Ecology and proposed naturalisation of Upper Dawson Creek

Prepared for:
Selwyn District Council

AEL Report No. 178

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Final Report

October 2019

Looking upstream at a typical reach within the development area

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1 Executive Summary

Selwyn District Council (SDC) propose to convert a 22-hectare area of existing agricultural use into a community recreational park. This area encompasses the headwaters of Dawson Creek, which forms a tributary of the Halswell River.

The section of Dawson Creek that falls within the proposed development area was assessed for macroinvertebrates and fish. Macroinvertebrates were collected from a single site using a kick-net and soft-bottom sampling technique. Fish were sampled using electric fishing, fyke nets and Gee Minnow™ traps at several sites through the development area. The faunal community was representative of a degraded system. However, this was likely to be attributable to poor habitat quality and possible fish passage impediment rather than poor water quality. Therefore, this development is considered as an excellent opportunity to restore and naturalise the headwaters of Dawson Creek. A recommended restoration design and order of operation is provided. In addition, it is recommended that after naturalisation, both freshwater mussels/kākahi (*Echyridella menziesii*) and kōura (*Paranephrops zealandicus*) are stocked into the site. Both species are classified as 'At Risk – declining', are important taonga species and do not require sea access. Restoring this waterway will add significant value to the distinctly rustic, ecologically enhanced, rural style that this development strives to achieve.

2 Introduction

Selwyn District Council (SDC) propose to convert a 22-hectare area of existing agricultural use into a community recreational park. This park will complement the existing parks network in the area, and will service Prebbleton, Lincoln, Rolleston and Springston (Selwyn District Council & Global Leisure Group 2019). In addition to providing the community with sporting grounds and a dog park, there will be facilities and activities provided for young children, youth and adults, but also areas for cultural harvest and public foraging (Selwyn District Council & Global Leisure Group 2019). The development of this park is proposed to have a strong element of native planting, and to naturalise and remediate the section of Dawson Creek that transverses it (Selwyn District Council & Global Leisure Group 2019).

This report investigates the aquatic ecology of Dawson Creek within the proposed development area, and the potential ecological impacts of the development

3 Objectives

SDC commissioned Aquatic Ecology Limited (AEL) to evaluate

- Identification of any existing ecological values of significance and required protection.
- If ecological values of significance are identified, an assessment of the ecological impact of the development.
- Mitigation measures to avoid, reduce or compensate for any impacts that are identified.
- Recommendations regarding treatment of the existing water race, including advice regarding processes to be followed should the water race location be altered, or the banks of the water race be altered.

4 Methods

4.1 Field methods

A map of the area is provided in Figure 1. A macroinvertebrate sample was collected from near Site 2, and four sites were selected for electric fishing on the basis of possessing relatively high fish habitat value compared to other habitats in the development area (Figure 1). In other reaches where electric fishing was unsuitable, baited fyke nets and Gee Minnow™ traps were deployed.

4.1.1 Habitat assessment

A rapid habitat assessment was undertaken at Sites 1 – 4 on 22 August 2019 using the technique outlined in Clapcott (2015). This assessment measures key habitat attributes associated with habitat quality and high biodiversity which are individually scored and summed to develop a Habitat Condition Score. The scores from ten different habitat parameters are summed and range from 10 – 100.

Spot surface water temperature and electrical conductivity at Site 1 was recorded (ECTestr11) around midday on 23 August 2019, after all field work had been completed.

4.1.2 Macroinvertebrates

Macroinvertebrates are aquatic invertebrates large enough to be seen with the naked eye and are conventionally captured with a 500-micron (0.5 mm) mesh insect net. Sampling was undertaken on 22 August 2019 at just downstream of Site 2, and followed the conventional protocols for macroinvertebrate sampling of soft substrate habitats (Stark et al. 2001). A composite macroinvertebrate sample from an approximate streambed area of 3 m^2 was sampled. This sample was composed of kick-net sub-samples in submerged bankside vegetation (9/10 sub-samples) and submerged root mat (1/10 sub-samples), each of 0.3 m x 1 m. Samples were preserved in isopropyl alcohol before being transported to the AEL laboratory for identification.

In the laboratory, invertebrates were identified under a low-power binocular microscope to the lowest practicable taxonomic level, enough to calculate stream health metrics. Standard keys were used for identification (Winterbourn 1973; Winterbourn et al. 2006; Chapman et al. 2011).

