Appendix H - Ecological Assessments prepared by Freshwater Solutions

report

November 2019

162 Studholme Street Development Ecological Assessment

Submitted to:
Lockerbie Estates Limited

fresh water solutions
environmental consultants

Quality Assurance

This report has been prepared and reviewed by the following:

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1.0 Introduction

Lockerbie Estates Ltd are proposing to develop a residential subdivision at 162 Studholme Street, Morrinsville (the site) (Figure 1). The Lockerbie Estate development has been master planned by Transurban Ltd in conjunction with Matamata-Piako District Council and Waikato Regional Council (WRC) and a team of specialists including Maven Associates Ltd. The proposed plan will deliver 900 residential lots, a 120-unit retirement village and a neighbourhood commercial centre.

The site is approximately 80 ha and currently an operational dairy farm with vegetation comprising grazed pasture, hedges, shelterbelts and occasional exotic species. The southern portion of the site is zoned residential whilst the northern portion is zoned rural but identified as a future residential policy area (i.e., future urban growth). Lockerbie Estates Ltd are proposing to develop the site in stages with an indicative site layout shown in Figure 2.

There are four main watercourses draining the site hereafter referred to as Watercourses S1, S2, S3 and S4. The proposed development would see the retention and enhancement of natural watercourses in the northern portion of the site (S2 and S3), reclamation of the watercourse in the southern portion (S1) and construction of up to six off-line wetland stormwater management devices throughout the site.

This report assesses freshwater ecological characteristics and values and assesses effects and mitigation/offset requirements for a site-wide stormwater consent application.

2.0 Site Description

The site is located on the northern boundary of Morrinsville and in the Hinuera Ecological District (ED). Soils are characterised by brown granular clays on old andesitic cones with peat soils on the margin of raised peat bogs (McEwan 1987). Historically, the entire site would have been covered with indigenous lowland forest, with large areas of swamp forest and peat wetlands on flatter, poorly drained land. There are four main watercourses draining the site (S1, S2, S3 and S4) and three smaller side branches or farm drains that feed into Watercourse S2 (referred to as S2a, S2b, S2c). All watercourses draining the site are within the wider Piako River catchment.

Watercourse S1 flows in a southerly direction and exits the site via a pipe network that starts near the southwestern tip of the site. Watercourse S1 emerges from the pipe network under Morrinsville to the immediate south of Snell Street where it flows for ~250 m before discharging into Morrinsville Stream. Below this confluence, Morrinsville Stream flows for ~2.15 km downstream before converging with Waitakaruru Stream, which flows for a further 750 m till it joins the Piako River to the south of Morrinsville.

Watercourses S2, S3 and S4 drain in a northerly direction and occur in the northern portion of the site. Watercourses S2 and S3 converge to the immediate north of Taukoro Road. This watercourse flows northwards for ~3.9 km where it joins the Maungahaumia Stream, which flows for a further 2.9 km before joining the Piako River at Haumia Road between Mangateparu and Te Puninga.

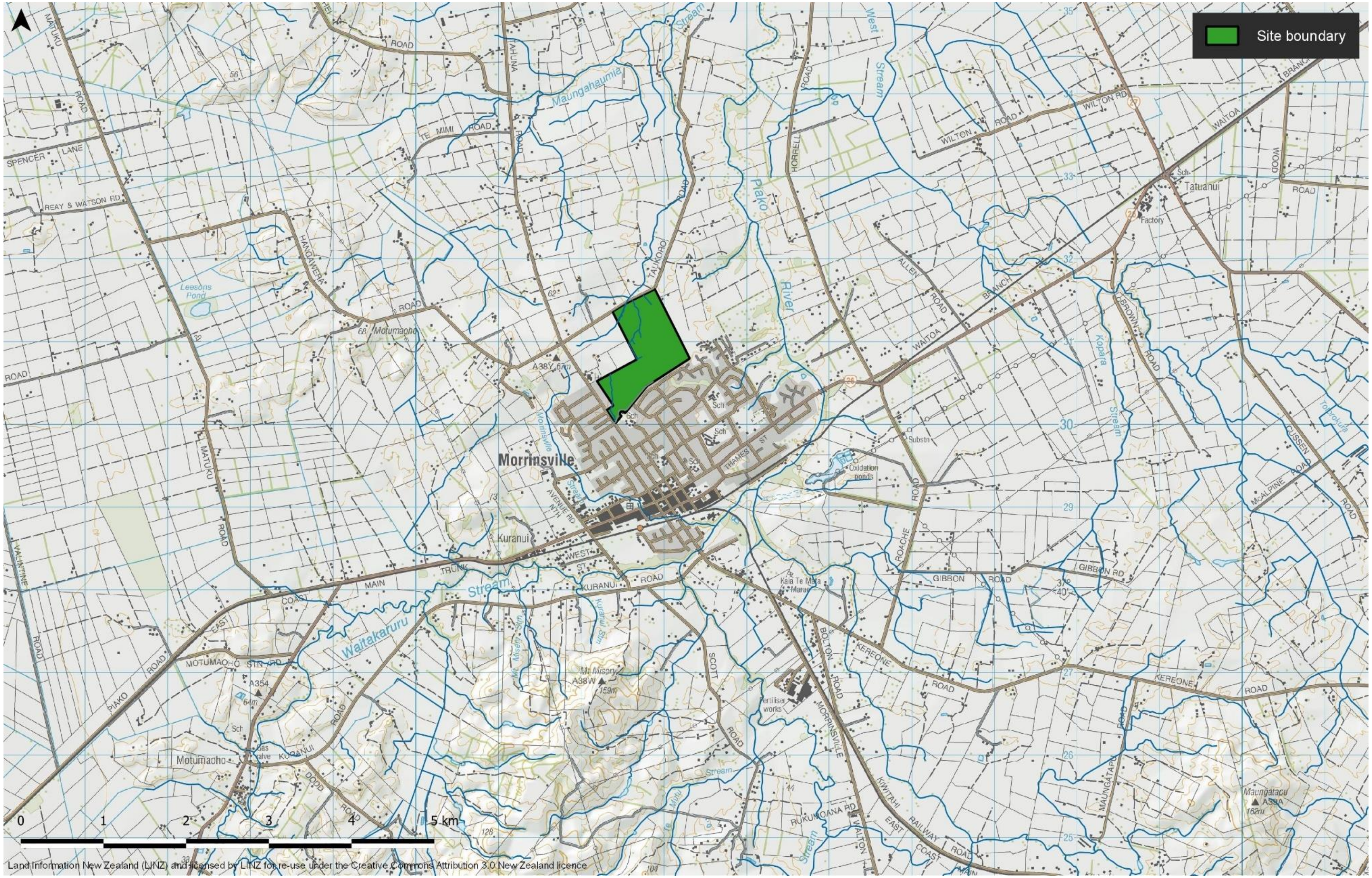


Figure 1: Location of proposed development at 162 Studholme Street.

Figure 2: Proposed development layout (from Transurban 2019).

3.0 Study Methods

3.1 Desktop Review

The Matamata-Piako District Plan and WRC plans, policies and maps were reviewed to determine if any significant freshwater resources occurred within the site. Aerial photographs from 1940, 1941 and 1948 were obtained from Retrolens and assisted with identifying historical stream alignments. Engineering plans and stormwater details were obtained from Maven Associates Limited.

3.2 Data Collection

Surveys and Timing

Surveys were carried out on 28 August 2019 and 10 October 2019. There was 2.8 mm and 0.2 mm of rainfall over the two days prior to the 28 August and 10 October surveys at the Ruakura 2 ews station (National Climate Database). There was 36.0 mm and 4.4 mm of rainfall over the 7 days prior to the 28 August and 10 October surveys.

Stream Classification

Watercourses within the site were classified in accordance with the definitions outlined in the WRP for the Waikato Region (i.e., artificial, farm drainage canal, modified, ephemeral or perennial). The farmer whom had farmed the site for 10 years assisted by providing a plan that showed watercourses that flowed year-round and those that did 'not' flow continuously for at least three months between March and September. The WRP definitions are:

- *Artificial* – a watercourse that contains no natural portions from its confluence with a river or stream to its headwaters and includes irrigation canals, water supply races, canals for the supply of water for electricity power generation and farm drainage canals.
- *Farm drainage canal* - an artificial watercourse on a farm that contains no natural portions from its confluence with a river or stream to its headwaters, and includes a farm drain or a farm canal.
- *Modified watercourse* - an artificial or modified channel that may or may not be on the original watercourse alignment and which has a natural channel at its headwaters.
- *Ephemeral* – streams that flow continuously for at least three months between March and September but do not flow all year.
- *Perennial* – streams that flow year-round assuming average rainfall.

General Habitat Characteristics

Aquatic and riparian habitat characteristics along each of the watercourses were described and included the measurement or visual estimation of wetted width, floodplain width, water depth, habitat type, streambed substrate, shade, erosion, flow velocity, aquatic plant cover and periphyton cover.

Invertebrate and Fish Fauna

Freshwater Solutions did not survey invertebrates or fish as this information had been collected from watercourses draining the site by Wildlands in 2019 (unpublished report). Fish data was supplemented with data held in the New Zealand Freshwater Fish Database (NZFFD) for watercourses within the site and wider catchment.

Stream Ecological Values

The Stream Ecological Valuation (SEV) assessment tool was originally developed for use in the Auckland Region where urban development resulted in significant pressures on streams (Storey et al. 2011, Neale et al. 2016). The use of the SEV is required by the Auckland Unitary Plan when assessing stream values and stream habitat loss in the Auckland Region. The SEV method was used to assist with the ecological values assessment for streams within the site and guide the assessment of effects including mitigation and offsetting (refer to Section 3.4).

3.3 Assessment of Effects Methodology

The method applied to this assessment of ecological effects broadly follows the Ecological Impact Assessment Guidelines (EcIAG) (Roper-Lindsay et al. 2018) published by the Environment Institute of Australia and New Zealand (EIANZ). The method involves assigning ecological values and assessing the magnitude of effects based on criteria outlined in Table 1 and the overall level of effect using the matrix in Table 2.

Table 1: Criteria for describing magnitude of effect (Roper-Lindsay et al. 2018).

Magnitude	Description
Very high	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Table 2: Criteria for describing level of effects (Roper-Lindsay et al. 2018).

Magnitude	Ecological value				
	Very high	*High*	*Moderate*	*Low*	*Negligible*
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

3.4 Mitigation and Offset Assessment

The SEV and Environmental Compensation Ratio Method

The SEV and methodology was originally designed to determine the value of Auckland urban streams, but is now being applied by other regional councils to evaluate effects management proposals associated with impacts of modifying streams (Maseyk et al. 2018). The WRP and Waikato Regional Policy Statement (WRPS) do not require that the SEV method be used in the Waikato Region.

The Environmental Compensation Ratio (ECR) method using SEV scores was developed for the Auckland Region as a means for quantifying an area of stream required to be restored relative to an amount of stream area impacted to ensure 'no net-loss' of ecological function and values. The SEV/ECR methodology has predominantly been applied in the Auckland and Wellington regions but has been adopted on an ad hoc basis in other regions (Maseyk et al. 2018). The ECR method is based on predicted SEV scores relating to 'potential' and 'after-impact' values of an impacted stream and the 'current' and 'after-restoration' values of a reach where the offset will occur. The ECR equation (see below equation) includes a 1.5 multiplier to address potential time lags, risk and uncertainty in the delivery of stream ecological benefits arising from proposed offsets (Storey et al. 2011).

For the most part, the SEV method is a robust and effective 'tool' to support decisions on suitable offset packages for the modification or loss of freshwater stream habitats (Maseyk et al. 2018). Maseyk et al. (2018) however state in the 'Biodiversity Offsetting under the Resource Management Act Guidance Document' that *there are aspects of the SEV methodology and its current application that make parts of its application inconsistent with good practice biodiversity offsetting and environmental compensation*. Maseyk et al. (2018) go on to state that the issues with the SEV/ECR relate mostly to technical matters that arise from how the SEV treats the current state of the environment, how it communicates an overall score representing the 'value' of a stream, and how the ECR calculation adds multipliers (i.e., the 1.5 multiplier). Maseyk et al. (2018) conclude that these *matters can compromise the SEV's intended purpose as a tool for achieving no-net-loss*.

ECR = [(SEVi-P – SEVi-I) / (SEVm-P – SEVm-C)] x 1.5

Where: *SEVi-P is the potential SEV value for the site to be impacted.*

SEVm-C is the current SEV value for the site where environmental compensation is applied.

SEVm-P is the potential SEV value for the site where environmental compensation is applied.

SEVi-I is the predicted SEV value of the stream to be impacted after impact.

Restoration length = (impact area x ECR) / restoration channel width

Approach Applied in this Assessment

The WRP and WRPS do not prescribe an approach to use when there is a loss of stream habitat and offsetting is required. The WRPS puts an emphasis on maintaining or enhancing indigenous biodiversity and specifically states that for non-significant habitats such as the watercourses draining the Lockerbie Estates property, there is a focus on:

a) Working towards achieving no net loss of indigenous biodiversity at a regional scale.

b) The continued functioning of ecological processes.

c) The re-creation and restoration of habitat and connectivity between habitats.

d) Providing ecosystem services.

e) Managing the density, range and viability of indigenous flora and fauna.

f) The consideration and application of biodiversity offsets.

Section 11.1.3 of the WRPS states that regional and district plans for non-significant indigenous habitats:

a) Shall require that where loss or degradation of indigenous biodiversity is authorised adverse effects are avoided, remedied or mitigated (whether by onsite or offsite methods).

b) Should promote biodiversity offsets as a means to achieve no net loss of indigenous biodiversity where significant residual adverse effects are unable to be avoided, remedied or mitigated.

c) When considering remediation, mitigation or offsetting methods may include the following:

    i) Replacing the indigenous biodiversity that has been lost or degraded.

    ii) Replacing like-for-like habitats or ecosystems (including being at least equivalent size or ecological value).

    iii) The recreation of habitat.

    iv) The legal and physical protection of existing habitat.

    v) Replacing habitat or ecosystems with indigenous biodiversity of greater ecological value.

With the above considerations in mind, the SEV/ECR method has been applied in the assessment and is treated as the starting point to **guide** offset requirements.

4.0 Stream Classifications

Watercourses within the site were classified in accordance with definitions outlined in the WRP (see Section 3.0). Aerial photographs from 1940 and 1941 were inspected to check historical and current channel alignments. Overall, watercourses within the site and shown on historical photographs matched up with present-day alignments. Stream classifications based on WRP definitions are shown on Figure 3 and summarised in Table 3.

Watercourse S1 has a total length of 610 m within the site and comprises 300 m of headwater flow path, 31 m of ephemeral stream and 280 m of perennial stream (33 m of which occurs on 280 Studholme Street). Watercourse S2 originates near the western site boundary and has an upper 300 m ephemeral reach and lower 310 m perennial reach. Watercourse S2a is a 103 m long flow path whilst S2b and S2c are artificial farm drainage canals. Watercourse S3 has an upper 157 m ephemeral reach and 106 m perennial reach. Watercourse S4 is an artificial farm drainage canal.

Figure 3: Stream classifications based on WRP definitions.

Table 3: Stream classifications according to WRP definitions.

Watercourse / drain	WRP status	Length (m)	Comment
S1	Flow path*	300 m	Flow path that has been artificially widened and deepened, farm drain characteristics
S1	Ephemeral	31 m	Extends d/s from culvert, lacks defined channel, grazing damaged, holds shallow diffuse surface water, bed lacks streambed sorting processes, marginal aquatic habitat
S1	Perennial	280 m	Extends d/s from where a row of poplars grow, has a defined channel, streambed sorting processes and flow
S2a	Flow path*	103 m	Short flow path branch that drains into S2 mainstem, has been artificially widened and deepened, farm drain characteristics
S2b	Artificial	71 m	Short artificial farm drain that has been constructed
S2c	Artificial	293 m	Long farm drain that feeds into the head of S2 mainstem, extends around the boundary of paddock/fence
S2	Ephemeral	300 m	Upper natural headwater section, lacks defined channel, artificially widened and deepened, wide floodplain, shallow diffuse surface water, most likely dry in summer, choked with grass and *Glyceria*, occasional areas of exposed bed with sorting processes
S2	Perennial	310 m	Lower section, wider channel, stable surface water year-round, flowing, moderate emergent macrophyte cover, flow sin V-shaped gully, channel widened and deepened in places
S3	Ephemeral	157 m	Headwater section, undefined channel, wide floodplain, shallow diffuse surface water, most likely dry in summer, choked with grass and *Glyceria*, marginal to no stable aquatic habitat
S3	Perennial	106 m	Lower section, wide floodplain, shallow gully, grazing damaged, no defined channel, water diffusely spread across base, very occasional pools of open surface water
S4	Artificial	157 m	Artificial farm drain, straight alignment, uniform, small amount of shallow surface water

Note: * = not a WRP watercourse definition but a term used in this report to account for overland flow paths within the site.

5.0 Habitat Characteristics

5.1 Watercourse S1

The section of Watercourse S1 draining the site is 610 m in length. Watercourse S1 flows in a southerly direction through the southwestern corner of the site. The stream leaves the site via a pipe network under Morrinsville and emerges as an open channel to the immediate south of Snell Street some 600 m to the southwest.

Upper Flow path

The upper 300 m of Watercourse S1 was assessed as being a modified overland flow path that drains a flat area of grazed pasture and lacking riparian vegetation (Figure 4). The flow path has been artificially widened and deepened, lacked a defined channel, was unfenced and grazing damaged, lined with grass and was dry at the time of the survey. There are two perched culverts (1 and 2) on the flow path however this section does not provide habitat for fish so they are not considered barriers to fish.

Figure 4: Flow path in upper reaches of S1.

Ephemeral Section

The upper flow path transitions into a relatively short section of ephemeral habitat in the vicinity of a row of poplar trees. The ephemeral section had a poorly defined channel (wetted width = 0.5 m), displayed evidence of streambed sorting process (e.g., silt), held shallow surface water (<0.02 m deep) at the time of the survey. The ephemeral section provided marginal aquatic habitat for invertebrates and is highly unlikely to support fish due to the water short and intermittent nature of the habitat.

Lower Perennial Section

The ephemeral section transitioned into a perennial section half way along the row of poplars near the western site boundary. The upper reaches of the perennial section had a silt streambed, narrow (~0.5 m wide), shallow (<0.15 m deep) and defined channel that was surrounded by exotic shrubs (e.g., arum lily, hawthorn, blackberry) and trees (e.g., grey poplar, Chinese privet) that provided some shade and restricted stock access (Figure 5). The upper perennial section crosses into the eastern corner of the neighbouring 180 Studholme Stream for 33 m and then drains back into the site.

The lower perennial section of Watercourse S1 flowed within a shallow depression that had been artificially widened over time after a long history of channel and floodplain widening, weed/macrophyte clearance and direct grazing damage causing pugging and poor channel definition (Figure 5). There was a single unperched culvert (3) in the lower reaches that was not a barrier to fish passage. The lower section had a wide floodplain (3–8 m), wetted channel width of 0.75 m was swampy in character and choked with grass and emergent macrophytes such as watercress *(Nasturtium officinale)* and willow weed (*Persicaria* sp.). Other macrophytes recorded along the lower section included spearwort *(Ranunculus flammula)*, starwort *(Callitriche stagnalis)* and duck weed *(Lemna minor)*.

There was little to no flow in the lower perennial section at the time of the survey, which reflected the diffuse spread of shallow water across the broad floodplain and the choked nature of the channel. The lower section was open and generally poorly shaded with occasional weeping willow *(Salix babylonica)* and a mature elm (*Ulmus* sp.) providing some shade. Sections of the stream where willow grew were wide and swampy as is typical. The perennial section provided stable but poor-quality habitat for invertebrates and fish.

Figure 5: Habitat along upper (top) and lower (below) perennial section of S1.

5.2 Watercourse S2

Overland Flow Paths and Artificial Drains

Watercourse S2a is approximately 103 m in length and is a flow path that drains a gentle sloping broad gully within a grazed pasture paddock. Watercourse S2a drains into the mainstem Watercourse S2 and has been artificially widened and deepened to an extent that the water table is at or near the base of the shallow depression and resulting in diffuse and shallow surface water. Watercourse S2a is choked with grass, *Glyceria*, grazed, lacks a defined channel and does not provide aquatic habitat. Watercourse S2a was not classed as an ephemeral or perennial stream due to its highly modified state and small catchment.

Figure 6: Modified flow path of Watercourse S2a.

Watercourses S2b and S2c were classified as artificial drains. Watercourse S2b is a 71 m long farm drain that drains a grazed pasture paddock, has a straight alignment, is lined with exotic grass, *Glyceria* and watercress, held a small amount of shallow non-flowing surface water and drains into the upper ephemeral section Watercourse S2 (Figure 7). Watercourse S2c is a 293 m long farm drain that feeds into the uppermost extent of the natural section of Watercourse S2 (Figure 8). Watercourse S2c has been dug along the western boundary fence and up to two ponds. There was no surface water in Watercourse S2c during the survey.

Figure 7: Artificial farm drainage canal S2b (top) and S2c (below).

Upper Ephemeral Section

The upper ephemeral section of Watercourse S2 is 300 m in length and has been artificially widened and deepened, is damaged by grazing and lacks a defined channel (Figure 8). The broad base of the depression (immediate floodplain) ranged in width between 2–4 m with diffuse and shallow (<0.02 m) surface water spread across it. The wetted width was estimated to be 0.7 m and was choked with *Glyceria*, exotic grass and watercress with occasional areas of open water with streambed sorting of the silt bed. The channel was unfenced, lacked riparian vegetation and poorly shaded. There are two unperched culverts on the ephemeral reach (4 and 5 = 6 m and 7 m in length). The ephemeral section provided marginal habitat for invertebrates and fish.

Figure 8: Habitat along upper ephemeral section of S2.

Lower Perennial Section

The lower perennial section is 310 m in length and drains a broad depression that becomes an increasingly steep V-shaped gully that meanders in a northerly direction towards the northern site boundary along Taukoro Road (Figure 9). The perennial section becomes increasingly more well-defined as it flows northwards with the lower 170 m section draining an incised, V-shaped gully with steep sides and is fenced on both banks. The upper unfenced perennial section is lined with grazed pasture grass whilst the lower fenced section has a riparian margin comprising weedy species (e.g., woolly nightshade, Chinese privet, ivy onion weed). The channel is generally poorly shaded with macrophytes recorded including *Glyceria*, willow weed, watercress and duckweed whilst long green filamentous was common in some areas. The perennial section channel has an average wetted width of 1.4 m and has depths ranging between 0.2–0.5 m with habitat comprising sluggish runs and pools. Watercourse S2 provides aquatic habitat of low quality for aquatic biota. There are three unperched culverts on the perennial reach (6, 7, 8; 5.5 m, 6.5 m, 6 m in length).

Figure 9: Habitat along upper unfenced section (top) and fenced lower section of perennial Watercourse S2.

5.3 Watercourse S3

Upper Ephemeral Section

Watercourse S3 is 263 m in length and originates on the neighbouring property to the west. The upper ephemeral section within the site is 157 m in length and is located within a broad gully (2–5 m wide) and has an estimated mean wetted width of 0.5 m (Figure 10). The gully narrows into a slightly higher gradient sections within a V-shaped gully before transitioning into the lower perennial reach. The ephemeral section was unfenced, grazed, lacked a defined channel and held a small amount of shallow and diffusely spread surface water at the time of the survey. There were two culverts on the ephemeral section (9 and 10 = 4 m and 6.5 m in length) with the lower culvert 10 being perched and a barrier to fish passage. The ephemeral section had similar characteristics to the upper reaches of Watercourse S2 and provided marginal habitat.

Figure 10: Habitat along upper ephemeral section of S3.

Lower Perennial Section

The lower perennial section of Watercourse S3 is approximately 106 m in length has similar characteristics to the upstream ephemeral section but with more surface water diffusely spread across the broad gully base (Figure 11). The floodplain is wide (5–10 m) and there was no defined channel due to a long history of grazing damage. The floodplain was choked with grass and emergent macrophytes (e.g., *Glyceria*, willow weed, watercress). The watercourse was not fenced, lacked riparian vegetation and was poorly shaded.

Figure 11: Habitat along lower perennial section of upper S3.

5.4 Watercourse S4

Watercourse S4 is an artificial farm drain that originates within the site and is 157 m in length (Figure12). The channel is narrow, lined with exotic grass/weeds and did not hold surface water at the time of the survey.

Figure12: Artificial farm drainage canal of Watercourse S4.

6.0 Biological Communities

6.1 Invertebrates

Invertebrate communities were sampled in Watercourse S1, S2 and S3 by Wildlands in 2019 (unpublished report). Invertebrate taxa richness ranged between 10–23 in Watercourses S2 and S1 respectively. Invertebrate communities recorded from Watercourses S1, S2 and S3 were dominated by Oligochaeta (61–86%) and reflects the silt dominated streambed and degraded conditions. None of the watercourses supported water and habitat sensitive EPT taxa (mayfly, stonefly, caddisfly). Macroinvertebrate Community Index (MCI-sb) scores were 81, 80 and 70 for Watercourses S1, S2 and S3 and on the threshold of 'poor-fair' stream health. QMCI-sb scores ranged between 3.3–3.9 and indicative of poor stream health.

6.2 Fish Fauna

The fish fauna in Watercourses S1, S2 and S3 was surveyed by Wildlands in 2019 (unpublished report) using an electric fishing machine and recorded four shortfin eel from the lower reaches of Watercourse S1 (length 300–500 mm) and a single shortfin eel from Watercourse S2 (length 200 mm). Shortfin eel are typically common in rural soft-bottomed streams, can tolerate a wide range of water quality and habitat conditions and are not a threatened species (Dunn et al. 2018).

A search of the New Zealand Freshwater Fish Database (NZFFD) revealed no fish records for the Maungahaumia Stream and Morrinsville Stream catchments. The fish fauna in the mainstem of the Piako River in the vicinity of Morrinsville has been well surveyed between 1990 and 2008 with 63 records held in the NZFFD (shown on Figure 13). A total of seven native fish including shortfin eel, longfin eel, torrentfish, banded kōkopu, īnanga, common bully and common smelt and three exotic fish including catfish, goldfish and *Gambusia* have been recorded in the Piako River near Morrinsville.

Of the species found in the Piako River in the vicinity of Morrinsville, only shortfin eel and the exotic pest fish *Gambusia* are likely to occur within the watercourses draining the Lockerbie Estates site based on the degraded water quality and habitat conditions and ephemeral nature of the upper catchment environments.

Black mudfish have not been recorded in the vicinity of the site and are unlikely to be present due to the highly modified and grazing damaged nature of the watercourses.

7.0 Ecological Values

An indication of the ecological and functional values of watercourses draining the site were assessed using the SEV method. SEV scores for the perennial stream sections were scored according to Storey et al. (2011) whilst the ephemeral sections were scored according to Neale et al. (2016). SEV data is presented in Table 4 and Appendix A.

SEV scores for the perennial sections of S1, S2 and S3 were 0.380, 0.328 and 0.304 and indicative of low ecological value. The ephemeral sections of S2 and S3 were 0.292 and 0.222 and indicative of very low ecological value. The watercourses scored moderate-low for hydraulic function (0.378–0.650), very low for biogeochemical function (0.174–0.302) due to poor riparian vegetation (i.e., no shade, organic matter inputs, filtering), very low for habitat function (0.176–0.217) and very low for biodiversity (0.085–0.257).

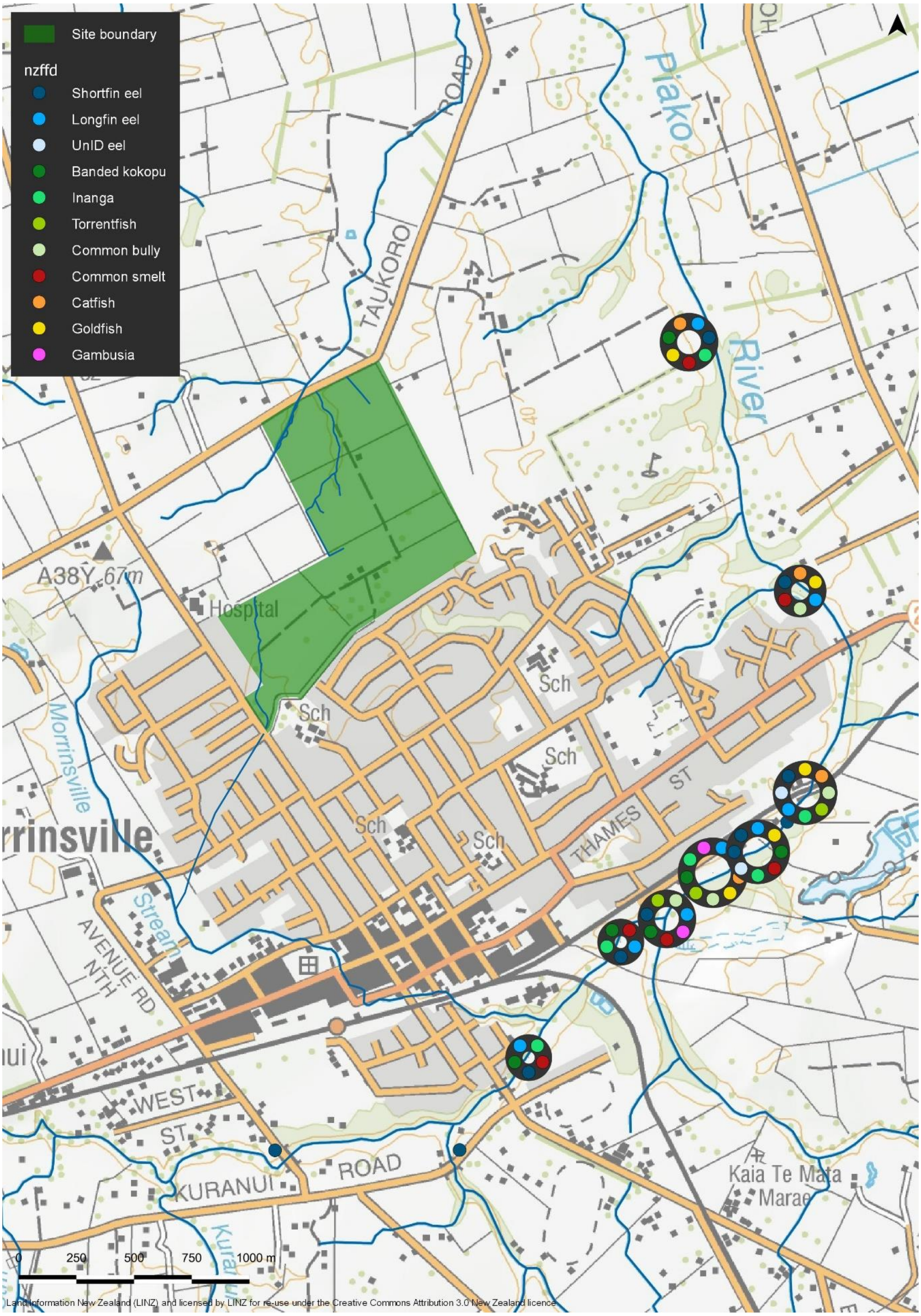


Figure 13: NZFFD fish records in the vicinity of the site.

Table 4: SEV scores for watercourses draining the site.

Function	Function	Perennial			Ephemeral	
		S1	S2	S3	S2	S3
Hydraulic	Natural flow regime	0.507	0.520	0.547	0.447	0.527
	Floodplain effectiveness	0.340	0.240	0.200	0.168	0.200
	Connectivity for species migrations	1.000	1.000	1.000	1.000	0.000
	Natural connectivity to groundwater	0.753	0.740	0.813	0.733	0.783
	Hydraulic function mean score	*0.650*	*0.625*	*0.640*	*0.587*	*0.378*
Biogeochemical	Water temperature control	0.120	0.000	0.000	0.000	0.000
	Dissolved oxygen levels maintained	0.400	0.400	0.400	0.400	0.400
	Organic matter input	0.170	0.100	0.000	0.000	0.000
	In-stream particle retention	0.360	0.360	0.280	0.170	0.000
	Decontamination of pollutants	0.462	0.364	0.399	0.473	0.469
	Biogeochemical function mean score	*0.302*	*0.245*	*0.216*	*0.209*	*0.174*
Habitat Provision	Fish spawning habitat	0.050	0.050	0.050	0.050	0.050
	Habitat for aquatic fauna	0.385	0.331	0.314	0.302	0.302
	Habitat provision function mean score	*0.217*	*0.191*	*0.182*	*0.176*	*0.176*
Biodiversity	Fish fauna intact	0.233	0.233	0.000	0.000	0.000
	Invertebrate fauna intact	0.323	0.150	0.166	0.252	0.288
	Riparian vegetation intact	0.216	0.108	0.090	0.090	0.090
	Biodiversity function mean score	*0.257*	*0.164*	*0.085*	*0.114*	*0.126*
	Overall SEV score	**0.380**	**0.328**	**0.304**	**0.292**	**0.222**

8.0 Assessment of Effects

8.1 Introduction

The assessment of effects has been undertaken in general accordance with the EcIAG produced by EIANZ (Roper-Lindsay et al. 2018) to determine the overall level of effects on the freshwater environment. The development has the potential to result in adverse effects through earthworks, stormwater discharges and reclamation or modification of watercourses. The following assessment is based on engineering and stormwater plan provided by Maven Associates and covers and following:

- Earthworks and sedimentation effects.
- Stormwater discharge effects.
- Reclamation of Watercourse S1 (perennial and ephemeral habitat).
- Removal and construction of culverts.

An overview of ecological values, magnitude of effect, proposed remediation, mitigation or offsetting measures and overall level of effect for each of the proposed activities that have the potential to impact the freshwater environment are summarised in Table 5 (refer to Table 1 and Table 2 in Section 3.3). Freshwater ecological values were assessed as low based on SEV results. The before-mitigation level of effect for proposed activities were assessed as ranging between ‘moderate and low’, but with proposed mitigation, the overall level of effect will be reduced to between ‘moderate and very-low’ (Table 5).

Table 5: Magnitude and level of effect for proposed development before and after mitigation.

Effect / activity	Habitat impacted	Ecological value	Reason for ecological value	Magnitude of effect	Level of effect (no mitigation)	Proposed mitigation measures	Level of effect (with mitigation)
Earthworks and sedimentation, smothering bed	Watercourses S2 and S3 and downstream receiving environment	Low	Rural grazing damaged-modified streams, low fish and invertebrate community values, no EPT taxa, shortfin eels, low SEV score (<0.38)	High	Low	Erosion and sediment controls implemented in accordance with Erosion and Sediment Control Plan (Maven Associates) will reduce magnitude of effect to 'low'	Very low
Stormwater discharge and effects on water quality in receiving environment	Watercourses S2 and S3 (on-site) and S1, S2 and S3 receiving environment (off-site)	Low	Rural grazing damaged-modified streams, low fish and invertebrate community values, no EPT taxa, shortfin eels, low SEV score (<0.38)	Moderate	Low	Construction of proposed stormwater treatment device that will treat stormwater generated from the site to required standards prior to discharge. Implementation of SMP.	Very low
Reclamation of ephemeral and perennial stream habitat resulting in permanent loss	Watercourse S1	Low	Rural grazing damaged-modified streams, low fish and invertebrate community values, no EPT taxa, shortfin eels, low SEV score (<0.38)	Very high	Moderate	*Offset required* as cannot be mitigated	Moderate (no change as cannot be mitigated)
Removal of existing farm culverts	Watercourses S2 and S3	Low	Rural grazing damaged-modified streams, low fish and invertebrate community values, no EPT taxa, shortfin eels, low SEV score (<0.38)	Positive	Net gain	Removal of existing farm culverts and reinstating the natural channel (daylight) will increase natural stream habitat	Net gain
Construction of new culverts and modification / loss of habitat	Watercourses S2 and S3	Low	Rural grazing damaged-modified streams, low fish and invertebrate community values, no EPT taxa, shortfin eels, low SEV score (<0.38)	Very high	Moderate	*Offset required* as activity will result in the permanent modification of stream habitat which cannot be mitigated	Moderate (no change as cannot be mitigated)

8.2 Earthworks and Sedimentation Effects

Physical works associated with developing the site have the potential to result in fine sediment mobilisation and runoff into streams. The perennial and ephemeral sections of Watercourses S2 and S3 to be retained have low ecological value in their current state. The addition of fine sediment to these stream environments has the potential to alter water chemistry, increase turbidity, decrease light penetration that affects primary production, smother instream surfaces and decrease habitat and food quality for benthic invertebrates.

All works will be carried out in accordance with erosion and sediment control plans prepared by Maven Associates and in accordance with Council guidelines. With the implementation of appropriate sediment control measures during construction the potential effects of earthworks on water quality, habitat and biota in the receiving environment will be avoided or minimised with the overall level of effect assessed as 'very low' (Table 5).

8.3 Stormwater Discharge Effects

Maven Associates (2019) sets out the stormwater Management Plan (SMP) for the site. The SMP sets out a process to mitigate the effects on the receiving environment, which consists of two distinctly different catchments that include 'Catchments A and B' that fall to the south and form part of the existing Morrinsville catchment and 'Catchments C, D and E' that fall to the north and ultimately discharge into the Maungahaumia Stream.

The SMP states that detention management and soakage form key components of the mitigation proposed for the receiving environment. The best practical option to mitigate the stormwater quality risk set out in the SMP (Maven Associates 2019) is as follows:

- Public roads are treated for stormwater quality. Public roads (within Catchments A, B and F) will be treated via raingardens. Catchments C, D and E will be treated via sub-catchment wide wetlands.
- At source treatment will be managed via consent notices on the titles – requiring inert building and roofing materials which will require consideration as part of any future resource / building consents.
- Catchments C, D and E will achieve stormwater quality improvement through the detention basins and wetlands for all stormwater runoff generated. This means that the development sites will achieve the requirements of GD01/ Waikato Stormwater Management Guidelines (WRC Technical Report 2018/01) without the need for on-lot devices.
- Planting of riparian margins, wetlands and detention basins. Protection of existing covenant tree areas from development.

The SMP provides the design details for three wetland areas and states that they will assist with achieving the following outcomes:

- Stormwater Quality – GD01 / TP 10 / Waikato Stormwater Management Guidelines (WRC Technical Report 2018/01)
- Water Sensitive Design – GD 04 / Waikato Stormwater Management Guidelines (WRC Technical Report 2018/01)
- Ecological connectivity through the development site
- Green corridor connectivity

- Flood storage (detention), ensuring additional flood storage and retention of pre-development flow rates for downstream properties.

The stormwater wetlands are offline and do not affect any stream habitat directly. The wetlands will be connected to the streams within the site and are expected to increase the diversity of habitats within the site. The wetlands are likely to provide habitat for shortfin eel and a range of benthic invertebrate taxa and birds. Overall, the wetlands are assessed as likely to have a positive effect on the ecological values of the site.

With the proposed level of stormwater treatment and management and given the highly modified nature and poor water quality of the receiving environments the stormwater related effects are expected to be 'very low' (Table 5).

8.4 Reclamation of Watercourse S1

The proposed development will result in the permanent loss of 280 m of highly modified perennial habitat and 31 m of highly modified ephemeral habitat along Watercourse S1 of low ecological value in its current state.

The overall level of the effect of reclaiming Watercourse S1 is assessed as 'moderate' given the magnitude of effect is 'very high' and the ecological values are 'low' (Table 5). The permanent loss of stream habitat cannot be mitigated so offsetting habitat loss is required and can be achieved by restoring or enhancing the values of other stream sections to ensure 'no-net-loss' of stream biodiversity occurs. An SEV/ECR assessment has been used as a starting point to provide an indication of the amount of restoration needed to offset the loss of habitat in Watercourse S1 (see Section 9.0).

Watercourse S1 supports shortfin eels so it is recommended that fish capture and relocation be undertaken prior to any instream disturbance in accordance with the Fish Relocation Plan (FRP) presented in Appendix C.

8.5 Removal and Construction of Culverts

There are currently five farm culverts on Watercourse S2 and two on Watercourse S3 (combined total length = 41.5 m) that will be removed and the natural stream channel reinstated (i.e., daylighted). The removal of the existing farm culverts and reinstatement of natural stream channels will have a net gain effect.

The proposed development will result in the construction of three culverts on Watercourse S2 and one culvert on Watercourse S3 for road crossings (combined total length = 115 m). The length of culverts is summarised in Table 6. Construction of the four new culverts will result in the permanent modification of habitat and result in a 'moderate' overall effect due to 'low' ecological values (Table 5) but does require offsetting (refer Section 9.0). The total length of stream proposed to be impacted by new culverts and required to be offset is reduced due to the proposed daylighting of existing culverts (i.e., 115 m (new culvert) – 41.5 m (daylighted culvert) = 73.5 m (culvert to offset)).

The new culverts on Watercourses S2 and S3 will be submerged below the streambed (20% submergence) to facilitate fish passage. Fish may be present in the location of proposed new culverts so fish may need to be relocated in accordance with the Fish Relocation Plan (FRP) presented in Appendix C.

Table 6: Summary of existing and proposed new culvert details.

Activity	Watercourse	Culvert #	Culvert length (m)	Stream length restored / impacted (m)
Remove / restore	S2 (ephemeral)	4	6.0	6.0
Remove / restore	S2 (ephemeral)	5	7.0	7.0
Remove / restore	S2 (perennial)	6	5.5	5.5
Remove / restore	S2 (perennial)	7	6.5	6.5
Remove / restore	S2 (perennial)	8	6.0	6.0
Remove / restore	S3 (ephemeral)	9	4.0	4.0
Remove / restore	S3 (ephemeral)	10	6.5	6.5
Total				**41.5**
New culvert	S2 (perennial)	1*	22.23	22
New culvert	S2 (perennial)	2*	23.06	23
New culvert	S2 (ephemeral)	3*	29.35	31
New culvert	S3 (ephemeral)	4*	32.93	39
Total				**115**

Note: * Culvert number taken from Maven drawing C460-200.

9.0 Stream Offset Assessment

9.1 Introduction

The proposed development will result in the permanent loss of 280 m of highly modified perennial habitat and 31 m of highly modified ephemeral habitat along Watercourse S1. The development will also result in the construction of four culverts that require offsetting. The following presents an offset assessment using the SEV/ECR method as a tool to provide an indication of offset requirements. The Waikato Regional Policy Statement puts an emphasis on maintaining or enhancing indigenous biodiversity and specifically states that for non-significant habitats (e.g., watercourses on the property) there is a focus on:

a) Working towards achieving no net loss of indigenous biodiversity at a regional scale.

b) The continued functioning of ecological processes.

c) The re-creation and restoration of habitat and connectivity between habitats.

d) Providing ecosystem services.

e) Managing the density, range and viability of indigenous flora and fauna.

f) The consideration and application of biodiversity offsets.

Section 11.1.3 of the Waikato Regional Policy Statement states that regional and district plans for non-significant indigenous habitats:

d) Shall require that where loss or degradation of indigenous biodiversity is authorised adverse effects are avoided, remedied or mitigated (whether by onsite or offsite).

9.2 Restoration Streams

Watercourses S2 and S3 draining the northern area of the site will be retained and have been used as restoration reaches in the offset assessment. Watercourses S2 and S3 have ephemeral and perennial sections and have generally similar characteristics to Watercourse S1 (i.e., unfenced, grazing damaged, lack riparian vegetation) and have high potential for enhancement through riparian planting and retirement. The removal of grazing stock and a programme of riparian planting along Watercourses S2 and S3 would increase channel shade, woody debris inputs (e.g., potential instream habitat), improve streambank stability, reduce evaporation of surface water and improve overall ecological values.

9.3 Assumptions Applied in Offset Assessment

The following summarises assumptions applied when scoring the 'potential' SEV values of impact and restoration streams and used in the calculation of ECR values (refer to Appendix B for detailed list of assumptions):

- The impact Watercourse S1 has a mean wetted channel width of 0.75 m while restoration streams have wetted widths ranging between 0.5–1.4 m.
- Total riparian planting widths proposed along restoration stream sections were assumed to range between 14–45 m (i.e., both banks).
- Riparian planting widths applied when scoring predicted potential values (SEVi-P) of the impact Watercourse S1 was set at 10 m.
- Riparian planting will focus on planting with appropriate native species in floodplain areas with low-stature wet tolerant species and introduce canopy and sub-canopy tiers with native trees/shrubs on banks.
- The post development value (SEVi-I) of Watercourse S1 after it has been reclaimed was assumed to be zero.
- The post development value (SEVi-I) of proposed new culverts on Watercourses S2 and S3 was set at 0.200.
- The total length of stream modified by proposed new culverts and required to be offset was reduced from 115 m to 73.5 m due to the proposed daylighting of 41.5 m of existing farm culverts on Watercourses S2 and S3.
- Fish passage in the upper section of Watercourse S3 will be improved by retrofitting the existing perched culvert or removing it.

9.4 Environmental Compensation Ratio Calculation

A summary of SEV data used to derive ECR values is summarised in Table 7 with detailed SEV scores presented in Appendix B. ECR values were calculated for each 'impact / restoration' reach combination as required.

The predicted potential value (SEVi-P) of the sections of Watercourse S1 proposed to be reclaimed was 0.610 and compares with an existing value of 0.380. The predicted potential value (SEVi-P) of Watercourse S2 and S3 where new culverts are proposed to be constructed range between 0.588–0.691. The predicted potential values (SEVm-P) of restoration stream sections ranged between 0.626–0.708 and compares with current values (SEVm-C) of 0.235–0.351. ECR values applied in the assessment range between 2.49–2.98 for the reclamation of Watercourse S1 and between 1.26–2.40 for the construction of culverts on Watercourse S2 and S3.

Table 7: Predicted and current SEV scores used to derive ECR values.

Impact stream	Impact scores		Restoration stream	Restoration scores		ECR value
	SEVi-P	SEVi-I		SEVm-P	SEVm-C	
S1 reclaim (perennial)	0.610	0.000	S2 (perennial)	0.695	0.351	2.66
S1 reclaim (perennial)	0.610	0.000	S3 (perennial)	0.708	0.341	2.49
S1 reclaim (perennial)	0.610	0.000	S2 (ephemeral)	0.626	0.319	2.98
S1 reclaim (ephemeral)	0.610	0.000	S2 (ephemeral)	0.626	0.319	2.98
S2 culvert (perennial)	0.691	0.200	S2 (ephemeral)	0.626	0.319	2.40
S2 culvert (perennial)	0.691	0.200	S3 (ephemeral)	0.698	0.235	1.59
S2 culvert (ephemeral)	0.588	0.200	S3 (ephemeral)	0.698	0.235	1.26
S3 culvert (ephemeral)	0.639	0.200	S3 (ephemeral)	0.698	0.235	1.42

9.5 Offset Calculations

The offset assessment using the SEV/ECR method determined the restoration of 755.6 m of perennial and ephemeral habitat along Watercourses S2 and S3 would offset the reclamation of Watercourse S1 and proposed construction of four new culverts on Watercourses S2 and S3 and result in no net loss.

Channel dimensions, ECR values and lengths required to be restored are summarised in Table 8 with the restoration stream lengths and indicative planting areas shown on Figure 14. The offset assessment determined there would be a 35.4 m length of ephemeral habitat along Watercourse S3 that would still be available, and if restored, represents a net-gain.

The significant lengths of Watercourse S2 and S3 proposed to be planted as part of the development represents a significant enhancement of the natural character of the streams which currently have very low natural character values as a result of a long period of modification associated with the current land use.

Refer to Section 10.0 for details regarding proposed riparian planting along Watercourses S2 and S3 as part of proposed restoration to offset stream habitat loss.

Table 8: Offset calculations for the reclamation of Watercourse S1 and construction of four proposed culverts.

Impact reach				ECR		Restoration reach							
Stream	Length (m)	Width (m)	(a) Area (m²)	ECR	ECR x Area	Stream	Length available (m)	Width (m)	Area available (m²)	Calculated restoration length required (m)	(b) Offset length required (m)	(c) Restoration stream length still available (m)	(d) Outstanding area not offset (m²)
S1 reclaim (per.)	280	0.750	210.0	2.66	558.9	S2 (per.)	267.0	1.400	373.8	399.2	267.0	-132.2	69.5
S1 reclaim (per.)	-	-	69.5	2.49	173.3	S3 (per.)	139.0	0.900	125.1	192.5	139.0	-53.5	19.3
S1 reclaim (per.)	-	-	19.3	2.98	57.7	S2 (eph.)	269.0	0.700	188.3	82.4	82.4	186.6	-
S1 reclaim (eph.)	31	0.50	15.5	2.98	46.2	S2 (eph.)	186.6	0.700	130.6	66.0	66.0	120.6	-
S2 culvert (per.)	27*	1.40	37.8	2.40	90.7	S2 (eph.)	120.6	0.700	84.4	129.5	120.6	-9.0	2.6
S2 culvert (per.)	-	-	2.6	1.59	4.2	S3 (eph.)	116.0	0.500	58.0	8.3	8.3	107.7	-
S2 culvert (eph.)	18*	0.70	12.6	1.26	15.9	S3 (eph.)	107.7	0.500	53.8	31.7	31.7	76.0	-
S3 culvert (eph.)	29*	0.50	14.3	1.42	20.3	S3 (eph.)	76.0	0.500	38.0	40.6	40.6	35.4	-
											755.6		

Notes: (a) = Streambed area impacted based on channel widths at 10 SEV cross sections;

(b) = Length of restoration stream to restore calculated by ('ECR x Area' / 'