that the wet weather inflows are higher than the dry weather inflows. This reflects the impact of I&I to the network upstream of the WWTP. The influence of I&I on the inflow to the WWTP can be significant with the peak wet weather flow being over six times the peak dry weather inflow.

Figure 6, Appendix A shows a plot of WWTP inflows and rainfall. Increased inflows to the WWTP appear to be observable in even moderate rainfall events of greater than approximately 5 mm. The greater the rainfall event, the larger the I&I appears to be, with significant I&I occurring during periods of extreme rainfall. It also appears that increased inflows are observed for days after the rainfall event has finished.

The total surface area of the three WWTP ponds is approximately 1.18 ha. Large rainfall events are likely to contribute a significant volume of water to the ponds. For example a 50 mm rainfall event on the ponds surface could contribute up to 600 m^3 of water to the ponds.

3.5 Wastewater Quality

3.5.1 Overview

Wastewater collected and conveyed to the Cheviot WWTP is domestic wastewater. No industrial wastewater is conveyed to the WWTP. Contaminants in the untreated wastewater are expected to include organic material, Nitrogen, Phosphorus, metals and micro-organisms.

3.5.2 Wastewater Treatment Quality

HDC have provided PDP with recorded effluent quality data from January 2009 to 2013. Table 3 shows the buffer pond and collector drain water quality, from available monitoring data for the WWTP and discharge areas. This data gives an indicative overview of the treatment and to discharge into the environment.

Table 3: WWTP Water Quality Profile (Median Values)

Parameter	Unit	Buffer Pond[1]	Collector Drain[2]	Typical NZ Pond Concentrations[3]
BOD_5	mg/L	28	NA	27
TSS	mg/L	63	39	56
NH_3N	mg/L	13	0.37	7
Nitrate N	mg/L	0.20	0.5	-
TN	mg/L	19.1	5.1	11
DRP	mg/L	5.7	1.1	-
TP	mg/L	7.6	2	8.2
E. Coli	MPN per 100mL	130	2050	-
Faecal Coliforms	per 100mL	205	NA	4300

1. *Results based on 36 samples from 2009 to 2013*
2. *Results based on 22 samples from 2009 to 2013*
3. *Data from Hickey et al., 1989*
4. *NA means data not available*

Table 3 shows that generally the WWTP is performing as expected. Reductions in concentrations between the buffer pond and collector drain particularly for ammonical N, TN and TP indicate that the overland flow area is providing some level of "polishing" of the treated effluent.

3.5.3 Seasonal Effects on Wastewater Quality

There is limited data available for assessing whether I&I has an effect on wastewater quality. Figure 7, Appendix A shows an overlay of dissolved oxygen and WWTP inflows.

Based on the available data there does not appear to be a correlation between I&I and dissolved oxygen.

Table 4 shows a comparison of median water quality concentrations of treated effluent in winter from the buffer storage pond.

Table 4: Water quality samples from treated effluent in winter and summer

	Nitrate N (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Faecal coliforms (per 100mL)
Summer[1]	0.12	21	6.5	9.3	290
Winter[2]	0.30	19	3.5	5.9	180

1. *Summer: 1 November to 30 April: 22 samples*
2. *Winter 1 May 31 October:19 samples*

Table 4 shows that based on the limited monitoring data of effluent quality during winter and summer months, there no definitive correlation between effluent quality and climatic influences.

3.6 Current Wastewater Treatment Performance

3.6.1 Overview

The existing configuration of the WWTP and discharge areas has been in operation since 2009. A number of compliance reports have been undertaken as part of the existing consents (CRC091326 and CRC091327). Compliance reports indicate that treatment has generally been adequate however there are frequent issues with sampling frequency and minor issues with Nitrogen, Phosphorus and solids. A summary of the compliance reports is given below;

- February 2010: All conditions monitored were graded as fully compliant,
- May 2010: All conditions monitored were graded as fully compliant,
- July 2011: At least one condition monitored was graded as significant non-compliance or repeated minor non-compliance: Conditions 12b, 25, 26 not met. Generally non-compliance for this period was due to water quality sampling not being carried out and reported as required by the consent.
- October 2011: At least one condition monitored was graded as minor non-compliance: Condition 17f not met. Minor non-compliance for this period was related to Total Phosphorus exceeding the consent limits (8.9 mg/L for median of last five samples, consent limit is 8 mg/L).
- August 2012: At least one condition monitored was graded as minor non-compliance: Condition 12b, 17e, 17f not met. Non-compliance for this period was due to water quality sampling not being carried out and reported as required by the consent and for Total Phosphorus and Total Nitrogen exceeding the

consent limits (8.7 mg/L for median of last five samples, consent limit 8 mg/L for TP and 36mg/L for median of last five samples, consent limit 25 mg/L for TN).

- January 2012: At least one condition monitored was graded as minor non-compliance: Conditions 12b, 17b, 18, 19 not met. Non-compliance for this period was due to water quality sampling not being carried out and reported as required by the consent. A single total suspended solids reading exceeded the consent limits (120 mg/L, consent limit 60 mg/L). However this would not be considered non-compliant as the consent limit is based on the median of the last five samples not on a single reading.

3.6.2 Sludge Accumulation

A treatment capacity assessment for the primary pond was carried out by HDC in May 2013 (g2e 2013). The aim was to determine the desludging requirements for the WWTP ponds. As part of this study a survey of the primary pond was carried out by Dredging Solutions Ltd. The survey found that the average sludge depth in the primary pond was 0.4 m. It is estimated that the volume of sludge in the primary pond is approximately 1,700 m^3 or 30 % of the total pond capacity. There has currently been no investigation on sludge accumulation in the secondary or buffer storage ponds. However, as these ponds are of much more recent in construction than the primary pond, it is anticipated that the volume of sludge, as a percentage of total operating volume, would be lower than the primary pond.

The 2013 investigation concluded that the sludge accumulation in the primary pond was moderate to high (g2e 2013), however the sludge accumulation did not yet have a significant impact on overall treatment capacity. This is likely due to the effective operation of the secondary pond having compensated for the reduction of volume in the primary pond.

3.6.3 Land Application Flows

The existing consent states that the average daily volume of wastewater discharged onto the land application area must not exceed 240 m^3/day, where the average is calculated by taking the total volume discharged over a calendar year divided by the number of days where a discharge is occurring. The monitoring of land application discharge from 2009 to 2013 shows that discharge from all years on record since 2009 have been less than this limit.

3.6.4 Overland Flow

The existing consent states that the volume of wastewater discharged onto the overland flow area shall not exceed 800 m^3/day, except for 10 days per year where it may not exceed 1,200 m^3/day. The monitoring shows that each year there can be expected to be at least some exceedances of the 800 m^3/day limit. The number of days that this is exceeded is less than ten days in all years except for 2010 where there were 14 exceedances. All discharges are under the maximum limit of 1,200 m^3/day, apart from one occurrence when the WWTP ponds were being pumped out for emergency maintenance.

4.0 Description of the Environment

4.1 Overview

The following description of the environment outlines key aspects of the environment within the vicinity of the Cheviot WWTP. The WWTP includes the treatment facility, land application and overland flow area.

4.2 Location

The Cheviot Township is located within north Canterbury between the Hurunui and Waiau Rivers (Map Ref: BV26:2146-5988). The community is made up of mainly permanent occupied houses with approximately 217 dwellings within the urban area of the township.

The Cheviot WWTP and discharge areas are located approximately 300 m west of the Cheviot urban area within an area known as Mina Flats. Figure 1, Appendix A shows the location of the Cheviot Township and WWTP. Table 5 shows the current title details of the land that includes the WWTP, land application and overland flow discharge areas. All land within the WWTP and discharge areas is controlled and maintained by HDC. Appendix E gives the certificate of title for each land parcel, with the exception of Section 132 BLK VII Cheviot SD. There is no title available for this parcel.

Table 5: Title of Land that Includes WWTP and Discharge Areas

Section	Area (ha)
Section 131 BLK VII Cheviot SD	3.6725
Section 130 BLK VII Cheviot SD	2.0234
Block IV Town of Cheviot	2.0234
Section 132 BLK VII Cheviot SD	4.3494

4.3 Surrounding Land Use

Land use to the north, west and south of the WWTP can be classified as rural, with pasture and cropping activities being the dominant landuse type. There is a number of “lifestyle” properties located to the north west of the WWTP. The WWTP is bounded on the north by Mina Road/Seddon Street.

There are a number of existing discharge permits within the vicinity of the WWTP. ECan GIS system identifies eight active discharge permits within 2 km of the WWTP. Four of these permits are classified stormwater discharges, three are human effluent discharges and one is classified as contaminated water discharge in the ECan GIS records. Table 6 shows details of the three effluent discharges permits within 2 km of the WWTP.

Table 6: Active Discharge Permits Within 2 km of WWTP

Consent Number	Type	Consent Holder
CRC091326	To Land - Human Effluent	Hurunui District Council
CRC111946.1	To Land - Human Effluent	Mr M J Morgan & Mrs H C Knox
CRC073666	To Land - Human Effluent	Peter Andrews Gifkins

4.4 Topography

The Mina Flats area where the WWTP is situated is generally flat with a gentle slope west to east. The land is on a slightly lower elevation compared to surrounding land to the west, north and south of the site. The wider Cheviot area is located within the Cheviot basin which is bounded by the Hurunui River to the south, Waiau River to the north, Lowry Peaks Range to the west and Hawkswood Range to the east.

4.5 Climate

Cheviot has fairly consistent rainfall from month to month and a seasonal variation in temperature and evapotranspiration. Table 7 shows the mean monthly rainfall and evapotranspiration for the area based on National Institute of Water and Atmospheric Research (NIWA) virtual climate database (Cliflo).

Table 7: Mean monthly rainfall and evapotranspiration for Cheviot area

Month	Rainfall (mm/month)	Evapotranspiration (mm/month)	Earth temp at 10cm (°C)
January	49	142	18
February	51	108	17
March	74	90	15
April	68	56	11
May	65	37	7
June	83	28	4
July	88	29	4
August	80	43	5
September	58	66	8
October	64	97	11
November	58	120	14
December	50	140	17
Total	**788**	**955**	-

Notes: Data based on NIWA virtual climate database 1972 - 2012

Table 7 shows that from September to March evapotranspiration is greater than rainfall creating the potential for a soil moisture deficit. However in the winter months from April to August rainfall is greater than evapotranspiration.

4.6 Geology

The Cheviot Township and WWTP is located within an area known as the Cheviot Basin. The geological map for the area (Rattenbury, et al. 2006) indicates that the strata underlying the proposed site comprise Quaternary age fan deposits, which include silty, sub angular gravel with sand. Drillers logs for bores in the area are consistent with this description, indicating that the strata comprise, clays, clay bound gravels with some poor water bearing intervals and fine sands.

4.7 Soils

4.7.1 Overview

Soils in both the land application and overland flow areas are classified as Taitapu soils (Moore 1998). ECan GIS system classifies the soils as a heavy silt loam (ECan fundamental soils layer) These soils have developed under swamp vegetation on deep alluvial sediments in low lying areas where there are high water tables.

4.7.2 Soil Permeability in Discharge Areas

Auger holes taken from within the land application area in 2013 describe the soil as greyish brown earths with clayey silt which have been strongly influenced by local loess soils. This has created soil horizons which have low permeabilities. Borelogs for the area are consistent with this, indicating at least 5.2 m of fine silt and clay sediments overlying claybound and/or sandy gravel strata. According to the 2009 consent officers report (Holland, 2009) soil investigations carried out, which included an infiltration test indicated sub-soil infiltration rates of between 5 - 10 mm/hr with a saturated hydraulic conductivity of 3 - 5 mm/hr.

4.7.3 Soil Quality in Discharge Areas

Two composite soil samples were collected in late August 2013, one from the land application area and one from the overland flow area. The results are very similar for both areas. The results indicate that the soils have moderate to high fertility and concentrations of heavy metals within the range of background levels in Canterbury Soils (Tonkin & Taylor, 2006).

Total Nitrogen is measured as a percentage, and at 0.45 % for the land application area and 0.42 % for the overland flow area both concentrations are in the middle of the medium level for agricultural soils. Total Nitrogen is a measure of all Nitrogen present, both organic and inorganic. Typically a large proportion is held within the soil, by the biological matter present in the soil, and is not readily available to plants for uptake (or leaching from the soil profile).

Plant available Phosphorus is typically measured using the Olsen-P test. For these two samples the Olsen-P was 31 mg/L for the land application area and 48 mg/L for the overland flow area. Both are slightly above the medium range for agricultural soils.

The Total Phosphorus result reports P extracted by hot, concentrated acid and includes unavailable inorganic and organic forms of P. This result is not well correlated to plant available P, but does indicate the amount of P in the soil Phosphorus cycle. In a normal soil environment, there are equilibriums between different pools of soil P (inorganic and organic forms) that are either labile or non-labile.

The concentration of Phosphorus in unfertilised New Zealand soils varies between 200 and 2,000 mg P/kg soil with an average of 650 mg P/kg soil; this is similar to concentrations in overseas soils and is equivalent to about 1,000 kg per hectare of Phosphorus in the top, root containing, layer of soil. (I.S. Cornforth). The Total Phosphorus concentrations are 1,057 mg/kg for the land application area and 1,138 mg/kg for the overland flow area which are both well within the range for unfertilised soils.

4.8 Groundwater

4.8.1 Overview

ECan GIS system describes the underlying groundwater aquifer as unconfined or semi-confined with a depth to groundwater of less than 6 m. The geology for the area indicates that the underlying strata are typically low permeability and although higher permeability lenses may be encountered in some areas, such lenses are often spatially inconsistent and provide small yields.

The site is located within a basin and is surrounded to the south, east and west by low permeability basement strata. Surface water in the general area around the site flows south east to the Jed River and broadly groundwater flow is likely to follow topography. Given the presence of the low permeability strata to the east of the site, groundwater is therefore likely to discharge into surface water courses located to the south east of the site. Recharge is most likely to be a combination of rainfall recharge over the plains located to the west of Cheviot, together with some river losses.

4.8.2 Groundwater Flow Direction and Depth

PDP installed 5 piezometers in the land application and overland flows areas in August 2013. Groundwater contours and flow directions have been calculated from levels measured within the piezometers. It was confirmed that groundwater generally flows in a south-easterly direction. Figure 8, Appendix A shows the location of the piezometers and groundwater contours determined from the piezometer readings.

A search of wells from the ECan GIS database indicates that there are 36 wells within 1 km of the WWTP. The majority of these wells are located within the Cheviot Township, approximately 300 m to the east of the site. Wells in this area are generally shallow, between 2.5 m to 14 m deep. The nearest down-gradient drinking supply well (033/0133) is located 200 m from the eastern boundary of the land application area. Based on groundwater contours there are no known wells directly downs gradient of the WWTP.