Invertebrate results were assessed for:

- Macroinvertebrate Community Index$_{\text{soft bottom}}$ (MCI$_{\text{sb}}$)
- Quantitative Macroinvertebrate Community Index$_{\text{soft bottom}}$ (QMCI$_{\text{sb}}$)
- The so-called “EPT3 taxa”, specifically mayflies, stoneflies, and caddisflies minus the pollution-tolerant hydroptilids, and expressed as taxa richness and abundance
- Taxa sensitive to urban pollution
- Taxa with a ‘Threatened’ or ‘At Risk’ conservation status

The MCI, QMCI and %EPT3 were originally designed to assess organic pollution impacts in streams, and both the MCI and QMCI have been employed in recent years as measures of general stream health. Each identified macroinvertebrate possesses a pre-assigned score for stream health. These are ranked from 1 (most tolerant) to 10 (least tolerant), which are summed and averaged across all taxa from each site to calculate a combined MCI or QMCI score. The MCI is calculated by summing the scores and dividing by the number of taxa, then multiplying by 20, as given by the formula below.

$$MCI = \frac{Site\ score}{Number\ of\ scoring\ taxa} \times 20$$

An MCI score can vary of the range from 0 (when no taxa are present) to 200 (when all taxa score 10 points each).

The QMCI ranges from 0 to 10 and is calculated in a similar fashion as the MCI but is weighted by abundance of individual scoring taxa. The total number of individuals from each taxon is multiplied by its respective tolerance score. These numbers are then summed across all taxa for a site and divided by the total number of individuals collected at that site, as given by the formula below.

$$QMCI = \frac{Number\ of\ individuals\ \times respective\ tollerance\ score}{Total\ individuals\ at\ site}$$

MCI and QMCI scores can be compared against the water quality classes presented in Table 1 (Stark & Maxted 2007).

Table 1. Interpretation of MCI and QMCI scores based on Stark and Maxted (2007).

Quality class	MCI score	QMCI score
Poor	<80	<4.00
Fair	80–99	4.00–4.99
Good	100–119	5.00–5.99
Excellent	≥120	≥6.00

The %EPT3 measures the relative abundance of the three macroinvertebrates groups considered to be generally the most sensitive to contamination. It is derived by summing the number of mayflies, stoneflies and caddisflies (minus hydroptilids), dividing the sum by the total number of macroinvertebrates recorded, and then multiplying the product by 100. The %EPT3 ranges from 0 to 100.

Urban Community Index (UCI) scores were used to determine if the macroinvertebrate community represented any taxa that were sensitive to urban pollutants. Unlike the MCI and QMCI, there are no analogous category bands from which to determine waterway quality. Therefore, UCI scores for each taxa present were compared against UCI scores for all macroinvertebrates in New Zealand that currently have assigned UCI scores, to determine how sensitive the community was.

4.1.3 Fish

Sites 1 – 4 were electro-fished on 22 August 2019 using a conventional Kainga EFM300 electric fishing machine at an operating voltage of 300 – 400 V. D.C. A slightly higher than normal voltage was required because of the low electrical conductivity of the water (80 µS/cm). The higher voltage provided a sufficient electrical field size to prevent escapement. Electric fishing serves to briefly (approx. 3 seconds) render fish unconscious to facilitate their capture in nets for identification. The machine incorporates a timer, allowing the effective fishing time to be recorded. Overall conditions for fish capture using electric fishing were adequate, with low, but acceptable, water conductivity and sufficient water clarity.

Due to the sluggish and over-grown nature of some sites, electric fishing was supplemented with set-netting and trapping. This is because netting and trapping fishing techniques are more effective where slow-flowing water or abundant overhanging riparian vegetation is present. On 22 August 2019, two medium fyke nets, two mini fyke nets, and eight Gee Minnow™ lines were set overnight. All nets and traps were baited with fish pellets. Each Gee Minnow™ line was composed of five Gee Minnow™ traps, except for the most downstream line, which had four.

All captured fish were anesthetised, identified, measured, and after recovery, released back into their resident habitat.

4.2 Analytical methods and approach

Graphics were generated using Microsoft excel (graphs) and QGIS v 3.4.9 (maps).

5 Physical description: study area and downstream flow path

Dawson Creek is a low-elevation stream located on the southern outskirts of Prebbleton, and this first-order waterway rises from springs near the proposed park (Figures 1 – 2). The previous land uses for the park catchment include farming, cropping and horse training, but historically formed a lowland forest comprised of tōtara, mataī and kahikatea (Selwyn District Council & Global Leisure Group 2019).

Meandering south-east through non-dairying pasture, Dawson Creek discharges into the Halswell River south of the Halswell suburb. The Halswell River continues to flow for approximately 30 km to Te Waihora/Lake Ellesmere, south of Banks Peninsula. Te Waihora/Lake Ellesmere is a large coastal waterbody which discharges intermittently into the Canterbury Bight.

