

8. Leeston

The township of Leeston is the largest township covered within this assessment. It has the greatest range of land use activities of the townships.

8.1 Description of existing environment and stormwater discharge

8.1.1 Leeston township description, stormwater network and discharge location

The Leeston network consent application area covers the existing urban and residential areas of Leeston. The township is located on the Canterbury Plains on Leeston Road between Doyleston and Southbridge. The landuse activities in the area are primarily residential with approximately 600 houses, and commercial areas including pubs, cafés, automotive servicing, vehicle sales yards, engineering workshops, a gym and Leeston School. The stormwater network is shown in Figure 15. There are large areas of reticulated piped networks flowing through the township. As for most towns the township network has developed over time so includes a range of pipe sizes and types. Of particular note for the network the stormwater within the township can be separated into three subcatchments based on where discharges flow to as follows:

Leeston Creek subcatchment - The main subcatchment is the northern portion of the township in which discharges all enter Leeston Creek. This area contains some areas of older housing where drainage is mostly captured in curb and channel before discharging to the creek. Some sections do have grassed berms over which stormwater can flow prior to capture. The most northerly area is a newer subdivision in which stormwater is captured into a wetland and treated. In recent years SDC have undertaken works through this area to increase the conveyance of stormwater which has involved upgrading sections of Leeston Creek and other pieces of the drainage network. Various discharges from the township enter Leeston Creek and the downstream location of all these discharges is the intersection between Leeston Road and Volckman Road. At this point Leeston Creek passes through a large engineered concrete drain. This is considered to be the monitoring point for the cumulative effects of discharges from this subcatchment of the township. This subcatchment comprises roughly two thirds of the townships area (112 ha) with the majority of the township's residential housing plus the town centre and main commercial activities.

Leeston Lake Drain subcatchment - The middle section of the township also has generally an older network with stormwater captured in curb and channel and some grassed berm areas. Three discharge points exist from this area. Two of the discharges are located just outside the township boundary on Leeston and Lake Road (Figure 16). Discharges occur on both sides of the road, one into a heavily vegetated drain (Leeston Lake Drain) which ultimately discharges into Birdling Brooks (Figure 15). The discharge on the other side of the road is into Beethams Drain that flows down Leeston and Lake Road and across into Birdlings Brook. The third discharge is to Chapmans Drain near Woodville Road. This is also an open grassed drain that is normally dry which flows into Birdlings Brook. The three discharge point picks up about a quarter of the townships stormwater (approximately 150 buildings or 35 ha).

Birdling Brook Stormwater Basin subcatchment – The smallest and most southerly catchment discharges to Birdlings Brook and captures stormwater from newer subdivision areas. This is treated in a dry pond system prior to discharge. The discharge site is located at the end of Clausen Avenue. The stormwater basin is grassed with small events infiltrating through the basin and only large events passing to the stream once the basin is full. The basin picks up flows from approximately 100 houses (22 ha). A small discharge occurs from the vegetated roadside drains alongside High Street flows into Birdlings Brook. This is located above the dry pond discharge and takes flows from the road and a small number of roadside properties.