Information on depth to groundwater shows the highest recorded groundwater levels in the vicinity of the WWTP to be 0.6 m below ground level in well 033/0062 (4.2 m deep, monitored during 1987 and located 400 m west of the WWTP), and at 1.2 m below ground level in well 033/0059 (5.5 m deep, monitored from 1986 to 1988, and located 400 m to the east). Depth to groundwater, measured in the piezometers installed in August 2013, was very shallow and varied from 0.08 to 0.3 m below ground level across the piezometer locations.

This information indicates that near surface groundwater levels occur at the site.

4.8.3 Groundwater Quality

There is limited historical information on the groundwater quality in the area particularly in relation to down gradient water quality. Based on ECan GIS there are 9 wells with water quality data within 1 km of the site. Six of the wells have only one sampling round between 1963 and 2004. The remaining three wells have between 5 and 41 sampling rounds between 1987 and 2012. Nitrate-Nitrogen ($N0_3$-N) concentrations have been determined for 62 water samples from the 9 different wells. The results for $N0_3$-N gave readings of between 0.38 and 14.5 mg/L. A single sample of water from well 033/0074, located approximately 300 m to the west of the site gave a $N0_3$-N reading of 10 mg/L. Wells located approximately 500 m ENE of the site (033/0061 and 033/0014) gave $N0_3$-N readings of between 0.38 and 3.6 mg/L.

Sampling undertaken between years 1994 and 1997 showed no detectable *E. Coli* in any of the 48 samples taken from wells sampled with the exception of three samples of between 2 and 3 MPN/100ml from well 033/0049 between years 2008 and 2010. All samples taken from all wells since June 2010 have showed no *E. Coli* detection. Generally total coliform results are low but variable. Well 033/0049 has shown variable detection for total coliforms of between 1 and 1300 MPN/100ml. There were 16 less than detect results, 15 results between 1 and 10 MPN/100ml and 10 results greater than 10 MPN/100ml.

These analyses generally indicate variable water quality within the area surrounding the WWTP. Water quality from bore 033/0049 is however of lower of quality. Nitrate results from the WWTP buffer pond are low at around 0.2 mg/L (median value based on all sampling data from 2009 – 2013). Due to this, and the fact that bore 033/0049 is to the west of the WWTP, the relatively high levels of Nitrate Nitrogen readings are likely to be a result of up-gradient septic tanks from the many lifestyle block type residences.

The results of groundwater sampling at the 5 piezometer locations indicate that the levels of Nitrate, Nitrite and Dissolved Reactive Phosphorus (DRP) are low. The results for Total Nitrate and Nitrite varied from “below detection limits” to 0.055 mg/L across the piezometer sites, while levels of DRP varied from 0.005 to 0.034 mg/L across the five sites. In contrast to this, levels of Total Nitrogen (TN) and Total Phosphorous were higher across the piezometer sites located within the spray irrigation area (Piezometers 2 to 5). Across these locations, levels of TN varied from 1.3 to 5.8 mg/L and levels of TP varied from 1.07 to 4.9 mg/L. A review of the nutrient profile indicated that these TN and TP readings are predominantly organic in form. The very high levels of groundwater are likely to be limiting the natural processes which convert these organic forms of Nitrogen, in particular, and Phosphorus to more usable forms for uptake by plants. As the groundwater levels recede in spring, it is expected that the aerobic processes in the soil will restart and the by-products will then be available for uptake by the plants during the growing season. The results of piezometer 1 have been discounted as they were heavily influenced by on-going operation of the overland flow area and are not indicative of the natural groundwater at that location.

4.8.4 Community supply wells

According to ECan GIS system there are no community supply wells within 2 km of the site. The WWTP is not within a community supply protection zone.

4.9 Surface Water

4.9.1 Overview

A number of surface water bodies are located within the vicinity of the WWTP and discharge areas, flowing from the foothills of the Lowry Peaks Range into the Cheviot Basin area. The nearest waterway is the Crystal Brook, located approximately 600 m to the south of the WWTP pond facility (Figure 2, Appendix A). According to ECan GIS system, there are no springs identified within a 2 km radius of the WWTP.

During summer months discharges from the WWTP to the Crystal Brook are rare, with a discharge to dry irrigated land the preferred option. During winter, wastewater is usually discharged via spray irrigation to a separate overland-flow treatment area. The overland flow area collector drain discharges to a community stormwater drain located approximately 320 m to the south east of the WWTP. This community drain then flows approximately 400 m to the south before entering the Crystal Brook at the discharge point. The discharge point is located approximately 350 m upstream of the SH1 Bridge. The Crystal Brook flows to the south of the WWTP and passes under the SH1 Bridge south of the Cheviot Township where it enters the Jed River approximately 500 m downstream of the SH1 Bridge. Another Jed River tributary; Woolshed Creek also enters the Jed River at this location.

The Crystal Brook originates from the lower foothills of the Lowry Peaks Range and is the main tributary of the Jed River. It is largely ephemeral aquatic habitat, with permanent habitat only present after a prolonged period of rain and/or high groundwater level. Over the years it has been significantly realigned in several locations. Under the Natural Resources Regional Plan (Chapter 4) the Crystal Brook and Jed River have a classification of Hill-fed – lower.

A significant portion of the Crystal Brook and wider Jed River catchment is predominantly pastoral and other various types of agricultural land (Section 0). There are a number of small tributaries flowing into the Crystal Brook, most of which are small drains collecting runoff from the agricultural land. According to the 2009 consent officers report (Holland, 2009) the Jed River catchment has a total catchment area of approximately 2,217 ha.

4.9.2 Flow

Flow data shows that there is a large variation in flow in the Jed catchment throughout the year, with often no flow occurring within the Crystal Brook and Jed River during summer, but that moderate flows occur during winter (when wastewater is usually discharged; Table 4; Aquatic Ecology 2012). Historical Jed River flows recorded at the Domain Road Bridge (located downstream of the Woolshed, Crystal Brook confluence) have been recorded between 0.3 L/s to 177 L/s in July (based on readings taken in 1986, 1987 and 1988). This information indicates that the Jed River and the Crystal Brook are ephemeral streams.

Seasonal variability of flow in Crystal Brook is further reflected in the hydrological study by ECan (Lockington et al. 2007). Their work, which has implications to fish passage, indicated that there is a significant seasonal variability of flow in Crystal Brook, with a mean annual flow at the Homeview Road ford of 132 L/s (1951-1980). Analysis of rainfall and flow data by Aquatic Ecology (2013) noted that it took 24.5 mm of rainfall to induce any flow at the Homeview Road ford, which was previously dry (however, that gauging followed a very dry late summer).

4.9.3 Surface Water Quality Monitoring

ECan have undertaken sporadic water quality samples from the Crystal Brook and Jed River since 1997, with a more intense and directed monthly sampling round occurring over 2010 - 2011. In order to further investigate potential effects on the receiving environment from the WWTP discharge, the Hurunui District Council (HDC) engaged Aquatic Ecology Ltd to undertake ecological baseline investigations (Appendix D). Both ECan and Aquatic Ecology investigated environmental parameters spatially along the Crystal Brook and Jed River (i.e., upstream and downstream of the discharge point of the overland flow area collector drain into the Crystal Brook. Table 8 and Figure 2, Appendix 1 detail the location of each sampling site.

Table 8: Water Quality and Ecological Sampling Sites

Site Name	Site Description	Sampling Authority	E	N	Parameters Measured
Buffer Pond	WWTP Buffer Pond	HDC	1621482	5259934	BOD_5, Total suspended solids, Ammonia-N, Nitrate-N, Total N, Dissolved Reactive P, Total P, Faecal coliforms, *E. Coli*, Temperature
Collector Drain	Collector drain at confluence with community stormwater drain	HDC	1621766	5259697	Dissolved Oxygen, Total suspended solids, Ammonia-N, Nitrate-N, Total N, Dissolved Reactive P, Total P, *E. Coli*
CB 50m Upstrm	Crystal Brook 50 m upstream of Discharge	ECan	1621820	5259460	BOD_5, Ammonia-N, Nitrate-N, Total N, Dissolved Reactive P, Total P, *E. Coli*, pH, Clarity, Conductivity, Ecosystem Health (Aquatic Ecology)
CB < 70m SH1	Crystal Brook 70 m downstream of SH1 bridge	ECan	1622270	5259458	BOD_5, Ammonia-N, Nitrate-N, Total N, Dissolved Reactive P, Total P, *E. Coli*, pH, Clarity, Conductivity, Ecosystem Health (Aquatic Ecology)
JR DnStrm WC	Jed River downstream of Woolshed Creek Confluence	ECan	1622487	5259276	BOD_5, Ammonia- N, Nitrate-N, Total N, Dissolved Reactive P, Total P, *E. Coli*, pH, Clarity, Conductivity, Ecosystem Health (Aquatic Ecology)

It should be noted here that there is some confusion over the terminology of the Crystal Brook and Jed River and where the stream changes name. For the purpose of this report and sake of clarity we have referred to the Crystal Brook as the length of stream as indicated in Figure 2, Appendix A, until Woolshed Creek confluences and the stream becomes the Jed River.

4.9.4 Summary of Water Quality Results

4.9.4.1 Environment Canterbury (Robinson and Stevenson 2011)

Summary of main findings:

- Water quality in the Crystal Brook and Jed River indicates that the treated wastewater discharges are having some influence on water quality (Figure 9 and 10, Appendix A);
- Elevated DIN, Ammonia-Nitrogen and DRP results at the Jed River SH 1 site during winter are potentially influenced by wastewater discharges during a period of reduced nutrient uptake by plants and when wet soils limit infiltration potential;
- Treatment process is relatively effective at removing *E. Coli*;
- *E. Coli* results were elevated below the Woolshed Creek confluence, indicating a need to address the agricultural source of these inputs;
- Conductivity, pH, water clarity and DRP are likely to be influenced in some way by catchment geology, with leaching and erosion of soft tertiary marine sediments;
- Unrestricted stock access to many of the stream margins; bank erosion and faecal inputs are likely;
- Any mitigation attempts should include the entire catchment, with particular emphasis on the smaller first-order tributaries where riparian planting appears to be more effective.

4.9.4.2 Aquatic Ecology (2013)

Summary of main findings:

- Water quality monitoring suggests that the overall impact of the WWTP discharge on water quality of the Crystal Brook and Jed River was minor (Aquatic Ecology 2013, Appendix D) and that the impact on water quality appears to be limited to increased Phosphorus and Ammonia Nitrogen concentrations at SH1;
- Phosphorus concentrations were observed to decline to background concentrations in the Jed River, once below the confluence with Woolshed Creek (Aquatic Ecology 2013, Appendix D);
- An improvement in the water quality of Jed River at SH1 between two sampling periods in 1997-2007 and 2010-2011 was also observed (Aquatic Ecology 2013, Appendix D). Although only three determinands were measured during both periods (Nitrate + Nitrite-Nitrogen, DRP and *Escherichia coli* (*E. Coli*) and

able to be compared, all three showed reduced mean or median (*E. Coli*) concentrations in the latter sampling period (Figs. 10-12; Aquatic Ecology 2013; Appendix D);

- Improvement at SH1 was mirrored by an improvement in water quality in Crystal Brook above the discharge. They suggest the improvement at this site might reflect improved land management practices in the upper catchment;
- Water quality in the Crystal Brook and Jed River typically reflects agricultural activity in the catchment, lack of flow and geology rather than a direct result of the WWTP discharge and that the impact of WWTP discharge on water quality was minor.

4.9.5 Additional Data Exploration

Robinson and Stevenson (2011) briefly discussed seasonal differences in water quality among sampling sites in the Crystal Brook and Jed River. Given environmental conditions (i.e. water logged soils, reduced infiltration) and overland flow as opposed to spray irrigation over winter months, it is likely that the receiving environment would be under the most pressure from high nutrient loading during this time. Therefore, further investigation and data analysis into seasonal water quality patterns has been conducted.

Available raw water quality data for the Cheviot areas was obtained from ECan for the period July 2010 – September 2011. Based on the available data set and irrigation records, data were categorised into 'Summer' (25 Nov – 7 April 2011) and 'Winter' (May – 1 September 2011) and medians calculated (Table 9 and Figure 11, Appendix A). Furthermore, it was identified from previous studies (Aquatic Ecology and Robinson and Stevenson 2011) that the sites of most interest, where change was detected were, the Crystal Brook above the discharge, the Crystal Brook below SH1 and the Jed River below Woolshed Creek. Therefore the analysis presented incorporates and elaborates on these three sites. It has also been identified through previous studies that the main parameters of interest in the Crystal Brook and Jed River are, Nitrogen, Phosphorus and *E. Coli*, therefore these parameters are discussed below.

Table 9: Summary Water Quality Table (median values)

Season	Site Name	NH_3-N (mg/L)	NNN (mg/L)	DIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	*E. Coli* (MPN/100ml)
Summer 2010-11	CB 50m UpStrm	0.026	0.007	0.029	1.900	0.230	0.810	130
	CB <70m SH1	0.029	0.006	0.035	0.710	0.260	0.700	41
	JR DnStrm WC	0.143	0.003	0.148	1.500	0.140	0.380	2200
Winter 2011	CB 50mUpStrm	0.011	0.037	0.046	1.000	0.071	0.160	8
	Collector Drain	0.434	n/a	n/a	3.550	0.485	0.775	195
	CB <70m SH1	0.360	0.190	0.550	2.500	0.290	0.850	96
	JR DnStrm WC	0.290	0.081	0.371	0.640	0.064	0.230	>2400

Notes: Sample size summer = 4 per site and winter = 5 samples per site

It is recognised that the data set is limited (13 samples of which only 9 were analysed due to season category). However, for the purpose of this report, the data provides some insight into seasonal patterns in water quality.

4.9.6 Collector Drain contribution

Water quality data was also obtained (although limited and not the sampling dates as used for Section 4.9.4) from the Collector drain over the period 2010 – 2011. Only four samples from April – August 2011 are available for analysis. The four samples occurred over winter 2011 and as such have been used to provide an indication (and only an indication, as the sampling dates are not the same as the Crystal Brook and tributaries) of likely nutrient load in the collector drain entering the Crystal Brook over winter 2011.

It is important to note here that the collector drain flows for 260 m at the bottom of the overland flow area, before it joins a community drain originating above the WWTP (HDC has reported discharge of transport stock trucks frequently occurring in this area) and passing through the spray irrigated area. The drain then flows for another 400 m through agricultural land before it joins the Crystal Brook. The sampling location of this site is located below the confluence of the two drains, in a pond/pool type swale.

Nutrient and microbial concentrations from the collector drain over winter 2011 can provide an indication of potential contamination to the Crystal Brook. As it is a collector drain, water quality targets set in the NRRP for Hill-fed lower waterways are not applicable as for the other sites (Crystal Brook and Jed River).

Information provided below should not be treated as a definitive exercise in quantifying the effects of the WWTP discharge on the quality of the Crystal Brook and the Jed River as there are multiple sources, but rather as an indication of potential contaminant load based on the limited data available.