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Figure 1. Overview map of the Dawson Creek flow path, with ecological assessment locations (inset)

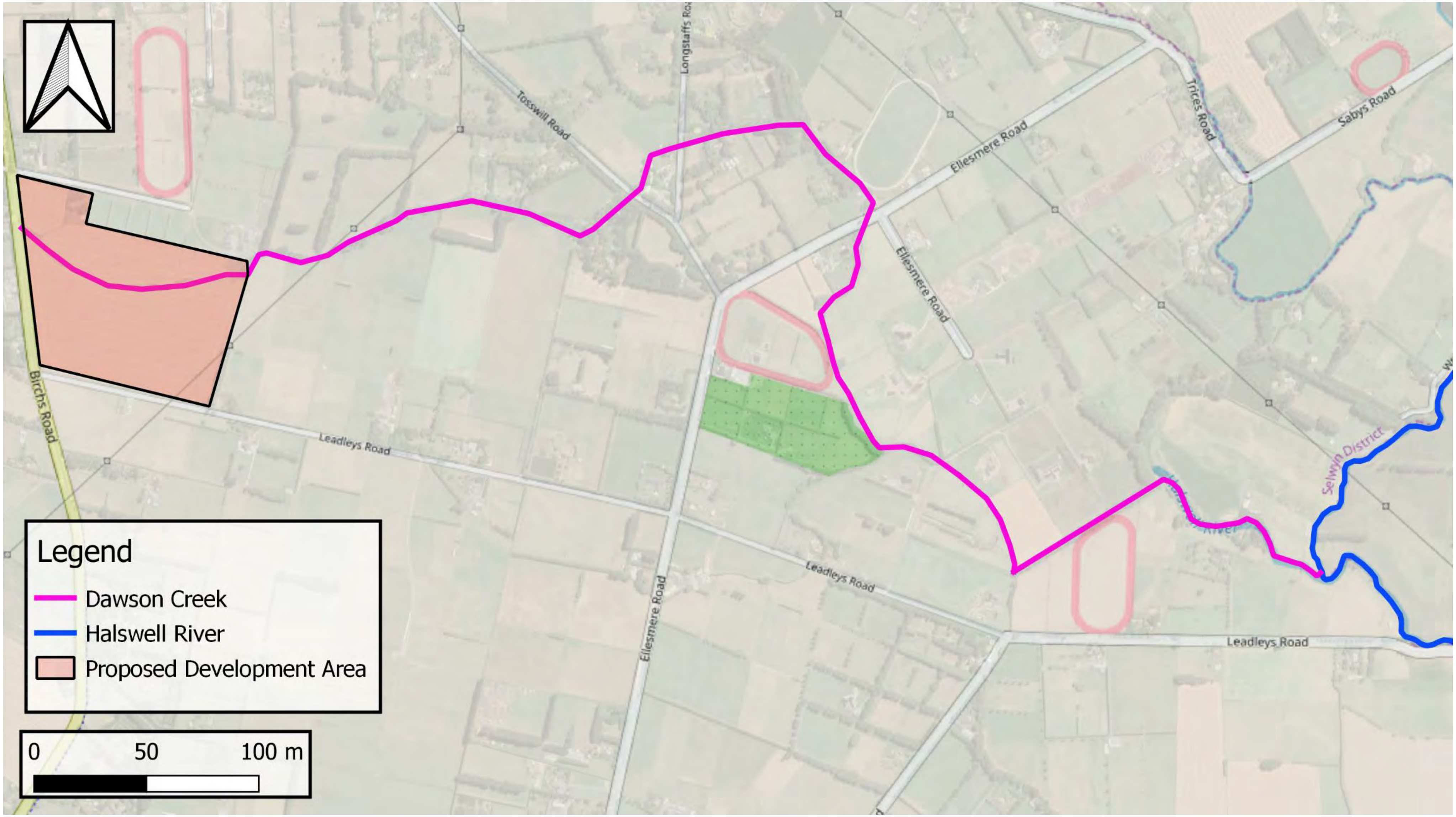

Figure 2. The flow path and adjacent land use of Dawson Creek upstream of its confluence with the Halswell River.

6 Results

6.1 Physical habitat

Overall, the habitat assessment showed that Sites 1, 2 and 4 were of similarly poor quality, with total scores ranging from 28.5 – 30 (Figures 3 – 7). Site 3 was in slightly better health, but still poor, with a total score of 39.

All four sites were characterised by having high sediment cover, low active bank erosion and low invertebrate habitat diversity/abundance (Figure 3). Riparian vegetation typically consisted of long pasture grass, with occasional native vegetation, bracken, bramble and gorse (Figures 4 – 7).

At all sites, the long grass provided fish cover in the form of overhanging vegetation. Additional fish cover was provided by undercut banks (Sites 1 – 3), root mats (Site 2) and debris (Site 4). Despite Site 2 having a greater diversity of fish cover, Site 3 the most fish cover amongst the four sites (Figure 3). This was largely due to the extent of undercut banks at Site 3. Hydraulic heterogeneity was comparably low at all sites and ranged from slow to fast run (Figure 3). Riparian width was greater at Sites 1 and 4 (Figure 3). At Site 4 this was mostly likely due to the shallow, uneven bank creating an unsuitable base for sowing bankside grass. There was no clear reason for the larger area of unsown pasture on the north bank at Site 1. Riparian shade was substantially higher at Site 3, as both banks were deeply incised (Figures 3 – 6).

Around midday on 23 August 2019, surface water conductivity and temperature were 80 µS/cm and 6.9 °C respectively.