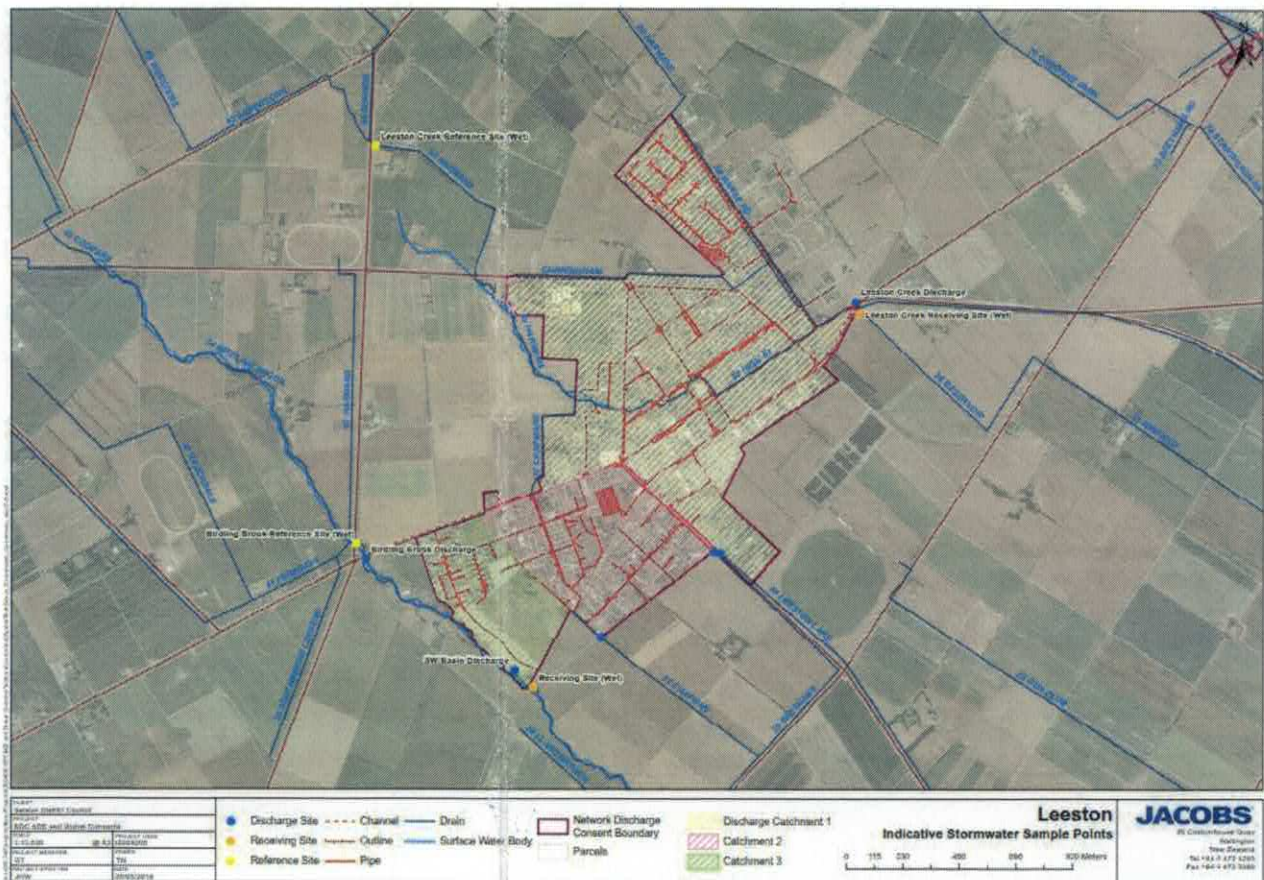


Figure 15 : Proposed Leeston stormwater network consent area and stormwater discharge points.



Figure 16 : Discharge points at Leeston. Left is the Birdling Brook stormwater basin, middle is Leeston Creek discharge and the right is Leeston Lake Drain discharge. All photos were taken on the 28 February 2017.

8.1.2 Monitoring sites

The stormwater discharge from the township flows ultimately into two waterways, Leeston Creek and Birdling Brook. Leeston Creek is a spring fed lowland stream. Numerous waterways and drains that are tributaries of the creek pass through Leeston before coming together near the junction of Leeston and Volckman Roads. Leeston Creek then flows through farmland towards Lake Ellesmere roughly 10 km away.

Birdling Brook is also a spring fed lowland stream located south of the township. Birdling Brooks flows along the township boundary and also ultimately flows into Lake Ellesmere. Leeston lake Drain enters Birdling brook downstream of Leeston.

Reference Sites

The reference site for Leeston Creek is located on Hermans Road approximately 150 m from the junction with Andersons Road (Figure 15). Leeston Creek is a small artificial intermittent stream/drain, which has some coverage from trees. The stream was dry at the time of dry weather sampling and showed a cracked soft sediment bottom with high vegetation along the stream. The creek flows through agricultural land before the township.

The reference site for Birdling Brook and Leeston Lake Drain was located just above the High Street and Hermans Road intersection. The site is characterised by starkly different land use from one side of the road to the other (Figure 17). There is high vegetation growth on the township side of Birdling Brooks in comparison to the grassed farmland on the opposite side. The site was dry during the dry weather site visit. This reference site is not directly upstream of Leeston Lake drain as the township drainage network forms all of the lake Drain catchment. This site is therefore the closest most relevant upstream point on an adjacent waterbody that can be monitored.