4.9.7 Results: Seasonal Water Quality Analysis 2010 - 2011

4.9.7.1 Dissolved Inorganic Nitrogen

During summer 2010-11 median DIN concentrations were generally below water quality standards set for Hill-fed lower streams (0.47 mg/L: NRRP) for all three monitored sites (Table 9 and Figure 11, Appendix A). Over winter months, DIN concentrations for the Crystal Brook 50 m were similar upstream of the discharge to summer mean concentrations. However, a notable increase was observed at the sampling site, Crystal Brook 70 below SH1 and Jed River below Woolshed Creek confluence. In the Crystal Brook 70 below SH1 median concentrations increased from median = 0.035 mg/L to median = 0.55 mg/L from summer to winter respectively, exceeding NRRP guideline of 0.47 mg/L. In the Jed River below Woolshed Creek confluence median concentrations increased from summer median = 0.148 mg/L to winter median = 0.371 mg/L.

Data suggests a strong seasonal change between summer and winter at the two sites (Crystal Brook below SH1 and Jed River below Woolshed Creek). DIN concentrations were similar across summer to winter in the upper most Crystal Brook monitoring site, which suggests a likely source input occurring downstream.

4.9.7.2 Nitrate-Nitrite Nitrogen

Median NNN concentrations increased at all monitored sites from summer 2010-11 to winter 2011, with the largest increase observed at the Crystal Brook 70 m below SH1 (Table 9 and Figure 11, Appendix A). Median concentrations increased at this site from summer = 0.006 mg/L to winter = 0.190 mg/L. Although median concentrations increased over winter at the upper Crystal Brook, Crystal Brook below SH1 and the Jed River below Woolshed Creek compared to summer months, medians were below the water quality target value of NNN = 0.444 mg/L (ANZECC (2000) and 1.7 mg/L (Hickey and Martin, 2009) for protection of aquatic organisms.

4.9.7.3 Ammonia-Nitrogen

Median Ammonia Nitrogen (NH_3-N) concentrations showed a very similar trend to NNN in that a notable increase was observed from summer 2010-11 to winter 2011 across all three monitored sites. A particularly notable increase was observed at the site on the Crystal Brook below SH1 where median NH_3-N increased from 0.029 mg/l to 0.36 mg/L (Table 9 and Figure 11, Appendix A). Median concentrations were within the 0.9 mg/L (ANZECC 2000) guideline for protection from toxicity of aquatic organisms. However across both seasons (with the exception of uppermost Crystal Brook) the 0.021 mg/L (ANZECC 200) guideline for protection of excessive weed growth was exceeded.

An indicative measure of potential NH_3-N contribution over winter 2011 from the collector drain suggests NH_3-N concentrations were high, with a median value of 0.434 mg/L (Table 9 and Figure 11, Appendix A). A very high spike of 5.3 mg/L was recorded in the collector drain in April 2011. No discharge to the overland flow area was reported at this time.

4.9.7.4 Dissolved Reactive Phosphorus

Median DRP concentrations at all three monitored sites over summer 2010-11 and winter 2011 exceeded water quality standards set by the NRRP for Hill-fed lower waterways (0.006 mg/L). DRP concentrations at the uppermost site, Crystal Brook 50 m upstream of the discharge and at Jed River downstream of Woolshed Creek were higher over summer than winter. This was in contrast to the Jed River 70 m below SH1 were median DRP concentrations increased slightly from summer to winter (median = 0.26 mg/L and median = 0.29 mg/L respectively) (Table 9 and Figure 11, Appendix A).

Similarly as for DIN and NH_3-N, an indicative measure of potential DRP contribution over winter 2011 from the collector drain suggests DRP concentrations were high, with a median of 0.485 mg/L. A notable spike in DRP concentration of 5.7 mg/L was observed in April 2011. No discharge to the overland flow area was occurring at or around the time of sampling in April.

4.9.7.5 Escherichia coli

Over summer months 2010-11 median *E.coli* concentrations were below the water quality action level of 550 MPN/100ml for contact recreation, as specified in MfE's Microbial water quality guidelines (MfE 2003) for the uppermost site on the Crystal Brook and the lower Crystal Brook (70 m below SH1). However, at the Jed River below the confluence with Woolshed Creek, median *E. Coli* concentrations exceeded the water quality target with a median of 2,200 MPN/100ml over summer and a median equal to or greater than 2,400 MPN/100ml over winter.

During effluent discharge periods *E. Coli* results were variable. Elevated *E. Coli* results did not coincide with heavy discharge events or rainfall (Robinson and Stevenson 2011).

An indicative measure of potential *E. Coli* concentration in the collector drain over winter 2011 was low with a median *E. Coli* value of 195 MPN/100ml (Table 9 and Figure 11, Appendix A). In April 2011, a high spike in *E. Coli* concentration was observed of 5,000 MPN/100ml. No discharge to the overland flow area was occurring at or around the time of sampling in April.

4.9.7.6 Irrigation and Overland Flow

The timing of spray irrigation and use of overland flow over the 2010 – 2011 period was also investigated with regards to response in water quality parameters.

Differences in application methodologies due to changes in climatic conditions, such as higher rainfall and water logging/ponding over winter allows for use of overland flow under Resource Consent CRC091326. Over the summer months as used in the above analysis, spray irrigation occurred for 50 days (Nov – April 2011). Over the winter months, spray irrigation occurred for 15 days and 13 days of discharge via overland flow occurred. It was observed that water quality sampling generally occurred either on the day or a few days (2-6 days) post spray irrigation and/or overland flow discharge.

Higher nutrient concentrations observed over winter are likely a result of a combination of factors, including discharge to overland flow, higher groundwater levels (increased precipitation), lower atmospheric temperatures (reduced evapotranspiration, plant growth), reduced soil temperatures (reduced bacterial processes) and thus reduced retention time for nutrient uptake and processing.

Discharge to overland flow had not been occurring before or close to the time of sampling in April 2011 when unusually high nutrient concentrations were recorded, nor had there been any rainfall (according to the national NIWA climate database). Spray irrigation had however been occurring for 14 days previous and on the day of sampling. Given the location of the sampling point (at the swale which collects from the community drain and the collector drain) it is possible that ponding may have been occurring and that the results were reflective of runoff collected from the spray irrigation area, rather than collector drain input. Other potential sources include illegal dumping of septic waste and transport stock trucks which release waste near / into the community drain above the WWTP.

4.9.7.7 Summary - seasonal effects 2010-2011

The majority of DIN in Canterbury waterways is generally NNN, of which Nitrate (NO_3) is dominant over Nitrite ($N0_2$) (Stevenson et al 2010). However in the Crystal Brook and Jed River the majority is of DIN is NH_3N. Ammonia-Nitrogen is the common reduced form of soluble Nitrogen and originates from animal urine, breakdown of urea and animal proteins, industrial processes, or reduced Nitrogen under anoxic conditions. Given the landuse in the catchment, and known stock and bird populations in, and around waterways, it is likely that urine and breakdown of urea are attributable to observed high NH_3N concentrations.

Based off the limited data set, seasonal changes in water quality are strongly observed. The WWTP is likely having a seasonal influence on water quality in the Crystal Brook, primarily over winter when discharging to the overland flow area. The influence appears to be localised and by the time the Crystal Brook confluences with Woolshed Creek, concentrations of DRP have reduced to levels similar of the uppermost Crystal Brook. Concentrations of Nitrogen species however, are still high, particularly NH_3N (Section 4.9.7.3).

Microbial contamination appears to be an issue year round in the Jed River and given the low median values at both sites on the Crystal Brook, it can be hypothesized that microbial contamination is an issue from the point somewhere along Woolshed Creek rather than as a result from the WWTP. In-fact, the WWTP appears to be very effective at treating *E. Coli*.

4.9.8 Ecology

Work has been undertaken by Aquatic Ecology Ltd (for HDC) to investigate the ecology of the Crystal Brook and Jed River catchment. Their data indicate that the discharge from the WWTP does not degrade the Crystal Brook Waterway (and thus the Jed River), nor does the stream health appear to be getting worse. A summary of these studies is given below (copies of reports attached in Appendix D).

- Instream values in Crystal Brook, in the vicinity of the Cheviot Oxidation pond outfall (Aquatic Ecology 2009);
- The potential impacts of the Cheviot Sewage Discharge on Crystal Brook (Aquatic Ecology 2012;
- Crystal brook flows, water quality, ecology and the environmental impact of the Cheviot Wastewater discharge (aquatic Ecology 2013).

4.9.8.1 Macroinvertebrates

The most up to date and comprehensive information on benthic macroinvertebrates in the Crystal Brook is derived from biological monitoring Aquatic Ecology 2009 and 2013. Copies of the monitoring reports are included in Appendix D. Biotic indices at all monitored sites were low (MCI <80 = poor and QMCI < = poor; Stark and Maxted 2007) during 2009 and 2013, suggesting that the sites have poor macroinvertebrate health (Table 10). Fauna were sparse and numerically dominated by ostracods at both sites in 2013 (Table 10). Invertebrate species diversity was slightly higher above the discharge (12 taxa) in 2009 and downstream at SH1 (11 taxa) over 2013.

Table 10: Macroinvertebrate Health Scores

	2009		**2013**	
Score	**CB < discharge**	**CB > discharge**	**CB > of discharge**	**CB at SH1**
MCI-sb	47	54	61	54
QMCI-sb	1.9	2.6	2.2	1.9
Taxa	12	8	8	11
Total Abundance	15	12	69 (plus ostracoda)	50 (plus ostracoda)

Aquatic Ecology suggests that the differences between ecological results for the Crystal Brook in 2009 and 2013 are reflected by apparent differences in flow. For example, the winter (July) 2009 sampling was undertaken in the Crystal Brook above and below the discharge during a higher flow (estimated at 20-30 L/s), so it lacked the pond skaters and damselflies which were present in the low, virtually-ponded water in 2013. In winter 2009, algal-grazing water snails were rare, but in May 2013, algal–grazers and detrital feeders dominated the fauna. In both the autumn 2013 and winter 2009 samples, micro-crustaceans (ostracods and copepods) were abundant. Both of these groups are particularly drought resistant, because of adaptations, such as a long-term encystment of their bodies and eggs (Chapman et al. 2011). These adaptations would explain their high numbers in the ephemeral or nearly ephemeral environment of Crystal Brook in 2013, when it was virtually a pond.

Aquatic Ecology concludes that the aquatic communities recorded within the Crystal Brook reflect the physical habitat of soft-sediment streambed with terrestrial grasses and cover of floating sweet grass and the ephemeral nature of its flow rather than its contamination status.

4.9.8.2 Fish

Due to the soft-sediment substrate, and lack of stony sections, aquatic habitat for fish species is poor in the Crystal Brook. No fish were identified within the Crystal Brook upstream of SH1 (this includes both above and below the discharge to the Crystal Brook) in 2013. Small numbers of physiologically tolerant fish, Upland Bully and Short-finned Eel where found below SH1 and in Woolshed Creek. The most recent review of the status of New Zealand's freshwater fish fauna (Allibone et al 2010), suggests that shortfin eels, common bully and upland bully are of no conservation concern. They are considered wide spread, with stable numbers.

Presence of upland bully (although sparse in comparison to other Christchurch Drains) indicates a degree of permanent water and at least moderate water quality at SH1. Furthermore, small fish abundances in the catchment are likely related to the closure of the mouth of the Jed River for extended periods of time (inhibiting migration, with the exception of eels which can climb over damp surfaces). Ephemeral flow and lack of waterway connectivity would likely impact fish passage and permanence.

4.9.8.3 Aquatic Vegetation

A formal survey of aquatic vegetation (macrophytes and periphyton) was not undertaken by Aquatic Ecology. However they noted the stream channel tended to be overgrown by pastoral grasses such as the perennial ryegrass (*Lolium perene)* and white clover (*Trifolium repens*) after dry periods and floating sweet grass (*Glyceria maxima)* after wet periods. Cyanobacterial mats were not noted in the Crystal Brook or Jed River.

5.0 Assessment of Environmental Effects

5.1 Overview

This section outlines the adverse effects of the WWTP discharges on the environment including:

- Adverse effects of discharge on groundwater quality;
- Adverse effects of discharge on surface water quality;
- Adverse effects on ecology;
- Adverse Effects of discharge on soil quality;
- Adverse effects of discharge on odour;
- Adverse effects of discharge on visual amenity;
- Adverse effects on cultural values;
- Adverse effects on recreation;
- Adverse effects on public health.

5.2 Adverse Effects of Discharge on Groundwater Quality

5.2.1 Overview

Groundwater quality has the potential to be influenced by elevated levels of contaminants entering shallow underlying aquifers. The most likely pathway for contaminants to enter groundwater would be via infiltration of effluent through soils underlying the land application and overland flow areas. Potential contaminates that could have an adverse effect on groundwater quality include BOD, Nitrogen, Phosphorus, pathogens and heavy metals.

5.2.2 Effect of BOD on Groundwater

High BOD can cause a reduction in dissolved oxygen, leading to anaerobic conditions, mortality of river flora and fauna and growth in undesirable flora and fauna. A healthy soil environment can assimilate up to 600 kg BOD/ha/day (NZLTC, 2000). Based on treated effluent samples taken from the storage buffer pond by HDC, the expected BOD in the treated effluent is expected to be around 24 mg/L. This would result in a loading of BOD much less than 600 kg/ BOD/ha/day and therefore the amount of BOD in excess of the natural capacity of the environment will be negligible. It is unlikely that there will be any significant amount of BOD entering groundwater due to the discharge. Therefore the effect of BOD from the WWTP on groundwater is expected to be minor.

5.2.3 Effect of Nitrogen on Groundwater

Potential adverse effects of Nitrogen on groundwater become apparent when groundwater enters surface water or is used for potable or stock water.

As described in Section 4.7.3, soil samples taken from the land application and overland flow areas show that Total Nitrogen concentrations are in the middle of the medium level for agricultural soils. Based on samples taken from the storage buffer pond by HDC, current Nitrogen loading rates are within appropriate levels for grazing pasture (200 kg/ha/yr as defined by Vanderholm 1984). The current concentrations and low loading rates of Nitrogen in the soil ensure that a substantial proportion of applied N will be taken up by plants, sequestered by soil, or volatilised/denitrified. It is unlikely that there will be any significant amount of Nitrogen entering groundwater due to the discharge.

The results of groundwater quality sampling at the 5 piezometer locations indicated that in general, the levels of Nitrate and Nitrite varied from “below detection limits” to 0.055 mg/L for the piezometer sites. In contrast to this, levels of Total Nitrogen (TN) were higher across the piezometer sites located within the spray irrigation area. Across these locations, levels of TN varied from 1.3 to 5.8 mg/L. A review of the nutrient profile indicated that these TN readings are predominantly organic in form. The very high levels of groundwater are likely to be limiting the natural processes which convert these organic forms of Nitrogen to more usable forms for uptake by plants. As the groundwater levels recede in spring, it is expected that the aerobic processes in the soil will restart and the by-products will then be available for uptake by the plants during the growing season.