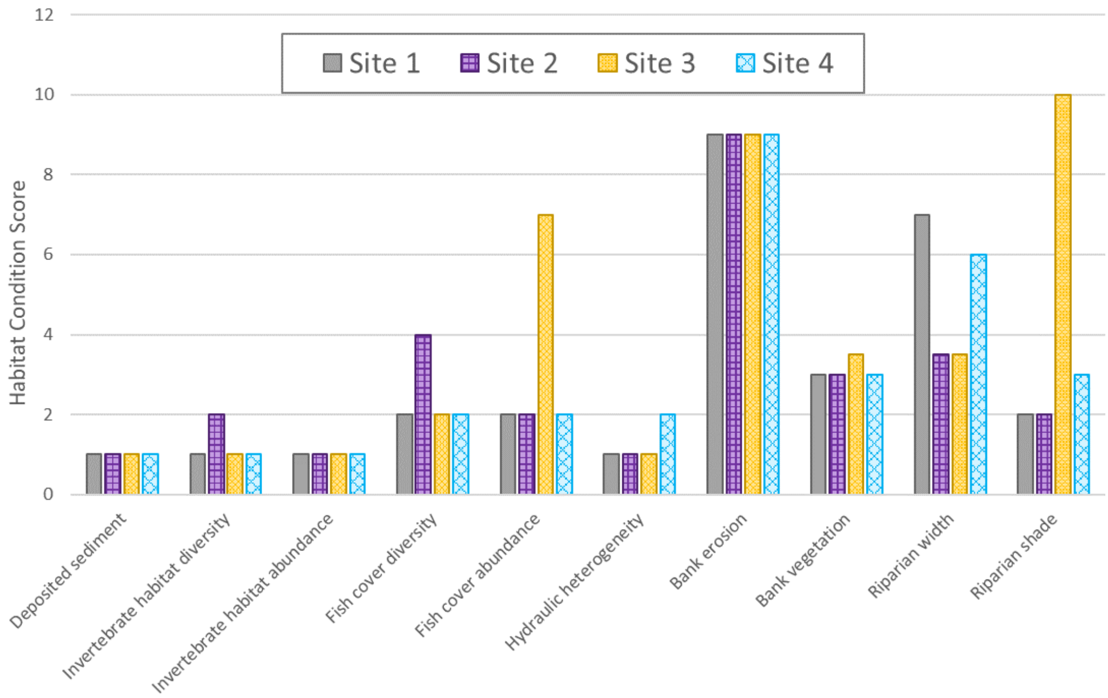

Figure 3. Habitat parameters assessed as part of the Rapid Habitat Assessment (Clapcott 2015). Low scores represent poor quality and high scores represent high quality. Note that the category "Invertebrate habitat abundance" refers to habitat suitable for Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa.

Figure 4. Looking upstream at Site 1.

Figure 5. Looking upstream at Site 2.

Figure 6. Looking upstream at Site 3.

Figure 7. Looking upstream at Site 4.

6.2 Macroinvertebrates

Both the MCI_{sb} (70.8) and $QMCI_{sb}$ (3.5) were low and fell within the 'poor' category. EPT3 abundance and taxa richness were also low, with EPT3 represented by just one species – the stick cased caddisfly *Triplectides* at 4.2% relative abundance.

The dixid midge *Paradixa* was the only taxa identified with a high (>7) MCI_{sb} score (8.5). It was the third most abundant macroinvertebrate identified and represented 17.5% of the sample. The snail *Potamopyrgus antipodarum* and the seed shrimp Ostracoda were the two most abundant taxa, at 28.7% and 23.1% respectively. Both of these taxa have low MCI_{sb} scores.

Taxa present in Dawson Creek are generally tolerant of urban environments. With three exceptions, all taxa present in Dawson Creek had a UCI score below the national median (Figure 8). No taxa were recorded above the 75th percentile.

No 'Threatened' or 'At Risk' species were identified in the samples (Grainger et al. 2018). However, the genera *Oxyethira* was identified. There are four known species in this genera, one of which is considered 'naturally uncommon', two 'data deficient', and one is 'Not Threatened' (Grainger et al. 2018). It is probable that the species identified was *Oxyethira albiceps* ('Not Threatened'), as the other three are only known from North Island locations (Wise 1998; Collier et al. 2009).