Figure 17 : Reference sites for Birdling Brooks (Left and middle) and Leeston Creek (Right). Photos taken 28 February 2017

Receiving Site

The receiving site for Leeston Creek was based at the junction between Leeston Road, Volckman Road and Station Street (Figure 18). The drain at the time of surveying 28th February 2017 was dry. The drain splits into two at this location with flows governed by manual control structures. The main flow follows Volckman Road. Leeston Creek Drain was observed to be flowing during a site visit on the 26th July 2017. This was following a large rain event that caused localised flooding across the district. Figure 18 contains images of the discharge point in both wet and dry weather. Leeston Creek is therefore an intermittently flowing waterbody.

The receiving site for the Leeston Lake Drain subcatchment is the Leeston Lake Drain that runs alongside Leeston and Lake Road. This is a grassed straightened drain that is intermittently flowing. Figure 16 shows a picture of the drain on the 26th July 2017 following heavy rain where a small clear baseflow could be seen in the narrow grassed channel.

The receiving site for the Birdling Brook stormwater basin discharge was located downstream of the township past the stormwater basin at the end of Clausen Avenue (Figure 18). The surrounding environment included farm land and new housing development. Birdling Brooks stream was dry at the time of surveying 28th February 2017, however was flowing during a wet weather survey on 26th July and therefore the stream is considered to be intermittent.



Figure 18 : Receiving sites for Birdling Brooks wet weather (top left) and dry weather (bottom left) and Leeston Creek wet weather (top right) and dry weather (bottom right). Photos taken on 28 February and 26 July 2017

8.1.3 Existing water quality

Leeston Creek and Birdling Brooks were visited in dry weather on the 28th February 2017. No water samples were taken as the sites were dry. Wet weather water quality samples were taken on the 9th October 2017 after a rainfall event during the 7th and 8th October 2017 and the data is provided in Table 17. The data indicates that:

- In the Leeston Creek subcatchment total suspended solids increased downstream of the township discharges as did total phosphorous.
- In this catchment all other parameters were in generally similar concentrations upstream and downstream. Copper and zinc were above guideline values both upstream and downstream of the cumulative township inputs.
- Birdlings Brook above and below the stormwater basin discharge had low total suspended solids and mostly broadly similar results for other parameters except metal concentrations.
- Dissolved zinc and copper were elevated above guidelines both upstream and downstream of the discharge point with higher concentrations observed downstream.

It is therefore likely that the various discharges into Leeston Creek are giving rise to the elevated total suspended solids that are being observed. Without having data from the discharge from the dry stormwater pond it cannot be easily concluded whether that discharge was giving rise to the slightly elevated metals concentrations recorded at the downstream site.

Table 17 : High flow data for upstream and downstream of discharge sites in Leeston. Samples taken 9 October 2017.

Parameter (mg/L unless stated)	Leeston Creek		Birdling Brook Stormwater Basin		Guidelines
	Reference	Receiving	Reference	Receiving	
Total Suspended Solids	<3	11	<3	<3	-
Dissolved Copper	0.0025	0.0021	0.0011	0.0035	0.001
Dissolved Lead	<0.0005	<0.0005	<0.0005	<0.0005	0.001
Dissolved Zinc	0.008	0.009	0.007	0.011	0.0024
Total Nitrogen	17.1	12.6	12.8	8.37	-
Total Ammoniacal – N	0.02	0.02	0.02	0.02	2.18
Dissolved Reactive Phosphorus	0.008	0.009	0.014	0.012	0.016
Total Phosphorus	0.008	0.025	0.028	0.021	-
pH	6.75	7.21	6.87	6.48	Between 6.5-8.5
Conductivity	530	559	431	452	
Temperature	12.5	12.8	12.8	12.6	<2 °C change

Note: ¹Guidelines from Canterbury Land and Water Regional Plan – Water Quality Management Units and Classes for Spring-fed Plains.

Data in BOLD indicates that results are above guideline values.

No historic water quality data is available for Birdling Brooks on the Canterbury maps system. However, there is water quality data available in a AEE collected by Kingett Mitchel Limited for Leeston Creek in 2006. The AEE was carried out for Leeston North Subdivision to support the application for a stormwater diversion channel and included the effects of subdivision construction activities. The monitoring was undertaken in winter after a few wet days when the creek was flowing. This data shows a broadly similar pattern of water quality to the recent wet weather data with total suspended solids rising slightly after passage of water through the township and copper and zinc being above guidelines but not changing much with passage through Leeston.