Based on soil sampling results, current loading rates and groundwater sample results described above it is unlikely that there will be any significant amount of Nitrogen entering groundwater due to the discharge. Therefore the effect of Nitrogen from the WWTP on groundwater is expected to be minor.

5.2.4 Effect of Phosphorus on Groundwater

Potential adverse effects from Phosphorus occur when groundwater enters surface water were it can contribute to eutrophication.

As described in Section 4.7.3, soil samples taken from the land application and overland flow areas show that Phosphorus concentrations are within the typical range for unfertilised soils. Based on samples taken from the storage buffer pond by HDC, current P loading rates are within appropriate levels for grazing type pasture (30 kg/ha/yr as defined by Vanderholm 1984). The current concentrations and low loading rates of P in the soil ensure that a substantial proportion of applied P will be taken up by plants. It is unlikely that there will be any significant amount of P entering groundwater due to the discharge.

The results of groundwater quality sampling at the 5 piezometer locations indicated that in general, the levels of DRP were low. Levels of DRP varied from 0.005 to 0.034 mg/L across the five sites. Total Phosphorus (TP) levels were higher across the piezometer sites located within the spray irrigation area (Piezometers 2 to 5). Across these locations, levels of TP varied from 1.07 to 4.9 mg/L. A review of the nutrient profile indicated that these TP readings are predominantly organic in form. The very high levels of groundwater are likely to be limiting the natural processes which convert these organic forms of P to more usable forms for uptake by plants.

As discussed in Section 3.2 land application is likely to be in use from November to April. It would be expected that groundwater levels begin to recede during spring and therefore it is expected that the aerobic processes in the soil will restart and the by-products will then be available for uptake by the plants during the growing season. As a result it is unlikely that there will be any significant amount of P entering groundwater due to the discharge during periods where land application is in use. Therefore the effect of P from the WWTP on groundwater is expected to be minor.

5.2.5 Effect of Pathogens on Groundwater

Potential adverse effects from pathogen contamination of groundwater arise from the risk to human and animal health.

The main mechanisms that operate within the soil matrix to ensure pathogen removal are filtration, adsorption and die-off. It is understood that 92 - 99.9 % of applied microbes are removed in the top 10 mm of the soil (Crane and Moore, 1984; Gunn, 1997). This indicates that during infiltration the bacterial components will be filtered by the fine soil.

Pathogens will die off as they pass through the *in situ* soil strata, underlying clay sub-soil and free running shingles and then pass through into groundwater, where they will be diluted and dispersed.

As described in Section 4.8.3 sampling undertaken for *E. Coli* contamination within the area surrounding the WWTP showed no detection in any of the 48 samples taken from wells sampled with the exception of three samples. All samples taken from all wells since the detection in 2010 have showed no *E. Coli* detection. Total coliform results are low but variable. Well 033/0049 (up-gradient) has shown variable detection for total coliforms of between 1 and 1300 MPN/100ml. There were 16 less than detect results, 15 results between 1 and 10 MPN/100ml and 10 results greater than 10 MPN/100ml.

Based on the described removal mechanism and sampling results, the likelihood of pathogens entering groundwater is low. There are also no community or private drinking supply wells directly down gradient of the WWTP and as such, the risk to human health from pathogens is low. Therefore the effect of pathogens from the WWTP on groundwater is expected to be minor.

5.2.6 Effect of Heavy Metals on Groundwater

As described in Section 4.7.3, soil samples taken from the land application and overland flow areas indicate that that the soils within the discharge areas have concentrations of heavy metals within the range of background levels in Canterbury Soils (Tonkin & Taylor, 2006). It is unlikely that there will be any significant amount of heavy metals entering groundwater due to the discharge. Therefore the effect of heavy metals from the WWTP on groundwater is expected to be minor.

5.2.7 Pond Seepage

According to the 2009 consent officers report (Holland, 2009) the secondary and buffer ponds are lined with a 300 mm thick clay material liner. This liner can be expected to have a permeability of less than 10^{-7} m/s. The report also states that the primary pond is largely impermeable due to years of sludge accumulation. Seepage of effluent through the base of the ponds is therefore not likely to be significant. As described in Section 4.7 the soils in the area have low permeability. Therefore seepage of treated effluent from the ponds is not likely to be significant.

5.2.8 Effect on Drinking Water Supplies

There are no community supply wells within 2 km of the site. The WWTP is not within a community supply protection zone. There are a number of private drinking water supply wells within the vicinity of the WWTP. The nearest drinking supply well (033/0133, 5.5 m deep) is located 200 m from the eastern boundary of the land application system. This well however is not located directly down-gradient of the WWTP or discharge areas. Groundwater contours indicate that there are no drinking supply wells directly down gradient of the WWTP or discharge areas. Therefore there will not be any adverse effects on the quality of drinking water supplies as a result of the discharge.

5.3 Adverse Effects of Discharge on Surface Water Quality

5.3.1 Overview

As described in Section 4.9.3, Aquatic Ecology Ltd (Aquatic Ecology 2009; 2012; 2013) and ECan (Robinson and Stevenson 2011) have undertaken work which investigated water quality and ecology of the Crystal Brook and Jed River. Discussions around potential effects are discussed on the basis of this work, and the preliminary seasonal water quality analysis conducted by PDP.

A cautious approach into interpretation of water quality result is required given the multiple sources of possible contamination from inflowing waterways. For example the community drain carries water from above the WWTP as well as passing through the spray irrigated area (stock also contribute and have access to this drain), where it then joins the collector drain (from overland flow) and into what has been termed a swale. It is at this swale that water quality samples were taken. The swale/drain then meanders for 460 m through agricultural land, where again, stock have access until discharging into the Crystal Brook. It is difficult to identify and attribute a sole source responsible for increased contaminants with the water quality data available. However, based on available information (buffer pond and collector drain) the WWTP is likely a key source of contamination over winter months, particularly with regards to NNN, NH_3N, and DRP.

5.3.2 Effect of BOD on Surface Water

Biochemical oxygen demand (BOD) concentrations are generally higher in slow sluggish streams where organic matter can accumulate. The potential adverse effect of BOD on surface water is a reduction in the dissolved oxygen content of the water to cause anoxic conditions. This leads to stress on the ecosystem and potentially death of in-stream flora and fauna. Furthermore, as a result of anoxic condition in sediments, reducing conditions may occur, leading to release of nutrients in the water column.

As discussed in the Aquatic Ecology Ltd (2013) and reported in PDP's Condition 20 Report sampling results showed mean BOD_5 concentrations in the Crystal Brook were not noticeably different between SH1 and above the discharge point (Tables 3 & 4; Aquatic Ecology 2013). The guideline value of 1 mg/L (ANZECC 2000) was exceeded at all locations on a number of occasions (mean concentration 3 – 3.3 mg/L).

Sample results indicate that BOD appears to be a catchment wide issue (Robinson and Stevenson 2011). Based on this information the WWTP discharge is unlikely to have a major influence on the BOD_5 concentration in the receiving waters. Therefore the effect of BOD from the WWTP on surface water is expected to be minor.

5.3.3 Role of Nutrients (Nitrogen and Phosphorus)

There are a number of different forms of Nitrogen and Phosphorus which can be measured, each of which is useful for diagnosing particular water quality issues. Nitrogen and Phosphorus are a major controlling factor in the proliferation of benthic algae (periphyton) and macrophyte (aquatic plant) communities. Of which, the bioavailable forms readily available for plant growth, and important in controlling the proliferation of algal and plant growth, are DIN and DRP.

5.3.3.1 Effect of Nitrogen on Surface Water

Potential adverse effects of Nitrogen species on surface waters may include:

- Excessive growth of nuisance aquatic algae and macrophytes;
- Reduction in dissolved oxygen;
- Toxicity to aquatic fauna;
- Alteration of river flow due to blockage by macrophytes;
- Change in biodiversity; and
- Reduction in recreation amenity.

Median DIN values of the monitored sites for the Crystal Brook exceeded the guideline value for protection of aquatic biodiversity (0.01 mg/L; MfE 2002), but were still within the water quality target of DIN = 0.47 mg/L for Hill-fed lower waterways (NRRP) (Figure 9, Appendix A). Median DIN concentrations measured 70 m below SH1 were substantially higher than above the discharge point (Robinson and Stevenson 2011), likely as a result of increased Ammonia-Nitrogen concentrations (as discussed in Section 4.9.6.3).

Further investigation into seasonal effects (Section 4.9.7.1) showed that increased DIN contribution was occurring over the winter months of 2011. Application rates were then investigated and it was observed that sampling of receiving waterways occurred a few days (2-6 days) post spray irrigation and/or overland flow discharge during winter. Increases in DIN (and thus NNN and NH_3N) appear to be localised to the area below the uppermost Crystal Brook site and by the time water mixes with Woolshed Creek, DIN concentrations reduce to below target values.

Ammonia-Nitrogen concentrations were well below the toxicity value (0.9 mg/L at pH 8; ANZECC 2000) for aquatic protection. The toxicity value was only compromised on one occasion (7 April, 2011), when 1.5 mg/L was recorded 70 m below SH1. With respect to guideline value for protection of excessive weed growth (NH_3-N = 0.021; ANZECC (2000)) all three water quality monitoring sites were in exceedance.

Seasonally, a notable increase in NH_3-N and NNN at all three sampling locations occurred, particularly at the site on the Crystal Brook 70 m below discharge SH1 (Figure 2, Appendix A). This is likely a result of winter climatic conditions combined with, stock and bird faeces and overland flow discharge. Due to water logged soils and reduced evapotranspiration over winter, there is limited infiltration of the WWTP discharge through the soil profile thus increasing direct runoff.

Although median DIN values were within NRRP water quality targets (based on July 2010 – September 2011 results), seasonally, over winter months in 2011 water quality targets were exceeded in the Crystal Brook below SH1. Nitrogen effects on surface water quality from the WWTP when comparing medians are small and would be considered minor.

However, a strong seasonal pattern has emerged where, over winter months, Nitrogen concentrations increase at SH1 (below WWTP discharge) sampling location and appear to be influencing downstream Jed River (below Woolshed creek confluence) Nitrogen concentrations.

5.3.3.2 Effect of Phosphorus on Surface Water

Potential adverse effects of Phosphorus on surface waters are similar to those described for Nitrogen (Section 5.3.3.1). DRP is a form of dissolved phosphate (orthophosphate) that is readily available for algae and plant growth. The main sources of phosphates in waterways typically arise from raw and treated wastewater, animal manure, phosphatic fertilisers and breakdown of phosphatic rock and soil components. Phosphates typically bind to soil and sediment particles and thus do not leach readily into groundwater (unlike Nitrate). The predominant pathway of phosphate input to waterways from land is primarily overland flow (Stevenson et al 2010). Research has suggested that in Canterbury (Hanson and Abraham 2009) this may not be the case and that as a result of complex interactions in aquifers DRP can result from groundwater and leaching from soils.

Median DRP sampling results for the Crystal Brook generally exceeded the 0.006mg/L water quality standard for Hill-Fed-Lower rivers (Figure 10, Appendix A). Median DRP concentrations increased between the Crystal Brook and SH1 (below WWTP discharge), then decreased downstream (Figure 10, Appendix A). DRP appears to be a catchment wide issue, potentially related to high natural Phosphorus concentrations from soft-sediment geology. However, as low DRP concentrations were observed in Woolshed Creek (Robertson and Stevenson 2011) the increase in DRP is most likely influenced by the WWTP discharge. This is further observed during winter when concentrations of DRP are higher in the Crystal Brook below SH1, coinciding with increased discharges of WWTP to overland flow.

A strong seasonal pattern emerged where over winter months, DRP concentrations increased in the Crystal Brook by SH1 (below the WWTP discharge). However this pattern was not observed further downstream in the Jed River where DRP concentrations decreased to below background concentrations. Phosphorous effects on surface water quality from the WWTP when comparing medians are considered more than minor in the section between the upper Crystal Brook sampling point and SH1, although it should be noted that background concentrations in the upper Crystal Brook appear to be already high in Phosphorus.

5.3.4 Effect of Microbial Contamination on Surface Water

Faecal contamination and associated poor microbial quality is an issue for many waterways. Similar to nutrient enrichment, it is a lack of buffer and dilution capacity that makes small streams particularly susceptible to contamination from adjacent intensive land use activities. In addition stock having access and defecating in waterways, large colonies of birds or waterfowl (e.g. ducks and geese) can be a significant contributing factor (as can human sewage overflows or poorly maintained septic tanks).

The microbial quality of waterways is important to recreational water users and for drinking water supplies for humans and livestock. *E. Coli* is a particular type of faecal coliform and is an accepted indicator organism for the presence of faecal pollution. Elevated *E. Coli* results did not coincide with heavy discharge or rainfall events. The discharges from the Cheviot WWTP do not appear to have a significant influence on the microbial status of the Crystal Brook. Several livestock and bird populations have been reported in the area from the WWTP to the Crystal Brook. Where increased *E. Coli* concentrations occur, it is most likely a result of stock access and bird populations and resulting faecal inputs (diffuse or direct).

Based on indicator organism testing indicated above, the effect of pathogens from the WWTP on surface water is expected to be minor.

5.3.5 Effect of Clarity on Surface Water

Colour has never been measured in Crystal Brook, but clarity results suggest that the discharge would not cause it to change. Water clarity in the Crystal Brook, Jed River sites below SH1 and downstream of Woolshed Creek confluence all fall below the guideline value (85 cm Biggs 2002). With poor water clarity in the Crystal Brook above the discharge point, wastewater cannot be attributed to the sole source of poor water clarity. Poor water clarity is most likely a result of cumulative activities such as stock access, bank erosion, sediment input and livestock faecal input. High suspended solid concentrations and reduced water clarity is likely due to the soft sedimentary geology and soil erosion.

Therefore the effect of clarity from the WWTP on surface water is expected to be minor.

5.3.6 Effect of Dissolved Oxygen, Temperature pH and Conductivity on Surface Water

The amount of dissolved oxygen (DO) concentration in streams depends on many variables such as stream flow, aeration, water temperature, quantity of sediment, BOD and photosynthesis. Temperature influences DO concentrations; less oxygen dissolves in warm water than cold water.

Limited records are available for DO, although the available data indicates typical seasonal patterns of ephemeral waterways; higher DO over winter, when flows are higher and temperatures lower, conversely lower DO over summer when conditions are dry, water levels reduced and higher external temperatures. Low DO can be a natural phenomenon caused by a lack of flow in the stream during the summer period, combined with the growth of macrophytes and periphyton.

In-stream temperature is not likely to be altered by the discharge, and sampling shows that the pH and conductivity in Crystal Brook was not changed (Tables 3 & 4; Aquatic Ecology 2103). However, all sample results exceeded conductivity and pH guidelines.