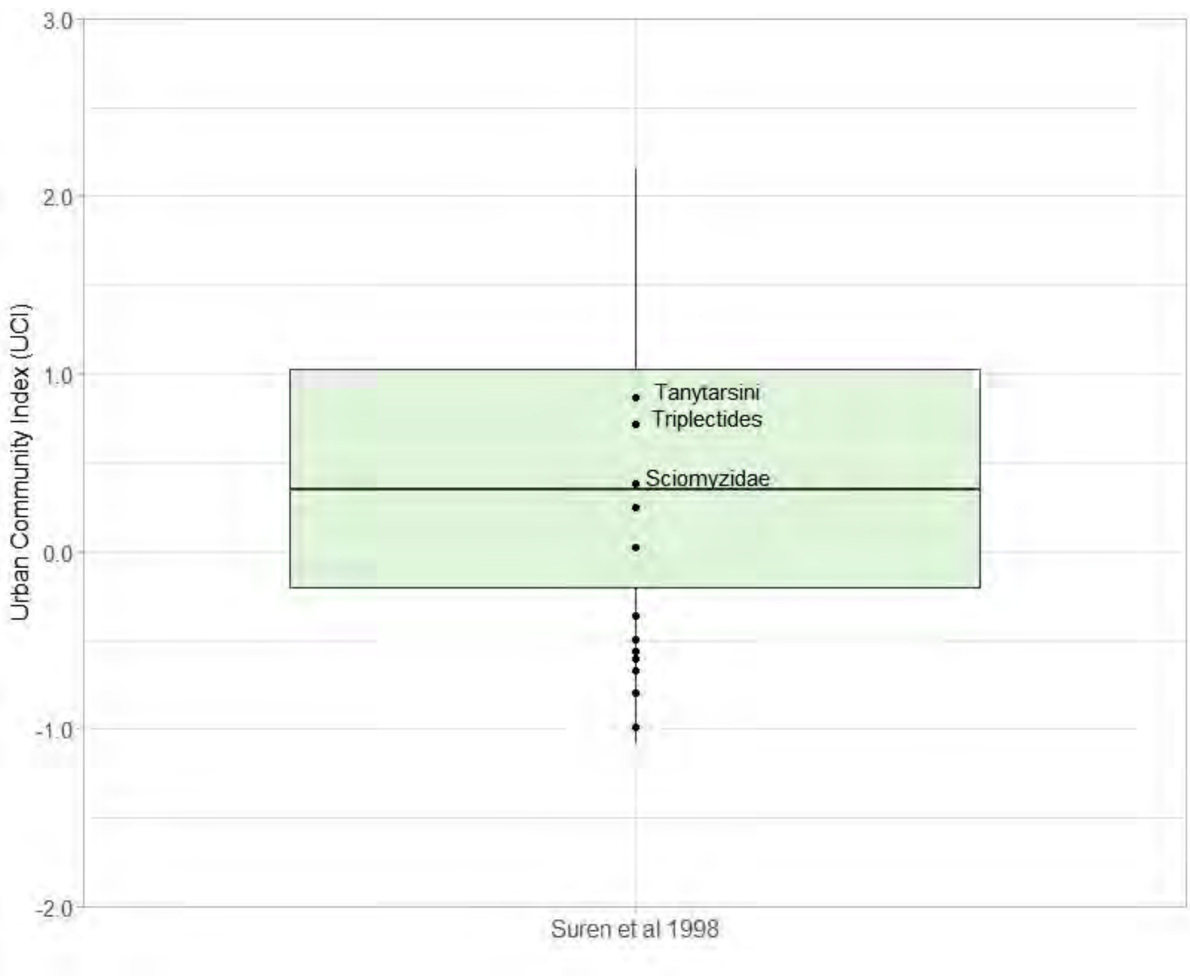

Figure 8. Boxplot showing the distribution of all Urban Community Index (UCI) scores for New Zealand macroinvertebrates (Suren et al. 1998), with UCI scores for all macroinvertebrates collected from Site 2 in Dawson Creek superimposed (black dots). Taxa present in Dawson Creek that have a UCI scores that exceed the national median are labelled.

6.3 Fish

Fish density was low in Dawson Creek. During electric fishing, upland bullies (*Gobiomorphus breviceps*) were identified from all sites except Site 3, where no fish were caught (Figures 6, 10). The maximum upland bully density of 0.5 fish per metre was recorded at Site 1. Shortfin eels (*Anguilla australis*) were recorded in low density at Sites 2 and 4, and a single common bully (*Gobiomorphus cotidianus*) was found at Site 2. Overall, Site 1 recorded the highest fish density, while Site 2 had the highest species diversity.

No fish were captured in any of the fyke nets. Five of the eight Gee Minnow™ lines were empty, while the other three captured a single upland bully each (Figure 10).

All of the captured fish had a conservation status of 'Not Threatened' (Dunn et al. 2017).

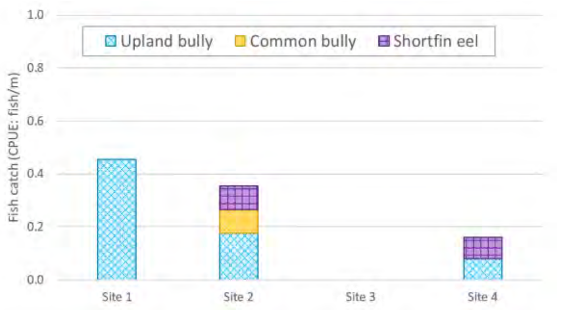

Figure 9. Fish catch per unit effort (CPUE) for each electric fishing site in Dawson Creek