Table 18 : Water Quality in Leeston Creek near the reference site and receiving site (19 June 2006)

Parameters	Leeston Creek at Harmans Road (At SDC Reference site)	Leeston Creek at Manse Road/high street intersection (300m above SDC receiving site)	Leeston Creek 300m below SDC receiving site	Guidelines ¹
Total Suspended Solids	<3	10	13	-
Dissolved Copper	0.0016	0.0017	0.0015	0.001
Dissolved Lead	-	-	-	0.001
Dissolved Zinc	0.008	0.05	0.005	0.0024
Total Nitrogen	12	6.9	11	-
Total Ammoniacal – N	0.04	0.05	0.07	2.18 ^A
Nitrate N + Nitrite N	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	1.1	0.8	1.3	-
Dissolved Reactive Phosphorus	0.019	0.026	0.039	0.016
Total Phosphorus	0.043	0.056	0.087	-
pH	7.0	7.2	7.3	Between 6.5 – 8.5
Temperature (°C)	8.0	4.9	6.2	< 2°C change
Conductivity (mS/m)	48	28	41	-

8.1.4 Existing water use and value

Leeston Creek runs through agricultural land and is frequently modified and straightened. Birdling Brook also flows through agricultural land, however is visually more appealing with a more natural channel form. No recreational or amenity use of the waterways is known. There are no known consented surface water takes in the vicinity of the township, however there are two community drinking water protection zones within the township for well or bore takes. The stormwater discharge is not expected to impact the drinking water protection zones.

8.1.5 Existing ecology

Kingett Mitchell Limited undertook an ecological assessment alongside the water quality assessment for Leeston Creek in 2006 and identified the following:

- No periphyton growth due to the lack of a stony substrate to colonise.
- Macrophytes present close to reference site but none at the receiving site.
- All macrophytes present were common and widespread, but regularly removed by contractors. Regular channel maintenance removes important macrophyte habitat for invertebrates and fish.
- Invertebrate communities are typical of lowland stream, being dominated by pollution tolerant amphipods and snails.
- No fish were recorded.

No existing ecological data was available for Birdling Brook, and the stream was dry at the time of the dry weather site visit. The habitat quality and ecological value is expected to be low as the stream is intermittent.

8.1.6 Stormwater quality

There is no existing stormwater quality data available for the six discharges from the three discharge subcatchments in Leeston. Stormwater is anticipated to contain the usual range of potential contaminants however it is the largest of all the townships being considered and contains the greatest variety of commercial activities. Stormwater quality is discussed for each subcatchment in turn:

Leeston Creek subcatchment – This is the largest subcatchment with the greatest amount of commercial activities and traffic generation. Leeston Creek receives the discharges from multiple sources and locations including the commercial activities within the township, which include: farm equipment stores, petrol station, restaurants and cafes and a supermarket. Closer to the township's centre there are less grassed areas and more kerb channel and sumps allowing untreated stormwater to enter into the engineered drain which flows from Messines Street to Station Road. It is therefore more likely that untreated stormwater is entering into the Leeston Creek discharge. Wet weather water quality data indicates that total suspended solids concentrations have risen with passage of Leeston Creek through the township and hence the township discharges may be contributing to these elevated concentrations. Within the north of this catchment is the Leeston North subdivision, from which stormwater passes through a wetland prior to entering Leeston Creek. Figure 19 contains an image of this wetland that was visually observed to be reducing turbid water to a much clearer discharge after passage through the wetland when visited after rain on the 26th July 2017. This wetland will provide for treatment of a proportion of the contaminants from this area. Overall given the size of the catchment and variety of landuses there is considered to be a medium risk of causing contaminated stormwater due to the untreated commercial landuse.

Leeston Lake Road subcatchment – This subcatchment contains mainly residential landuse and lower trafficked roads. As such it is likely to be of lower risk in terms of stormwater contamination than the Leeston Creek subcatchment.

Birdlings Brook Stormwater Basin – This catchment could be expected to be similar to the Leeston Lake Road subcatchment with a similar size and range of landuses. The final stormwater quality would be expected to be better given the presence of a new engineering dry pond system to provide treatment. However wet weather water quality data indicate that metal concentrations are rising downstream of the discharge which indicates that the stormwater could be having an impact.



Figure 19 : Wetland providing treatment of stormwater discharge from the northern subdivision of Leeston. Photo taken on the 26th July 2017

8.2 Assessment of Effects on the Environment

Water quality data is available from upstream and downstream of the stormwater discharges however no data is available from the discharges themselves, hence a semi-quantitative assessment of the potential effects of the discharges has been made. This assessment considers the primary contaminants associated with the stormwater and discusses them in turn.