Therefore the effect of dissolved oxygen, temperature pH and conductivity from the WWTP on surface water is expected to be minor.

5.3.7 Summary of Discharge Effects on Water Quality

PDP agrees with findings from the Aquatic Ecology (2013) report in that given background nutrient concentrations (DRP and NH_3N) in the Crystal Brook, undesirable plant growth would not be limited by the nutrient concentrations in the stream whether there is a discharge or not. PDP also agrees with Robinson and Stevenson (2011) in that elevated DIN, NH_3N and DRP at the Crystal Brook below SH1 during winter is likely influenced by WWTP discharge. The WWTP appears effective at removing *E. Coli.* However stock access and large bird populations around the discharge area are likely having some influence on water quality parameters. Furthermore, elevated *E. Coli* concentrations in the Jed River, at the confluence with Woolshed Creek, indicates a need to address/identify sources of contamination.

Based on available information water quality issues in the Crystal Brook are a catchment wide issue and on an annual basis the influence of WWTP discharge is considered minor. However, seasonal patterns have emerged. Spray irrigation over summer months appears to be effective and does not result in adverse change to the water quality of the Crystal Brook. The discharge to overland flow during winter has been identified to be causing a localised increase in nutrients to the Crystal Brook, which are not present in the downstream monitoring site in the Jed River.

The increased nutrient load (DIN, NH_3N and DRP) is likely short-term and localised. A localised increase in nutrient concentrations does not in itself constitute an adverse effect on aquatic ecosystems. An adverse effect would have occurred if this localised increase resulted in changes in ecosystems, such as overgrowth of periphyton, algal blooms, and changes to the structure of biological communities. As discussed in Section 4.9.8 this has not been observed and the ecology is fairly similar above and below the discharge to the Crystal Brook.

It is recommended that some form of remediation options be investigated to minimise runoff during the identified winter period. It should be noted that nutrient enrichment and microbial contamination is a catchment wide issue and a collaborative approach would be required to see an overall improvement in the Crystal Brook, Jed River and Woolshed Creek areas.

As a first step, such mitigation measures for the WWTP discharge could include:

- Riparian planting along the collector drain to help treat and process nutrients coming off the overland flow area and improve aesthetics;
- Riparian planting along perimeter of the spray irrigated area to help treat and process nutrients coming off the overland flow area and improve aesthetics;
- Fencing out of stock from the collector drain, community drain and area draining flow until discharging to Crystal Brook to help reduce erosion, nutrient and microbial contamination; and

- Bird maintenance programme investigated to help reduce nutrient and microbial contamination.

It is also recommended that a review of the water quality and ecological sampling design be conducted and tailored to suit objectives and recommendations from previous studies and this report.

5.3.8 Overflow and Plant Failure

There is the potential risk of overflow, or plant failure, at the WWTP resulting in uncontrolled discharge of effluent. The most likely cause of a failure would be at the pump which discharges treated wastewater to the land application and overland flow areas. In the unlikely event of this pump failing, treated effluent would flow onto land to the south east of the WWTP and discharge into the collector and community drain. It is unlikely that there would be any discharge onto properties not already utilised for land application or overland flow discharge. Therefore the effect of overflow or plant failure from the WWTP is expected to be minor.

5.3.9 Land Application Area

As described in Section 4.7, sub-soil infiltration rates within the land application area of between approximately 5 - 10 mm/hr are expected with a saturated infiltration capacity of 3 - 5 mm/hr. Basic design principles outline that the hydraulic loading rate should be less than the infiltration capacity of the soil.

The instantaneous hydraulic loading rate from the K-line nozzle of 6.6 mm/hr may result in some short term ponding given the saturated hydraulic conductivity of the soil is in the range of 3- 5 mm/hr. Only part of the land application area is irrigated at one time allowing the K-line system to be shifted to minimise excessive application. In addition the site is very flat so that applied effluent will tend to pond rather than runoff. Therefore the likelihood of runoff from the land application area is expected to be low. As a result there is not expected to be any adverse effects on surface water quality as a result runoff from the land application area.

5.4 Adverse Effects on Ecology

As described in Section 4.9.8 work undertaken by Aquatic Ecology Ltd indicates that lack of summer flow and physical habitat tends to limit the distribution and diversity of macroinvertebrates and fish in Crystal Brook and Jed River rather than water quality.

Aquatic Ecology discusses an over-riding anecdotal perception of catchment degradation in the Jed River over the last half-century, and that this cannot be attributed to the wastewater discharge to Crystal Brook. Rather, habitat modification in the catchment, and the impact of the lack of flow and land development on the frequency of openings of the river mouth to the sea, are significant contributors to the current biological community in the catchment.

Given the above assessment, it is anticipated that the discharge from the WWTP will not adversely affect aquatic ecology. The water quality in the Crystal Brook and wider Jed catchment typically reflects agricultural activity in the catchment, ephemeral nature of the streams, lack of flow and geology. Therefore the effect on ecology from the WWTP on surface water is expected to be minor.

5.5 Adverse Effects of Discharge on Soil Quality

WWTP discharges within the land application and overland flow areas have the potential to have an adverse effect on soil quality. Contaminants of significant importance to soil quality and health are Nitrogen and Phosphorus.

Nitrogen and Phosphorus loading rates from the treated effluent on the land application area have been calculated based on daily land application volume data from the WWTP supplied by HDC from 2010 to 2013. Nitrogen and Phosphorus sampling data for the land application is also available from monitoring carried out by HDC. 13 samples were taken from the storage buffer pond during land application discharge periods by HDC between February 2010 and February 2013. The median Total Nitrogen concentration was found to be 23 mg/L, with a range between 1.8 – 39 mg/L. The median Total Phosphorus concentration was found to be 8.2 mg/L with a range between 3.1– 14 mg/L.

Table 11 shows the loading rates calculated for the last 4 irrigation seasons. Appropriate loading rates for grazing type pasture as defined by Vanderholm 1984 is also given.

Table 11: Nitrogen and Phosphorus Loading Rates

Callander Year	Average N (mg/L)[1]	Average P (mg/L)[1]	N Loading[2] (kg/ha/yr)	P Loading[2] (kg/ha/yr)
Recommended loading rate[3]	-	-	200	30
2010 - 2011	11.4	7.5	29	19
2011 - 2012	28.5	9.6	70	23
2012 - 2013	24.0	7.5	67	21

3. *Based on samples taken during the year from the buffer pond when the spray irrigation area is in operation.*
4. *Based on a spray application area of 5.9 h, concentrations in note 1 and HDC daily spray volume data*
5. *Vanderholm 1984 Table 7:3*

Loading results show that current Nitrogen and Phosphorus application rates are within appropriate loading rates for grazing type pasture as defined by Vanderholm 1984. Note that hay is occasionally harvested from the land application area. This will result in a higher annual rate of nutrients than for grazed pasture.

As described in Section 4.7.3 two composite soil samples were collected in August 2013, one from the land application area and one from the overland flow area. These results do not indicate excessive build-up of nutrients in both the land application and overland flow area. The lack of data prior to irrigation occurring means that it is not possible to determine the rate nutrients are accumulating, however with adequate farm management it is reasonable to assume that irrigation of this area could continue for some decades to come. Therefore the effects on soil quality from the WWTP are expected to be minor.

5.6 Adverse Effects of Discharge on Odour

The nature of wastewater means that the treatment processes that occur will produce odour. The typical reaction producing odours is a result of the onset of anaerobic conditions. This can lead to the production of sulphur based compounds. Efficient treatment aims to allow for the degradation of the waste material in such a way that produces odourless gases. In a well-run treatment plant, odours are not an issue, however there is always the potential for odour production should the inflow characteristics change or there is a malfunction within the treatment process.

Aeration in the primary pond will assist with controlling odour during peak inflows. With regard to the offensiveness, treatment ponds do not typically produce strong offensive odour, primarily as they do not receive high strength wastes. They are also equipped with mitigation measures, such as aerators to assist with avoiding the onset of problematic anaerobic conditions. As reported in Section 3.5 BOD levels are around 28 mg/L in the buffer pond. Therefore ponding could occur for up to 48 hours without odour being generated. The existing WWTP has not had any known odour problems or complaints from the Cheviot residents. Therefore the effects on odour from the WWTP are expected to be minor.

5.7 Adverse Effects of Discharge on Visual Amenity

The WWTP and discharges have the potential to have an adverse effect on the visual amenity of the Area. The WWTP and discharge areas are located within a rural setting with minimal structures and visual impact. The WWTP has been established in some form since 1964 and is considered an integral part of the Cheviot Township infrastructure. The K-line land application spray system is consistent with other irrigation occurring within the area. The overland flow area and collector drain are consistent with other drains within the area. The collector drain and discharge point into the Crystal Brook is bounded by pasture grass and some sedges and rushes. This is consistent with other drains within the area. The discharge point from the collector drain into the Crystal Brook is not visible from the town or roads. Therefore the effects on visual amenity from the WWTP are expected to be minor.

5.8 Adverse Effects on Cultural Values

Consultation has been undertaken with Te Rūnanga o Ngāi Tahu and Kaikōura Rūnanga representatives to discuss the proposed activity and to seek feedback. A Cultural Values Report (CVR) has been prepared for HDC by Ngāi Tahu on behalf of Kaikōura Rūnanga.

The purpose of the report is to document the cultural values associated with the Cheviot WWTP discharge area in the Jed River catchment. A copy of the CVR report can be found in Appendix F.

The CVR identifies the Jed River as valued by iwi for the following reasons:

- Water is a taonga;
- Its role as an indicator for the health of the entire catchment;
- Its important environmental function as an interface between the freshwater and coastal marine habitat; for its eel (tuna), flounder and other mahinga kia;
- For the intergenerational transfer of knowledge, cultural significance and ongoing kaitiakitanga responsibilities for Ngāti Kurī and Ngāi Tahu Whānui;
- The mauri of freshwater resources need to be protected, maintained and restored if impacted upon by human activities.

The CVR provides six recommendations to HDC for consideration in the preparation of the of the resource consent applications for the disposal of treated wastewater on land and into Crystal Brook/Jed River via overland flow. The six recommendations are as follows:

1. **Acknowledge the nature and extent of the cultural values in the Jed River catchment.**

   HDC, by initiating dialogue with Ngāi Tahu and Kaikōura Rūnanga as part of the preparation of the resource consent application, and through the consideration of feedback from both organisations, has demonstrated that it recognises that the Jed River is valued by iwi and others.

2. **Application of the 'ki uta ki tai" approach in the integrated management of the Jed River catchment.**

   HDC has proposed a monitoring programme which seeks to gain more robust information on the relationships between the discharges and water quality of Crystal Brook and the Jed River. Information gathered from the monitoring programme can be used to assess the impact of the WWTP discharges on the water quality of these streams, but can also provide information in the context of the greater Jed River catchment.

3. **An assessment of effects (including the cumulative effects) on the cultural values in the Jed River catchment.**

   The effects on mauri, mahinga kai, kaitiakitanga and taonga values have been highlighted in the CVR as key potential effects to consider. HDC has undertaken discussions with Ngāi Tahu and Kaikōura Rūnanga with the aim to gain feedback which would ensure that potential effects arising from the proposed discharges and land use activities are avoided or mitigated.

   The common theme among the key potential effects identified in the CVR is the importance of water quality. As discussed in Sections 5.2, 5.3, and 5.4, it is expected that the effects arising from the proposed discharges on the groundwater quality, surface water quality and ecology will be minor, when carried out in accordance with the recommended mitigation measures and proposed consent conditions.

4. **Improve the receiving environment.**

   Ngāi Tahu encourage the use of wetland systems and riparian management where there are discharges of treated wastewater to land. This proposal includes additional monitoring to establish the relationships between the discharges via overland flow and the water quality within Crystal Brook/Jed River. HDC has also proposed to fence out and plant a zone along the collector drain which will aid in reducing contaminant loading.

   Ngāi Tahu suggest that it is the responsibility of HDC to regulate all other discharges, including non-point sources discharges from agricultural and other land use activities in the upper catchment. While these activities within the catchment are likely significant contributers to the water quality issues in the catchment, regulation of these discharges is out of the scope of this application.

5. **Provide more information.**

   Kaikōura Rūnanga has identified information needs which should be included in an application so that potential adverse effects on cultural values can be assessed. They have identified hydrological information to assess the potential risks to groundwater resources and information related to the cumulative effects of discharges on Jed River/Crystal Brook. These information needs have been included in this AEE.

6. **Strive for the best.**

   Rūnanga policy is to expect that the highest environmental standards should be applied to any consent application involving the discharge of contaminants. In addition they encourage local authorities to be forward thinking.

   HDC proposes to implement an adaptive management water quality monitoring regime to better understand the relationship between the discharges and water quality of the Crystal Brook/Jed River catchment. The implementation of the additional monitoring demonstrates HDC effort to meet this recommendation.

The key values of interest to the Rūnanga are continuing to be addressed by the applicant and consultation and discussions with Rūnanga will continue throughout the project process.

5.9 Adverse Effects on Recreation

WWTP discharges have the potential to have an adverse effect on recreation. Adverse effects on recreation may be caused by treated discharge entering the Crystal Brook and Jed River.

The land adjacent to the Crystal Brook is privately owned. As such, access to this area is restricted to the public. As access is restricted to the Crystal Brook there is unlikely to be any adverse effects on recreation.

It is likely that there may be some use of the Jed River for recreational purposes. The highest risk to these users would be when there is a discharge from the overland flow area into the Crystal Brook and subsequently the Jed River. Monitoring indicates that discharge from the overland flow area is likely to occur during the winter months from May to October. This would be considered outside of the typical recreational period for the Jed River. Warning signs have been installed immediately upstream and downstream of the point of discharge to the Crystal Brook and immediately upstream of the SH1 bridge. Due to the installation of signage and the timing of discharges occurring outside of typical recreational months, the effects on recreation from the WWTP are expected to be minor.

5.10 Adverse Effects on Public Health

WWTP discharges have the potential to have an adverse effect on public health. Adverse effects on human health may be caused by being in contact with treated effluent within the land application area, overland flow area, collector drain and receiving streams. There is also potential for contamination of groundwater from seepage of contaminants through the WWTP and discharge areas.

Access to the land application and overland flow areas is restricted and not accessible to the public. The boundaries of the areas are fenced and have warning signs outlining the restricted access. The land to the south of the WWTP adjacent to the collector drain and Crystal Brook is privately owned and access is restricted. As access is restricted there is unlikely to be any adverse effects on public health from being in contact with treated effluent within the discharge areas.

The ECan Compliance Monitoring Officer has suggested that the original consent requirement for warning notices erected at 50 metre intervals on the fence surrounding the plant is excessive, and has recommended reducing the signage to three locations: one at each road and at the entrance. The consent condition has been modified to reflect this recommendation.