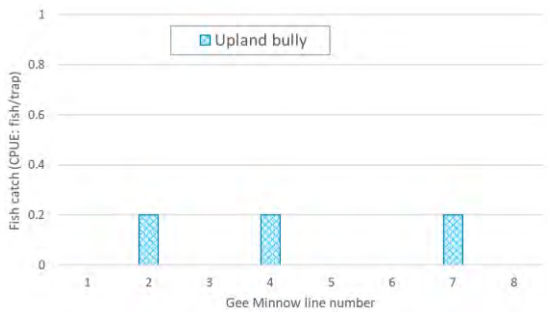

Figure 10. Fish catch per unit effort (CPUE) for each line of Gee Minnows™ in Dawson Creek

7 Discussion

7.1 Areas of ecological significance

The section of Dawson Creek that flows through the development area was thoroughly surveyed for fish life using both electric fishing and set nets/traps. Low densities of 'Not Threatened' shortfin eel/tuna, upland bully/toitoi and common bully/toitoi were identified (Dunn et al. 2017). In addition, none of the identified macroinvertebrates had a conservation status of 'Threatened' or 'At Risk', and based on UCI scores, none were particularly sensitive to urban contaminants (Suren et al. 1998; Grainger et al. 2018). Because the MCI/QMCI was developed to identify organic pollution rather than urban contaminants, the presence and abundance of the high scoring *Paradixa* indicates that organic enrichment was low. Organic enrichment often occurs when nutrient levels are high, however we found that surface water conductivity was low, indicating that nutrient levels in Dawson Creek were not elevated. Low conductivity is also indicative of low levels of dissolved metals, such as zinc and copper which are typical urban contaminants.

Given the probable low concentration of nutrients and dissolved metals in Dawson Creek, it is likely that the faunal community is impacted by poor habitat and possible fish passage impediment rather than poor water quality. This is supported by the habitat assessments which showed generally poor habitat was present at all sites. Given the above, this section of Dawson Creek does not provide any areas of ecological significance, however it is an ideal candidate for restoration and could be stocked with freshwater mussels/kākahi (*Echyridella menziesii*), kōura (*Paranephrops zealandicus*) and non-invasive native macrophytes.

Freshwater mussels and kōura have a conservation status of 'At Risk – declining' and are considered a taonga species. The inclusion of these two species, in conjunction with the development of an island planted with flax/toetoe for cultural harvest, could add significant value to the cultural aspect of the new park. If a mussel population is established, it is possible that the small nature of this waterway and their long lifecycle would mean that regular harvest would be unsustainable, however they would still add significant value to the ecosystem.

7.2 Impact of the proposal on the ecology

Given the generally low-quality state that this section of Dawson Creek was in, there are no specific recommendations that can be made. However, all works in and around a waterway can cause negative effects on instream biota and habitat. Therefore, it is recommended that all bank works occur in isolation from the existing channel, as described in Section 7.3.

7.3 Recommendations regarding treatment of Dawson Creek

7.3.1 Dawson Creek realignment

Stream features

It is recommended that the reach of Dawson Creek that flows through the development area is naturalised, with the new channel created adjacent to the existing location. This will enable the works to occur in isolation from the existing channel, minimising instream impacts. This section of Dawson Creek is an excellent candidate for stocking with freshwater kōura and freshwater mussels, as discussed in Section 7.1. Therefore, it is recommended that the naturalised form provides suitable habitat for these species, as well as the existing resident fauna.

Habitat requirements of freshwater mussels are not specific as they are habitat generalists and occupy a wide range of environments, from small fast flowing streams to lakes. However, mussels are dependent on fish to act as hosts for their parasitic larvae (glochidia). Koaro are typically considered the original host species (McDowall 2002 *cited in* Campbell 2005), however there are many breeding populations of mussels that exist where koaro do not, and they are commonly found on eels, giant bullies and common bullies (Butterworth 2008). Without fish to act as hosts, there will be no recruitment and the population will eventually become locally extinct. In order to establish a self-sustaining population, it is therefore necessary to follow the habitat recommendations outlined below.

The existing form of Dawson Creek is typically channelised and overly wide. To accommodate both the existing fauna and inclusion of kōura and freshwater mussels, it is recommended that the new channel is narrowed in most places and for it to follow a meandering form with intermittent pools. In the case of Dawson Creek, suitable water velocity would create slow run – riffle habitat throughout much of the reach, while lower velocities would be appropriate in pool sections. This will create a heterogenous habitat, which will naturally increase biodiversity and community stability (Tews et al. 2004; Schindler et al. 2015). Kōura favour still or slow flowing water below 0.4 m/s and around 0.2 – 0.3 m deep (Jowett et al. 2008). However, kōura will still inhabit much deeper water such as in lakes (Devcich 1979). Jowett et al. (2008) showed that young kōura were associated with shallow depths and fine substrate, therefore it is important that some areas of slow, wide run habitat are created.

It also recommended that the banks are terraced, with the lower and upper banks planted and sloped appropriately (Figure 11). This form is critical to the successful and self-sustaining rehabilitation of a waterway. The lower bank creates a channel that has suitable flow during baseflow conditions, where water depth and velocity is optimal for resident biota and excessive sedimentation of the bed does not occur. The lower bank should be planted with overhanging vegetation that can withstand periods of inundation, such as *Carex* and *Juncus* species. The overhanging vegetation will provide refuge for instream biota, as well as a terrestrial food source. This food may be in the form of detrital inputs or terrestrial invertebrates. Terrestrial invertebrates form an important part of the aquatic food web (Burdon 2004), particularly in headwater streams where aquatic invertebrate densities may be too low to sustain predatory fish (Allen 1951 *cited in* Burdon 2004). Further, dense riparian planting will stabilise the bank and prevent erosion. The upper bank will accommodate elevated flows during times of flood and can be planted with a much greater variety of vegetation, depending on elevation above the water level. All vegetation planted must be native and non-deciduous, as New Zealand's freshwater ecosystems have not evolved to cope with large autumnal leaf falls. Excessive leaf fall, as occurs in deciduous trees, can cause oxygen stripping and smother stream habitat, thus severely degrading systems.

It is recommended that the new channel bed is lined with a variety of different sized cobbles (60 – 260 mm), with occasional boulders (260mm+). Cobbles form an important part of the ecosystem, as they provide food and refuge for invertebrates and fish. Macroinvertebrates feed on the periphyton film that grows on stable substrates such as cobbles and seek refuge from predators in the small interstitial spaces between them. Fish feed on these macroinvertebrates and also utilise the interstitial spaces for refuge. In addition, a variety of different sized cobbles creates diverse microhabitat conditions, such as small-scale velocity changes. These differences in velocity create small pockets of habitat that are better suited to certain species (an ecological niche) and provide resting places for fish. Furthermore, adult kōura are known to favour cobble substrate (Jowett et al. 2008), and overlapping large cobbles/boulders can provide refuge for them from predators.

Habitat can be further enhanced by providing additional forms of refuge. Undercut banks are prime habitat for kōura (Jowett et al. 2008) and fish, and an upturned tree trunk secured in the bank can provide excellent cover (Department of Conservation 2019). Native macrophytes such as red pondweed (*Potamogeton cheesemanii*) and milfoils (*Myriophyllum sp.)* could be seeded into the new section. Native macrophytes tend not to form nuisance growths, particularly when stream shading is high. They provide habitat for fish and macroinvertebrates, and kōura can be found in macrophyte beds in high densities (pers. obs.).

Kōura habitat can be further improved by installing small PVC pipes (30 – 50 mm) in the banks just above the streambed, with a few situated further up the bank. These pipes mimic the natural burrows they inhabit, and so will help to provide shelter from fish/birds and will reduce intra-species competition for otherwise limited habitat during stream establishment. There are no known studies that have utilised pipes to mimic natural kōura burrows, and this provides an excellent opportunity to monitor the success of this approach. PVC pipes are frequently and successfully installed into banks to provide habitat for eels.

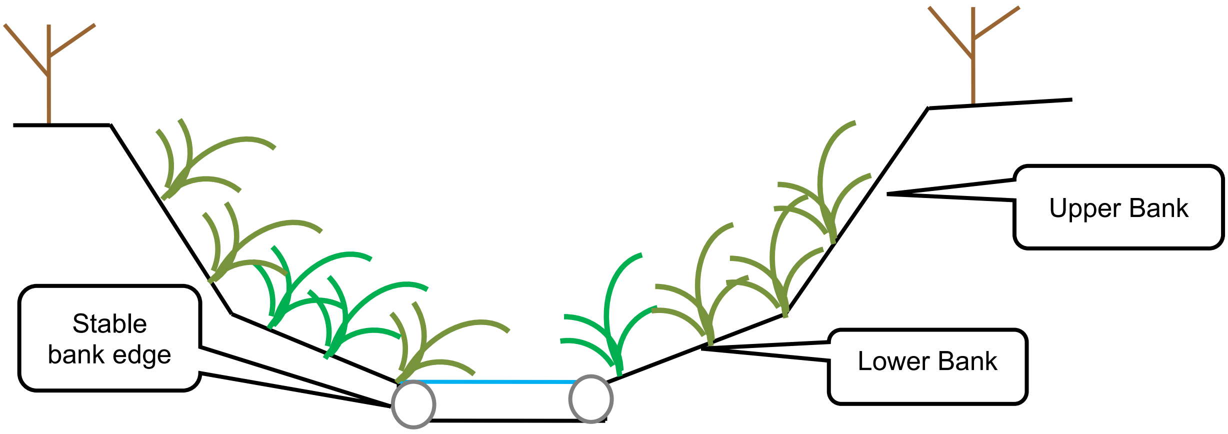

Figure 11. Hypothetical diagram of the vertical and vegetated form of the new channel. Vegetation is represented by green-brown icons.

Recommended approach to instream works

In order to naturalise Dawson Creek, AEL proposes the following methodology.

1. The new channel is constructed in isolation from the existing channel, following the recommendations outlined above. Instream macrophytes however, should not be planted until Step 4.
2. The old channel will be stopnetted upstream and downstream of the cut-in locations, with fish to be removed from the netted area by an ecologist and translocated downstream.
3. Once the fish salvage operation has been completed, the downstream end of the new channel will be broached first, followed by the upstream. The old channel can be bunded and filled in.
4. When water flows through the new channel, native macrophytes can be seeded in.
5. When a thin film begins to grow on the substrate, macroinvertebrates should be collected from downstream and seeded into the new channel.
6. When both macrophytes and the macroinvertebrate community have become established, kōura and freshwater mussels can be stocked into the new channel.

Treatment of existing culverts and proposed instream structures

There are two existing culverts in the section of Dawson Creek that flows through the development area. The downstream culvert is near the eastern border (c. 35 m long) while the upstream culvert is located near the western border (c. 25 m long). It is recommended that these are removed, and the creek naturalised through these areas. Culverts may present serious barriers to upstream crayfish migration, but there is little data from New Zealand. Kerby et al. (2005) conducted a small-scale experiment on American crayfish and found that in smooth culverts, all crayfish were pushed downstream at a velocity of 0.3 m/s. This same study also found that crayfish were frequently absent upstream of large barriers such as waterfalls and culverts. Furthermore, New Zealand culverts have been found to act as barriers to upstream winged-insect migration, considered partly due to behavioural inhibition from entering the culvert mouth (Blakely et al. 2006), regardless of barrel water velocity. For this reason, certainly for winged invertebrates, and possibly for crayfish, culverts may present critical colonisation impediments to headwater sites.

In contrast to invertebrates, there is plenty of evidence that culverts can inhibit fish migration, depending on fish species, water velocity and the orientation of the culvert in the channel. The recent MFE discussion paper (Ministry for the Environment 2019), strongly suggests that culvert use will be minimised wherever possible in the future, especially urban development.

The park masterplan indicates that bridges, stepping stones and potential shallow fords may be included in the final stream design (Selwyn District Council & Global Leisure Group 2019). Both bridges and stepping stones are acceptable methods for traversing the creek, however fords are not. The use of stepping stones, while acceptable, should be installed with care to ensure that fish and invertebrate passage is not hindered. The New Zealand fish passage guidelines indicate that fords are the least preferred option for crossing designs, while bridges are the most preferred (Franklin et al. 2018). While these guidelines are not yet fixed in law, it is important that the Selwyn District Council takes a leadership role towards following environmental 'best practice'. In addition to environmental benefits, bridges provide the greatest aesthetic appeal and match the tone of the park. The installation of bridges rather than fords or culverts provides an excellent opportunity for public education. Signs can be installed on or adjacent to bridges, explaining why bridges were chosen over other engineering designs. Other information plaques could also be included along the 'play spine' to further boost amenity value to the public. These could explain: the resident instream fauna; the importance of riparian vegetation, overhead shade, instream refuge, sufficient water velocity and stable flows; connectivity issues faced by freshwater fauna; the impact and source of poor water quality; mahinga kai values; history of the land.

8 Conclusions

The section of Dawson Creek that flows through the proposed park development area does not possess any values of particular ecological significance. This is likely due to poor habitat quality rather than poor water quality, therefore this site provides an ideal opportunity to restore the headwaters of Dawson Creek. Provided the recommended stream habitat features and order of operations are followed, this site could provide an ecologically significant site at a local scale.

9 Recommendations

AEL recommends the following:

- Dawson Creek is naturalised through the development area, following the habitat and order of operations recommendations detailed in Section 7.3
- Kōura and freshwater mussels are stocked into the site to improve the ecological and cultural quality of Dawson Creek

10 Acknowledgements

We thank Clinton Webb and Janine McIvor for assistance in the field.

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12 Appendix I. Macroinvertebrate taxa list

Table i. Summary of macroinvertebrates collected from Boltons Gully Waterway.

		Site 2	MCI_{sb}
CRUSTACEA			
Ostracoda		66	1.9
MOLLUSCA			
Gastropoda			
Hydrobiidae	*Potamopyrgus antipodarum*	82	2.1
Physidae	*Physa acuta*	20	0.1
	Gyraulus	4	1.7
INSECTA			
Diptera			
Tanypodinae		6	6.5
Chironominae	*Tanytarsus*	24	4.5
Dixidae	*Paradixa*	50	8.5
Sciomyzidae		4	3.0
Trichoptera			
Leptoceridae	*Triplectides*	12	5.7
Hydroptilidae	*Oxyethira*	10	1.2
Hemiptera			
Corixidae	*Sigara*	2	2.4
Coleoptera			
Dytiscidae	*Liodessus deflectus*	6	4.9
No. Scoring taxa		12	
TOTAL No. of animals		286	
MCI-sb		70.8	
QMCI-sb		3.5	
%EPT3		4.2	
EPT3 taxa richness		1	