8.2.1 Suspended Sediment

The wet weather monitoring data did not indicate any issues with the discharge from the Birdlings Brook dry pond system. This is as would be expected as the ponds are designed to contain stormwater prior to infiltration to ground in smaller events and only discharge directly in high flow events.

The data for Leeston Creek wet weather monitoring indicates that the township discharges may be contributing to the elevated suspended solid concentrations observed downstream of the township. However, concentrations at the receiving site, while higher than upstream, were not elevated to levels that may be likely to have ecological impacts. Concentrations in discharges of 50 mg/L are often used as limits on discharges to minimise the risk of adverse effects. Therefore, while this catchment may be giving rise to elevated suspended sediments they would appear to be unlikely to be having ecological impacts.

8.2.2 Nutrients

The township does not contain notable activities that would cause nutrient contamination above normal/residential stormwater. Water quality data from 2017 show similar concentrations of all parameters in upstream and downstream sites except total phosphorous which rose slightly. No guideline values exist for total phosphorous but the more bioavailable dissolved reactive phosphorous concentrations were below guideline values indicating that adverse effects on stream ecology are unlikely. Given the intermittent nature of the stream flow the growth of nuisance algae or excessive macrophytes as a result of this slight change in nutrient is considered to be unlikely.

8.2.3 Heavy Metals

Dissolved copper and zinc were elevated in both upstream and downstream sites in the wet weather sample taken from Birdlings Brook with concentrations increasing downstream of the dry pond discharge. This indicates that the township discharge may be having an impact on the water quality. It has been recommended as part of the Stormwater Monitoring Programme that discharge points are also sampled with the reference and receiving sites to aid future identification of the source of elevated metal concentrations, and further sampling would be required to build up a trend.

The wet weather water quality data for Leeston Creek again showed elevated concentrations of dissolved copper and zinc but concentrations were similar above and below the township.

No freshwater ecological assessment was conducted on Birdling Brooks as the stream was dry during the low flow season. However, it is assumed that, similar to Leeston Creek, the composition of invertebrates would be dominated by pollution and disturbance/intermittent flow tolerant species during wet weather. Therefore, the elevated heavy metals that may occur during high flow events are not expected to have the main controlling effect on the ecological value of the stream as the intermittent flow is considered most likely to be controlling the ecological value.

From the data provided Birdling Brooks discharge is expected to have a higher risk than the other discharge points of heavy metals entering into the downstream environment. Further sampling at the discharge point is required to identify if there is an issue within this catchment.

8.2.4 Hydrocarbons

Hydrocarbon concentrations are anticipated to be moderate due to the larger size of the township compared to the others within this assessment. Leeston therefore has greater amounts of traffic movements giving rise to a greater build up on drips of oils etc. Some stormwater passes through roadside swales and drains where passage through vegetation and soils will allow for adsorption of the hydrocarbons from where soil microbes can break them down over time. Other areas however do not have a similar level of treatment as the stormwater is captured in curb and channel areas.

The wetland servicing the Leeston North subdivision and the dry pond to the south are both expected to treat the hydrocarbon inputs such that no impact on the water quality and ecology below these sections of Leeston would be expected. The remaining areas of Leeston have less treatment and some hydrocarbons would be expected to enter the receiving waters.

If hydrocarbons are present in the stormwater then it is considered more likely these will be elevated early in a storm, as drips of hydrocarbons arising from oils and fuels from vehicles on roads/hardstanding are washed off. It is therefore considered that the majority of hydrocarbons entering dry channels such as the drains would be treated with the passage of smaller runoff events and the first flush of larger events through the soil. For Leeston Creek there would also be some adsorption within channel as the creek starts to pond after rainfall and then starts to flow. Given the fact that the Leeston Creek and drains are only intermittently flowing the ecology will be controlled primarily by the flow regime. Any small changes to water quality with hydrocarbon inputs at the start of rain events would not be expected to have an impact on the ecological values of the waterway.

8.2.5 Summary Assessment

Overall, the stormwater discharge from the six discharge points may be having some impacts on the water quality of Leeston Creek and Birdling Brook. This is primarily through sediment input to Leeston Creek and metals input to Birdling Brook. It is considered unlikely that these would be having a notable effect upon the ecology as the intermittent flow would be the primary control on the ecological value of the receiving environments. Due to the increases observed in some parameters it is recommended that further monitoring is undertaken for Leeston Township.