Monitoring indicates that discharge from the overland flow area is likely to occur during the winter months from April to October. This would be considered outside of the typical period for humans to be in contact with the Jed River for recreational purposes. Warning signs have been installed at various locations along the Jed River. Therefore there is unlikely to be any to be any adverse effects on public health as a result of discharge into the Jed River.

There are no community supply wells within 2 km of the site and the WWTP is not within a community supply protection zone. There are no private drinking supply wells directly down gradient of the WWTP. Therefore there is unlikely to be any to be any adverse effects on public health from groundwater contamination from the WWTP.

6.0 Consultation

The applicant has undertaken consultation with the following parties:

- Ward Committee
- Te Rūnanga o Ngāi Tahu and Te Rūnanga o Kaikōura
- Environment Canterbury
- Community Public Health

An update on the existing discharge consent status and the steps necessary to carry out the consent renewal process was provided to the Cheviot Ward Committee in August 2013. At the same meeting, Bill Bestic and Jane Demeter gave a presentation on the community monitoring project carried out in the Jed River with the assistance of Environment Canterbury.

Mr Bestic expressed his concerns with particular regard to the bully population of the Jed River and his view of their declining numbers in the Jed Estuary. Mr Bestic expressed the view that the waterwater treatment plant is unlikely to be the source or cause of the declining numbers, and expressed a desire for HDC to assist with further monitoring of an old timber treatment plant in Cheviot, which could be contributing to high levels of arsenic in the Jed River.

Mr Bestic and Ms Demeter both expressed a desire for increased riparian planting in the Jed River catchment, and sought a commitment from HDC to provide leadership in this respect.

Feedback from Cheviot Ward Committee members and the public has been incorporated into the development of this proposal, including the proposed monitoring management plan and the proposed draft consent conditions.

The applicant met with representatives of Ngāi Tahu and Te Rūnanga o Kaikōura in September 2013 to discuss the proposal and to identify area of concern with respect to the proposal. A site visit occurred in October 2013 during which the Rūnanga encouraged more plantings in the vicinity. A Cultural Values Report (CVR) was prepared by Ngāi Tahu on behalf of Kaikōura Rūnanga and can be found in Appendix F. The applicant has incorporated feedback from the discussions with Rūnanga into this application.

Consultation has taken place between the applicant and Environment Canterbury's Fresh Water Quality Team regarding the draft Monitoring Management Plan (Appendix C). Both parties are happy with the outcome and agree with the proposed Monitoring Management Plan. One point of clarification resulting from the discussion is the further clarification of the relevance of DRP within the monitoring management plan. DRP was included in the monitoring management plan for the buffer pond (Appendix C; Monitoring Plan point 4g), not for the purpose of compliance (as the buffer pond is already in compliance for P) but to gather information on the relationship between the WWTP and receiving environment. Thus, it is considered unnecessary to include a threshold value for DRP (there already exists a threshold for TP) in the buffer pond, given the buffer pond is already in compliance.

Pre-application discussion regarding the application processes, identification of key issues, draft monitoring management plan and draft consent conditions was undertaken with Catherine Challies (ECan Consent Planner) and Gillian Jenkins (ECan Compliance Monitoring Officer) between September and January 2014. Feedback on draft consent conditions and the proposed monitoring plan has been incorporated into this application.

At the recommendation of ECan, the applicant (via PDP) approached Community Public Health for feedback on the proposal. At this date of this report, we are awaiting feedback. A copy of any feedback provided by CPH will be forwarded to ECan once received.

7.0 Proposed Mitigation and Monitoring

HDC proposes to implement a monitoring management plan with the intent of identifying any adverse effects on the water quality of Crystal Brook arising from the overland flow discharge during winter. Should results of the continued monitoring programme demonstrate an adverse effect, appropriate recommendations to address the effect will be implemented. A draft copy of this plan is attached in Appendix C.

HDC has also proposed to fence out and plant a comparable zone along the collector drain. These mitigation measures, including planting and consideration of crop species, will aid in reducing contaminant loading during this period.

It should be noted that nutrient enrichment and microbial contamination is a catchment wide issue and a collaborative approach would be required to see an overall improvement in the Crystal Brook, Jed River and Woolshed Creek areas.

As a first step, such mitigation measures for the WWTP could include:

- Riparian planting along the collector drain to help treat and process nutrients coming off the overland flow area and improve aesthetics;
- Riparian planting along the perimeter of the spray irrigated area to help treat and process nutrients coming off the overland flow area and improve aesthetics;
- Fencing out of stock from the collector drain, community drain and area draining flow until discharging to Crystal Brook to help reduce erosion, nutrient and microbial contamination; and

- Bird maintenance programme investigated to help reduce nutrient and microbial contamination.

8.0 Legal and Planning Matters

8.1 Resource Management Act 1991

8.1.1 Land Use Activities

Section 9 (2)(a) of the RMA states that no person may use land in a manner that contravenes a regional rule unless the use is expressly allowed by a resource consent.

Land use activities associated with this application include the use of land for storing sewage and the use of land for activities that may result in the discharge of nutrients into water.

Mitigation measures include the planting of vegetation/minor earthworks adjacent to an artificial drain, which is also a land use activity.

8.1.2 Discharges

Section 15(1) of the RMA states that no person may discharge any –

a) *contaminant or water into water; or*
b) *contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or*
c) *contaminant from any industrial or trade premises into air; or*
d) *contaminant from any industrial or trade premises onto or into land -*
e) *unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan as well as a rule in a proposed regional plan for the same region (if there is one), or a resource consent.*

The proposal is to discharge treated human effluent onto land, which may result in a discharge of contaminants to groundwater. Furthermore, the discharge from the overland flow path area will be directed to a tributary of the Jed River (Crystal Brook).

In addition, the land application activity may result in a discharge of contaminants into air.

The discharge activities are subject to Section 15, and as such these discharges must either be authorised by regulations or by resource consent.

8.2 Relevant Regional Plans to Consider

The Canterbury Natural Resources Regional Plan (NRRP) became operative on 11 June 2011. A review of the activities against the rules contained in Chapter 3 Air Quality, Chapter 4 Water Quality and Chapter 5 Water Quantity was undertaken to determine the relevant rules within the operative plan.

The Proposed Canterbury Land and Water Plan (pLWRP) was publicly notified on 11 August 2012. The hearing of submissions to the pLWRP has been completed, and in December 2013, the independent commissioners appointed by ECan released their recommendations to the proposed plan. ECan has adopted the recommendations of the commissioners in full, and an amended version of the pLWRP was publicly notified on 18 January 2014.

Consideration of the rules contained in the pLWRP and amended version of the pLWRP must be made. The pLWRP contains rules relating to water and land, but do not contain rules directly relating to air quality.

The decision on submissions and further submissions to the proposed Hurunui Waiau River Regional Plan (pHWRRP) was publicly notified on 27 April 2013. Appeals to the plan have been resolved, and on 20 December 2013, the plan became fully operative. The HWRPP contains rules relating to the take, use, storage and damming of surface and groundwater in the Hurunui-Waiau catchments, as well as the use of land which may result in the discharge of nutrients to water.

8.3 Rules for Consideration

This section considers the relevant planning rules related to the proposed discharge to land, water and air activities, as well as the proposed land use activities. Table 12, Table 13 and Table 14 show the relevant rules relating to the activities for each plan as well as a classification and description for each rule.

Table 12: Natural Resources Regional Plan Rules and Compliance

Activity	**Rule**	**Rational**	**Activity Status**
Discharge of treated sewage effluent onto land from a community wastewater system	WQL14	Condition 1(a) not met: The WWTP land application and overland flow areas are located within 50 m of an artificial water course (overland flow area collector drain); Condition 1(c)(v) not met as site used for land disposal of wastes is included on Schedule WQL3; Condition 1(f) not met: The land application and overland flow areas are located over a unconfined/semi-unconfined aquifer where the highest groundwater level is less than 6 m below ground level.	Non complying
Discharge of treated sewage effluent into a river	WQL15	Condition 1(a) not met: The discharge from the collector drain into the Crystal Brook does not meet the water quality standards set out in WQL 1 for stream classification (Hill-fed lower).	Non complying
Discharge of contaminants to air from the land application activity	AQL63	Rule AQL63 applies as the waste management processes, including the land application of human effluent, was established before 1 June 2002, and the discharge of contaminants into the air arising from the activity has not increased in scale, intensity, frequency or duration. The Section 42A Officer's report (3 August 2009) prepared for the hearing of submissions related to CRC091326 and CRC091327 discusses the consenting requirements for the discharge of contaminants to air. The Officer's report was prepared prior to Chapter 3 Air becoming partly operative (27 October 2009) and Chapters 3 Air becoming fully operative (11 June 2011). In his report, the Investigating Officer (IO) notes that HDC does not hold resource consent for the discharge of contaminants (odour) into air. The IO concludes that the discharge to air may be able to meet the conditions of Rule AQL63.	Permitted

		A cross-check of Rule AQL63 in the proposed plan has been made against Rule AQL63 in the operative plan. This rule in the operative plan is very similar to the rule that the IO considered in 2009, and therefore, based on the same reasoning presented by the IO in his Section 42A report, we conclude that the discharge of contaminants arising from the waste management activities, including the land application of human effluent, is a permitted activity under Rule AQL63.	
Use of land for storing sewage	WQL26	Condition 1(a) not met: The combined volume of the WWTP ponds is approximately 12,000 m^3 and therefore the limit for the maximum volume of stored effluent of 1,500 m^3 is exceeded; Condition 2(b) not met: The WWTP ponds are located within 20 m of an artificial water course (overland flow area collector drain). The Section 42A Officer's report (3 August 2009) prepared for the hearing of submissions related to CRC091326 and CRC091327 discusses the consenting requirements for the use of land for storage of sewage. The Officer's report was prepared prior to Chapter 4 Water Quality becoming fully operative (11 June 2011). In his report, the Investigating Officer (IO) notes that HDC does not hold resource consent for this activity. The IO concluded that there was insufficient information regarding the storage ponds' history to determine whether consent was required under Rule WQL29 (as notified July 2004) or whether existing use rights (as per Section 20A(1) of the RMA) applied to the ponds. [NB: Rule WQL29 (pNRRP) is the comparable rule to Rule WQL26(NRRP).] Based on the Cheviot WWTP history, the effluent storage ponds have existed on site prior to the notification of Rule WQL29 in 2004, and therefore, do not require consent under Rule WQL26.	Not applicable

Table 13: Proposed Land and Water Regional Plan Rules and Compliance

Activity	Rule	Rationale	Activity Status
The **use** of land for a community wastewater treatment system, and the **discharge** of sewage sludge, bio-solids and treated sewage effluent onto land where contaminant may enter water	5.62 (11 August 2012) 5.84 (18 January 2014)	The proposed discharges from the discharge areas are not within a community drinking water supply protection zone therefore Rule 5.62 (11 August 2012) and 5.84 (18 January 2014) applies.	Discretionary
Discharge of treated sewage effluent into surface water	5.64 (11 August 2012) 5.86 (18 January 2014)	The collector drain which conveys treated effluent from the overland flow area discharges into the Crystal Brook which is a natural surface water body.	Non complying
Discharge of nutrients onto or into land that may result in contaminants entering water	7.5.1 (19 January 2014)	The land use activity associated with the discharge is authorised under Rule 10.11/11.1 of the Hurunui Waiau River Regional Plan, and there for fits within the permitted activity status of this rule	Permitted

Table 14: Hurunui Waiau River Regional Plan Rules and Compliance

Activity	**Rule**	**Rationale**	**Activity Status**
Land use activities that result in a discharge of Nitrogen or Phosphorus which may enter water in a Nutrient Management Area	10.1/11.1	Rule 10.1 is a permitted activity rule which applies to any existing land use that results in a discharge of Nitrogen or Phosphorus which may enter water. Condition 1(a) not met: It is unlikely that a catchment agreement for the Jed River catchment will be in place by 1 Jan 2017; Condition 1(d) not met: Potential contaminants discharged into the Crystal Brook from the overland flow area collector drain may breach of Drinking Water Standards of New Zealand 2008. Rule 11.1 applies to land use activities which do not comply with Rule 10.1. Matters of discretion are limited to: - methods to avoid, remedy or mitigate adverse effects on water quality resulting from nutrients lost or leached from the land; - methods to avoid, remedy or mitigate adverse effects resulting from a breach of Drinking Water Standards; - methods required to avoid, remedy or mitigate adverse effects from issues identified in plan in Schedule, having regard for Objectives 5.1 and 5.2 and Policy 5.1 and Policy 5.2; - consent duration.	Restricted discretionary

Table 15: Summary of Overall Activity Status

Activity	NRRP	Status under the NRRP	pLWRP	Status under the pLWRP	HWRRP	Status under the HWRRP	Final Classification
Discharge of treated sewage effluent onto land	WQL14	Non complying	5.62 (11 Aug 2012) 5.84 (18 Jan 2014)	Discretionary	N/A	N/A	Non complying
Discharge of treated sewage effluent into a river	WQL15	Non complying	5.64 (11 Aug 2012) 5.86 (18 Jan 2014)	Non complying	N/A	N/A	Non complying
Discharge of contaminants to air from the land application activity	AQL63	Permitted	N/A	N/A	N/A	N/A	Permitted
Use of land for storing sewage/waste treatment activities	WQL26	Not applicable	5.62(11 Aug 2012) 5.84 (18 Jan 2014)	Discretionary	N/A	N/A	Discretionary
Land use activities that may result in a discharge of nutrients into water	N/A	N/A	N/A	N/A	11.1	Restricted discretionary	Restricted discretionary

Where two plans classify the activity status of the activity differently, the more restrictive classification will take effect. Table 15 shows the summary of the activities with respect with to the three plans, and the final classification. To summarise, resource consent is required for the discharge of sewage effluent onto land, the discharge of treated sewage effluent into a river, use of land for a community treatment system, and the use of land for activities that may result in a discharge of nutrients into water.

8.4 Regional Objectives and Policies

Section 104 of the RMA directs the consenting authority to have regard to the relevant provisions of the operative and proposed regional policy statements and regional plan. This section assess the discharges and land use activities with the objectives and policies contained in the Regional Policy Statement 2013 (RPS), the Natural Resources Regional Plan (NRRP), the proposed Land and Water Regional Plan (pLWRP) and the Hurunui Waiau River Regional Plan (HWRRP).

8.4.1 Regional Policy Statement 2013

The most relevant objectives and policies in the Regional Policy Statement (RPS) are found in Chapter 7 Fresh Water.

Objective 7.2.3 applies to the protection of intrinsic value of water bodies and their riparian zones. This objective seeks to ensure that the overall quality of freshwater in the region is maintained or improved, and the life supporting capacity, ecosystem processes and indigenous species and their associated fresh water ecosystems are safeguarded.

Overall the water quality influence from the WWTP plant discharges to Crystal Brook are minor, however, the data may suggest a stronger seasonal influence during winter on water quality associated with the discharge from the overland flow area. Given the uncertainty in this relationship, the applicant proposes to implement a monitoring plan with the intent of identifying any adverse effects on the water quality of Crystal Brook arising from the overland flow discharge during winter. Should results of the continued monitoring programme demonstrate an adverse effect, appropriate recommendations to address the effect will be implemented.

Objective 7.2.4 recognises that importance of integrated management of fresh water resources. This objective aims to ensure that fresh water is sustainably managed in an integrated way within and across catchments, between activities, and between agencies and people with interests in water management in the community, considering:

a) *the Ngāi Tahu ethic of Ki Uta Ki Tai (from the mountains to the sea);*
b) *the interconnectivity of surface water and groundwater;*
c) *the effects of land uses and intensification of land uses on demand for water and on water quality; and*
d) *kaitiakitanga and the ethic of stewardship; and*
e) *any net benefits of using water, and water infrastructure, and the significance of those benefits to the Canterbury region.*

Of particular relevance to this proposal is engagement with Ngāi Tahu (1), the relationship between the surface and groundwater (2) and the effects of the land use on water quality (3).

Policy 7.3.1 aims to maintain or improve natural character of freshwater to avoid, remedy or mitigate the adverse effects of activities on freshwater.

As discussed in Section 5.0, the overall effects on the receiving environment is minor when carried out in accordance with the recommended consent conditions.

Policy 7.3.3 strives to enhance freshwater environments and biodiversity. This policy aims to promote, and where appropriate require the protection, restoration and improvement of lakes, rivers, wetlands and their riparian zones and associated Ngāi Tahu values, and to:

a) *identify and protect areas of significant indigenous vegetation and significant habitats, sites of significant cultural values, wetlands, lakes and lagoons/hapua, and other outstanding water bodies; and*
b) *require the maintenance and promote the enhancement of indigenous biodiversity, inland basin ecosystems and riparian zones; and*
c) *promote, facilitate or undertake pest control.*

The applicant has proposed to undertake fencing of waterways in the discharge areas and additional planting.

Policy 7.3.7 discussed the relationship between water quality and land uses. This policy aims to avoid, remedy or mitigate adverse effects of changes in land uses on the quality of fresh water (surface or ground) by:

a) *identifying catchments where water quality may be adversely affected, either singularly or cumulatively, by increases in the application of nutrients to land or other changes in land use; and*
b) *controlling changes in land uses to ensure water quality standards are maintained or where water quality is already below the minimum standard for the water body, it is improved to the minimum standard within an appropriate timeframe.*

As discussed in Section 5.0 of this report, data collected from the previous consent indicate that the discharge form the spray irrigation activity is not having an adverse effect, however there is some uncertainty with regards to the discharge from the overland flow area during winter. The applicant has proposed a monitoring programme to further identify the relationship of the overland flow discharge to the water quality in Crystal Brook.

Policy 7.3.13 aims to resolve freshwater management issues by encouraging the involvement of people and communities in the management of fresh water, including:

a) *community stewardship of water resources and programmes to address fresh water issues at a local catchment level;*

b) *Ngāi Tahu, as tangata whenua, exercising kaitiakitanga in accordance with tikanga Maori; and*

c) *providing opportunities for consent holders to take greater stewardship of fresh water resources, within consent conditions.*

This application represents feedback from tangata whenua, the community and other interested parties as discussed in Section 6.0.

In summary, the proposed discharges and land use activities are consistent with the objective and policies contained in the RPS.

8.4.2 Natural Resource Regional Plan (NRRP)

The NRRP contains objectives and policies which are used to address issues that are significant on a regional basis. Chapter 4 (Water Quality) contains the objectives and policies relating to the management of water quality within Canterbury. This section discusses the objectives and policies that are relevant to the proposal.

Objective WQL1.1 (2) states that in rivers where the outcomes in Table WQL5 are being achieved, manage the quality of the water and the bed to at least achieve the outcomes in Table WQL5. Where one or more outcomes in Table WQL5 are not being achieved, progressively improve the existing quality of the water and the bed.

It should be recalled that the WWTP discharge is not the sole contributor of contaminant-loading into the Crystal Brook catchment, as the community drain flows through agricultural lands (stock access and use of fertiliser.) The assessment of environmental effects in this report indicates that the spray irrigation activity is having a minor effect on the water quality of the Crystal Brook. However, the assessment indicates that the overland flow discharge during winter may be having an effect within the Crystal Brook and a monitoring programme to further assess the potential effect has been proposed.

Policy WQL1 addresses point discharge in relation to the impact on surface water quality.

As discussed in Section 5.0, the discharge from the spray irrigation activity is not having an adverse effect on the water quality of Crystal Brook. However, as discussed in that section, the data may suggest a stronger seasonal influence during winter on water quality associated with the discharge from the overland flow area. Given the uncertainty in this relationship, the applicant proposes to implement a monitoring plan with the intent of identifying any adverse effects on the water quality of Crystal Brook arising from the overland flow discharge during winter. Should results of the continued monitoring programme demonstrate an adverse effect, appropriate recommendations to address the effect will be implemented.

Policy WQL3 seeks to prevent the discharge of certain contaminants to surface water, specifically human sewage, and aims to avoid significant adverse effect on water quality, aquatic ecosystems and instream values of surface water.

Policy WQL3(1) seeks to prohibit the point source discharge of:

a) *untreated human sewage, except for unavoidable overflows or spills from an existing sewerage network into surface water or onto land where contaminants may enter surface water; or*
b) *treated human sewage into a river from a vessel; or*
c) *treated human sewage into a river upstream of a community drinking water supply intake.*

It should be noted that the applicant does not proposed to discharge untreated human sewage nor does the treated human sewage discharge point occur upstream of a community drinking water supply intake. This this policy is met.

Policy WQL3(2) requires that a community system used to collect, treat and discharge human sewage effluent:

a) *treats the effluent using the best practicable option and the effluent and the effluent is discharged onto or into land in accordance with Policy WQL7(1) and Policy WQL13; and*
b) *has in place effective measures to minimise the discharge of effluent to surface water or onto land where it may enter surface water, in the event of a system failure or overloading of the system beyond its design capacity.*

As discussed earlier in this report, the WWTP is effective in reducing the microbial content of human sewage prior to the discharge via spray irrigation and overland flow. Furthermore, additional processing of nutrients occurs as part of the land application, particularly during the summer months. When carried out in accordance the proposed consent conditions, measures are in place to minimise the discharge of the treated effluent entering surface water.

Policy WQL3(3) seeks to only allow a discharge of treated sewage to a river or an artificial water course in circumstances where:

a) *is it not practicable to:*
    i. *discharge the treated sewage effluent onto or into land because of the physical limitation of the land, or the discharge would contractive Policy WQL7; or*
    ii. *use individual on-site sewage effluent treatment and disposal systems to discharge onto or into land because the cumulative effects of the discharges on groundwater would contravene Policy WQL7; or*
    iii. *establish sewage effluent collection systems and remove sewage effluent for disposal off-site; and*
a) *the discharge is in accordance with Policy WQL1 and any adverse effects on the receiving water quality, aquatic ecosystems and instream values, including Ngāi Tahu cultural values and amenity values are no more than minor.*

Section 3.3 discusses the limitations imposed by the environmental conditions during winter, and the requirement for allowing some discharge into the overland flow area. Mitigation measures, including planting and consideration of crop species, will aid in reducing contaminant loading during this period. It is on this basis that this policy is considered to be met.

Policy WQL5.1 seeks to avoid or minimise the effects of non-point discharges to surface water.

Policy 5.1(1) seeks to avoid non-point discharges or where this is not practicable, minimum the cumulative adverse effects on surface water quality form non-point source discharges of: nutrients, organic matter, pathogenic micro-organisms, agrichemicals, vertebrate toxic agents, fertilisers or sediment.

The contaminants within the discharge of the treated effluent are likely to be limited to the Nitrogen and Phosphorus species.

The proposed discharges will be applied at a rate, and under circumstances, where opportunities for runoff from the spray irrigation area are avoided or minimised.

Policy 5.1(2) aims to manage the use of land in the riparian zone as provided for in Policy WQL6.

While the project boundaries do not include Crystal Brook and its associated riparian zone, HDC has proposed to fence out and plant a comparable zone along the collector drain.

Policy 5.1(4) aims to reduce the volume of runoff from irrigation land into surface water by implementing measures to increase the efficient use and application of irrigation water to land.

The applicant proposes to continue to discharge the treated effluent via spray irrigation at rates that a suitable for the soil, climate and other considerations.

Policy WQL5.2 relates to the restoration of water bodies. It is understood that the Jed River catchment is of interest to the local community and as such ECan has undertaken some investigation of the catchment quality. HDC recognises the importance of the catchment, and this proposal does not result in further degradation of Crystal Brook.

Policy WQL6 provides guidance on the management of riparian zones. Policy WQL6(1)(b) seeks to maintain or improve water quality, the quality of river bed substrate and aquatic habitats in a river by promoting the retention, maintenance or planting of native or exotic riparian vegetation that effectively: minimises the supply of sediment from bank erosion; reduced the concentration of nutrients, sediment and animal faecal matter in overland flow from adjacent land and shade water and controls the excessive growth of macrophytes or algae, or limits large fluctuations in the daily water temperature.

As discussed above in relation Policy 5.1(2) HDC has proposed to fence out and plant a comparable zone along the collector drain.

Objective WQL2.1 of the NRRP lists the water quality outcomes for groundwater. Objective WQL2.1(2) states:

In semi-confined, unconfined, or other confined aquifers manage groundwater quality to meet the following:

a) *If, during the life of the NRRP, the overall maximum Nitrate-Nitrogen concentration exceeds 5.6 milligrams per litre in any aquifer, any increase in Nitrate-Nitrogen concentration shall not exceed a rate of 1.5 milligrams per litre every ten years. This rate shall be based on the overall maximum concentration measured or reasonably deduced in an aquifer in the three years prior to 1 November 2010;*
b) *Notwithstanding (a) above, the overall maximum Nitrate-Nitrogen concentration in any aquifer shall not exceed 11.3 milligrams per litre;*
c) *The water quality shall remain within the Guideline Value for any aesthetic determinand listed in the Drinking-water Standards for New Zealand 2005, except for natural exceedances of the Guideline Value. If the water quality does not meet the Guideline Value, as a result of human activities, the water quality shall be improved so that the Guideline Value is achieved;*
d) *The median concentration of Escherichia coli shall be less than one colony forming unit per 100 millilitres of water; and*
e) *Any other inorganic or organic determinand of health significance or pesticide (excluding Nitrate-Nitrogen or Escherichia coli) listed in the Drinking-water Standards for New Zealand 2005 shall not be detected at a concentration greater than one half of the Maximum Acceptable Value for that determinand.*

As discussed in Section 5.2, the discharge meets this objective.

Objective WQL2.1 (3) states that where groundwater enters a river, the concentration of any contaminant in groundwater shall not result in the surface water quality being reduced below the relevant provisions of Objective WQL1.

Given that the spray discharge does not reduce the quality of the groundwater, it follows that groundwater contributions shall not compromise the surface water quality of Crystal Brook.

Policy WQL7 applies to point source discharges onto land which affect soil or groundwater quality.

Policy WQL7(1)(b) seeks to have a point source discharge onto land applies in a way and at a rate that

a) *does not, except for a period of up to two hours following the application, exceed the infiltration capacity of the soil or subsoil at the site of the discharge;*
b) *does not exceed the capacity of physical properties, chemical or biological processes in the soil to reduce the contaminant concentration in the soil drainage water and to minimise the concentration of any contaminant entering groundwater;*
c) *avoids risk to public health; and*

d) *will not result in the accumulation of a contaminant in the soil which will limit the future use of land beyond the boundary of the treatment area.*

The spray discharge activity will be carried out such that this policy is achieved.

Policy WQL8(2) seeks to allow the use of land for a facility used to store effluent or organic matter provided these land uses are located, constructed and operated to minimise contaminants from these facilities entering groundwater.

As described in Section 3.0, the effluent ponds have been lined with a thick clay material, and furthermore, the ponds have also accumulated a thick sludge layer aiding to low permeability.

Policy WQL10 seeks to minimise the leaching of nutrients, chemical and microbiological contaminants to groundwater by requiring the best management practices to:

a) *manage the input of Nitrogen so that it matches plant requirements; and*
b) *avoid the accumulation of Nitrogen or other contaminants in the soil which have a high potential for leaching, especially during autumn and winter;*
c) *limit the loss of contaminants from the soil profile to groundwater.*

The applicant proposes to enhance existing management practices by considering the use of more efficient nutrient-processing plant species with better nutrient uptake.

To summarise, the proposed discharges and use of land activities are consistent with and not contrary to the objectives and policies contained in the NRRP.

8.4.3 Proposed Land and Water Plan (pLWRP)

The pLWRP was notified in August 2012. The hearing of submissions to the pLWRP has been completed, and the independent commissioners appointed by ECan have released their recommendations on the proposed plan. In December 2013, ECan adopted the recommendations in full, and the amended pLWRP was publicly notified on 18 January 2014.

This section has been updated to reflect the objectives and policies as outlined in the 18 January 2014 publicly notified version of the pLWRP.

Section 7.1.1 of the pLWRP states that the pLWRP objectives, policies and rules do not apply to the matters controlled by the Hurunui and Waiau River Regional Plan. In this case, the HWRRP controls the cumulative effects of land use on water quality and therefore only the objective and policies within the pLWRP that relate to that land use activity are considered under the HWRRP.

The proposed discharge activities have been assessed against the objective and policies contained in the pLWRP, and are discussed in this section.

Section 3 of the pLWRP contains the plan's Objectives. The following objectives are considered relevant to this application.

Objective 3.1 seeks to have the land and water managed as an integrated resource and enable Ngāi Tahu relationships with water. Objective 3.2 seeks to apply the ethic of ki uta ki tau.. HDC have engaged in dialogue with Ngāi Tahu and Te Rūnanga o Kaikōura.

Objective 3.16 aims to maintain the health of freshwater bodies and their catchments. HDC propose to continue to continue to monitoring the water quality of the collector drain and local community drain to ensure that effects from the proposed discharges are managed appropriately.

Objective 3.13 aims for groundwater to continue to provide a sustainable source of high quality water for flows and ecosystem health in surface water bodies and for abstraction. As discussed earlier, the proposed discharges do not have an adverse effect on the quality of groundwater.

Objective 3.15 seeks to have those parts of rivers that are valued by the community for recreation suitable for contact recreation. It is understood that the local community value Crystal Brook for a variety of values. The proposed discharges will not have an effect on contact recreational values of Crystal Brook.

Objective 3.23 strives to ensure that soils are healthy and productive. The proposed discharges will not adversely affect the soil quality.

Objective 3.12 aims to have community outcomes for water quality and quantity. HDC proposes to carry out the discharge activities in a manner which does not further compromise the water quality of Crystal Brook.

Objective 3.24 seeks to have all activities operate at ‘good environmental practice’ or better to protect the region’s fresh water resource from quality and quantity degradation. The proposed spray irrigation activities will be carried out at a rate which will ensure that the water quality in Crystal Brook will be negatively influenced.

HDC propose to carry out further water quality monitoring on the overflow discharge to determine potential contributions to Crystal Brook water quality.

Section 4 of the pLWRP contains strategic policies (4.1 to 4.8) and activity and resource policies (4.9 to 4.98). The following is a discussion on the relevant policies with respect to the proposed discharges and land use activities.

Policy 4.2 seeks to manage rivers and aquifers in a way which will take into account the cumulative effects of land uses, discharges and abstractions in order to meet the freshwater outcomes. While the discharges from the WWTP have the potential to impact the receiving environment, it must been considered within the greater context of the catchment. Catchment studies have indicated that water quality in the Crystal Brook is a catchment-wide issue due to the extensive agricultural activity and therefore multiple sources of contaminant contributions.

HDC proposes to manage the WWTP discharges in a way which avoids or minimises the effects on the water quality of Crystal Brook as a result of its proposed discharges.

Policy 4.12(a) states that there shall be no direct discharges to surface water bodies or groundwater of untreated sewage, wastewater or biosolids. This policy is met.

Policy 4.13 states that for discharges of contaminants to surface water bodies or groundwater, the effects of any discharge are minimised by the use of measures that:

a) *first, avoids the production of the contaminant;*
b) *second , reuses, recovers or recycles the contaminant;*
c) *thirdly, reduces the volume or amount of the discharge; or*
d) *finally, where practice utilise land-based treatment, a wetland constructed to treat contaminants or a designed treatments system prior to discharge; and*
e) *meets the receiving water standards in Schedule 5.*

Policy 4.14 seeks that any discharge of a contaminant into or onto land shall be applied in a manner that will not adversely affect groundwater.

Section 3.0 describes the history and sizing of the community wastewater treatment plant, and how the proposal has evolved to the current application. Consent condition and the implementation of a water quality monitoring programme ensures that these two polices are met.

Policy 4.15 states that in urban areas, the adverse effects on water quality, aquatic ecosystems, existing uses and values of water and public health form the cumulative effects of sewage and wastewater discharges are avoided by:

a) *all sewage being discharged into a reticulated system where available;*
b) *the implementation of contingency measures to minimise the risk of a discharge from a wastewater reticulation system to surface water in the event of a system failure or overloading the system beyond its design capacity.*

HDC manages the community's sewage network, and has contingency measures in place.

Chapter 7 of the pLWRP contains the objectives and policies for the Hurunui-Waiau sub-regional zone, for which the Jed River catchment is included. This chapter has not been completed, however it contains outcomes in which the Hurunui-Waiau Zone Committee has developed as part of their vision for the Zone. Of relevance to this application:

a) *a thriving natural environment, safeguarded by protecting important ecosystems and bio-diversity; and*
b) *healthy waterways that provide abundant mahinga kai and recreational opportunities… so the mauri of the river is maintained and enhanced.*

The proposed discharges, when carried out in accordance with the proposed consent conditions will not compromise these outcomes.

Section 7.1.1 states that the pLWRP's objectives and policies do not apply to the matters controlled by the Hurunui Waiau River Regional Plan (HWRRP). In this case, the HWRRP control the cumulative effects of land use on water quality and therefore only the objective and policies within the pLWRP that relate to that activity are considered under the HWRRP. It is noted that there are no relevant objectives or policies relating to the discharge activities contained in the sub-regional chapter of the pLWRP.

To summarise, the proposed discharges and the land use activities are consistent with, and not contrary to, the relevant objectives and policies contained the pLWRP.

8.4.4 Hurunui Waiau River Regional Plan (HWRRP)

The decision on submissions and further submissions to the proposed Hurunui Waiau River Regional Plan (pHWRRP) was publicly notified on 27 April 2013. Appeals to the plan have been resolved, and on 20 December 2013, the HWRRP became fully operative. The relevant objectives and policies with respect to the use of land which may result in a discharge of nutrients to water are discussed.

Objective 1 is to allow people and communities of North Canterbury ready access to high quality and reliable supplies of human and stock drinking water. The discharges will not compromise the quality of water for human or stockwater supply.

Objective 5.1 states that concentrations of nutrients entering the Jed River are managed to:

a) *protect the mauri of waterbodies;*
b) *protect natural biota including riverbed nesting birds, native fish, trout and their associated feed supplies and habitat;*
c) *control periphyton growth that would adversely affect recreational, cultural and amenity values;*
d) *ensure aquatic specifies are protected from chronic Nitrate toxicity effects; and*
e) *ensure concentrations of Nitrogen do not result water being unsuitable for human consumption.*

Objective 5.2 states that concentrations of nutrients entering tributaries to the Jed River are managed to ensure they do not give rise to:

a) *chronic Nitrate toxicity effects on aquatic species;*
b) *water being unsuitable for human consumption.*

It should be recalled that the WWTP discharge is not the sole contributor of contaminant-loading into the Crystal Brook catchment, as the community drain flows through agricultural lands (stock access and use of fertiliser.) Section 5.0 demonstrates that the spray irrigation activity is having no effect on the water quality of the Crystal Brook. However the overland flow discharge during winter may be contributing to nutrient loading in the Crystal Brook and has proposed a monitoring programme to further assess the potential effect.

Policy 5.1 is to take a tributary and community based approach to managing water quality and improving nutrient management practices. HDC recognises that the community has an interest in Crystal Brook and the discharge is proposed to be managed in a way to improve its nutrient management practices.

Policy 5.2 seeks to ensure that all existing and new land use activities in the Nutrient Management Area shown on Map 4, have the best nutrient management practice in place by 2017. By way of this consent application, HDC is seeking to ensure that appropriate nutrient management practices are in place.

The proposed use of land activity is not contrary to the objectives and policies of the HWRRP.

8.4.5 Conclusion

Overall the evaluation of the objectives and policies has shown that the proposal is consistent and not contrary to the relevant objectives and policies in the relevant Regional Plans.

8.5 Non Complying Activities

Section 104(D) identifies particular restrictions for non-complying activities. This section states that the consent authority may grant resource consent for a non-complying activity only if it is satisfied that either (a) adverse effects of the activities on the environment will be minor or (b) the application for that activity will not be contrary to the objectives and policies of the relevant plan and proposed plans in respect of the proposed activity.

As described in Section 8.3 (Rules for Consideration) of this report, the proposed discharges of treated effluent to land and to water are non-complying activities.

Analysis of the objectives and policies contained in the NRRP, pLWRP and HWRRP finds that the proposed discharge activities are not contrary to the objectives and policies contained with these plans, and therefore Section 104(D) (b) is satisfied.

Furthermore, the expected effects arising from the discharges are minor as discussed in Section 5.0.

On this basis, the requirement of Section 104(D) is met.

9.0 Part II Purpose and Principles

9.1 Purpose of the Act – Section 5

Section 5(1) states that the purpose of the Act is to promote the sustainable management of natural and physical resources. Section 5(2) defines “sustainable management” as managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities for their social, economic and cultural wellbeing and for their health and safety while:

a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

b) Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and

c) Avoiding, remedying or mitigating any adverse effects of activities on the environment.

The consents sought allow HDC to be able to continue to provide the Cheviot community with a community wastewater treatment plant, which is vital for the health and safety of the community. Any adverse effects on the environment (in particular the groundwater and surface water (Crystal Brook/Jed River) arising from the proposed discharges and land use activities, when carried out in accordance with the recommended mitigation measures, will be avoided or mitigated so as to safe-guard the life-supporting capacity of water and soil.

9.2 Matters of National Importance – Section 6

Section 6 of the Act states:

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

a) The preservation of natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development;
b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use and development;
c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;
d) The maintenance and enhancement of public access to and along coastal marine areas, lakes and rivers;
e) The relation of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga;
f) The protection of historic heritage from inappropriate subdivision, use and development;
g) The protection of recognised customary activities.

It is considered that the proposed discharges and land use activities all matters of national importance are recognised and provided for, specifically (e). Engagement with Ngāi Tahu has been undertaken to ensure that (e) is provided for appropriately.

9.3 Other matters – Section 7

Section 7 of the Act states:

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development and protection of natural and physical resources, shall have particular regard to:

a) Kaitiakitanga;

aa) The ethic of stewardship;

b) The efficient use and development of natural and physical resources;

(ba) The efficiency of the end use of energy;

c) The maintenance and enhancement of amenity values;
d) Intrinsic values of ecosystems;
e) [Repealed];
f) Maintenance and enhancement of the quality of the environment;
g) Any finite characteristics of natural and physical resources;
h) The protection of the habitat of trout and salmon;
i) The effects of climate change;
j) The benefits to be derived from the use and development of renewable energy.

It is considered that (c), (d), (f) and (g) are relevant to this application. This assessment has demonstrated that potential adverse effects arising from the proposed discharges and the use of land, when carried out in accordance with the recommended mitigation measures, will be avoided or mitigated.

9.4 The Treaty of Waitangi – Section 8

Section 8 of the Act states:

In achieving the purpose of this Act, all persons exercising the functions and powers under it, in relation to managing the use, development and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

HDC, as part of its preparation of this application, have met with representatives of Te Rūnanga o Ngāi Tahu and Te Rūnanga o Kaikōura to discuss the proposal. Feedback provided by iwi has been incorporated into the proposal.

It is considered that the early engagement with Tangata Whenua as part of the initial application preparation, and the continued dialogue with Tangata Whenua, is consistent with the principles contained in Section 8.

10.0 Consideration of Alternatives

As part of the existing consent condition 19, HDC have been required to undertake a programme of works associated with the investigation and selection of a long-term method of treatment and disposal of wastewater from the plant. HDC have submitted to ECan an options report for wastewater treatment and disposal. This report includes investigation into options such as but not limited to; full land disposal, pond enhancements such as hanging media, filtration of pond effluent prior to overland flow and disinfection. The investigations found that beyond the mitigation proposed in this application the major restricting factor to these options was cost. Due to the relatively low number of wastewater connections to the WWTP implementing these options would be difficult to impose of the Cheviot community without generating significant hardship for ratepayers. Furthermore it has been indicated that the current level of treatment provided by the WWTP and disposal areas is generally sufficient and therefore a significantly higher level of treatment that these options would provide is not required.

11.0 Proposed Conditions

Proposed consent conditions for this application have been given in Appendix B attached to this report.

12.0 Conclusions

HDC are seeking resource consent from ECan for the discharge of treated wastewater from the Cheviot WWTP to land, discharge of treated wastewater from the Cheviot WWTP via overland flow to surface water and use of land for community wastewater treatment system and for use of land from activities which may result in the discharge of nutrients.

The Cheviot WWTP consists of a primary oxidation pond and a secondary maturation pond operating in series followed by a storage buffer pond. Pond effluent is discharged from the buffer pond to land via spray irrigation over the drier months of the year. For the remainder of the time treated effluent is "polished" using an overland flow area before being discharged via a collector drain into the Crystal Brook.

The proposed activities and the extent of their expected environmental effects have been described and assessed against relevant guidelines. Adverse effects of the discharge on groundwater, surface water, ecology, soil quality, odour, visual amenity, recreation, cultural values and public health have been considered as relevant to the proposed activities.

The proposed activities have been assessed against the relevant planning criteria including the regional policies NRRP, pLWRP and the HWRRP. Overall the evaluation of the objectives and policies has shown that the proposal is consistent and not contrary to the relevant objectives and policies in the relevant regional plans and therefore resource consent should be granted.

13.0 References

Aquatic Ecology Ltd, 'Instream values in Crystal Brook, near the Cheviot Oxidation pond outfall', Prepared for Hurunui District Council. AEL Report N°.74. August 2009

Aquatic Ecology Ltd, 'Potential Impacts of the Cheviot Sewage Discharge on Crystal Brook, August 2010 – August 2011, Prepared for Hurunui District Council. AEL Report N°.93. August 2013

Allibone, R.M., Hitchmough, R., Jellyman, D.J., Ling,N., Ravenscroft, P., Waters, J., (2010). Conservation status of New Zealand freshwater fish, 2009. *New Zealand Journal of Marine and Freshwater Research* 44 (4): 271-287.

ANZECC (2000). *Australian Water Quality Guidelines for Fresh and Marine Waters.* Australian and New Zealand Environment and Conservation council, Melbourne.

Biggs, B.J.F.(2000). New Zealand periphyton guidelines: Detecting, monitoring and managing enrichment of streams. Ministry for the Environment, Wellington.

Chapman, D. W.; Lewis, M. H.; Winterbourn, M. J. 2011: Guide to the freshwater Crustecea of New Zealand. Christchurch, New Zealand Freshwater Sciences Society. 188 p.

Crane, S.R. and Moore, J.A. (1984): Bacterial Population of Groundwater: A Review. Water Air & Soil Pollution, Vol 22 No1, Springer, Netherlands.

Global Environmental Engineering Ltd (g2e) 2013: Cheviot Treatment Plant Review, Relative to Sludge Accumulation Assessment.

Hickey, C.W; Quinn,J.M.; Davies-Colley, R.J. 1989b. Effluent charcteristics of domestic sewage oxidation ponds and their potential impacts on rivers. New Zealand Journal of Marine and Freshwater Research 23: 585-600.

Holland, I. 2009: Section 42A Officers Report. File Nº C06C/00627, Environment Canterbury.

I.S. Cornforth. Department of Soil Science, Lincoln University. The Fate Of Phosphate Fertilisers In Soil, http://nzic.org.nz/ChemProcesses/soils/2D.pdf.

Moore, C. 1998: ‘Principle Hearing Committee Report for Consents 981549 and 981550’.

MfE (Ministry for the Environment). 2003. Microbiological water quality guidelines for marine and freshwater recreational areas. Ministry for the Environment, Wellington.

Morton, J.D., Smith, L.C., Catto, W.D., and Trainor, K.D. (2000). Nitrogen responses on pastures in the southern South Island of New Zealand, Vol.62. New Zealand Grassland Association.

Lockington, P.; Griffiths, G.; Martin, A. 2007. Jed River and Leamington Stream, Water Resources Summary. Environment Canterbury, No. 29 p.

Pattle Delamore Partners Ltd, (2013). Review of Cheviot Waste Water Treatment Plant Effluent Disposal, prepared for Hurunui District Council.

Robinson, K. and Stevenson, M. (2011) Unpublished. Environment Canterbury. Water quality state of Jed River and tributaries 2010-11: Summary report. 15pp.

Stark, J., and Maxted, J (2007) A user guide for the macroinvertebrate community index. Cawthron Report No. 1166.

Stevenson, M., Wilks, T., Hayward, S (2010). An overview of state and trends in water quality of Canterbury rivers and streams. Environmental Canterbury, Report No R10/177.

Tonkin & Taylor. 2006. Background Concentrations of Selected Trace Elements in Canterbury Soils.

Vanderholm, D. H. 1984. Agricultural Waste Manual, Lincoln College.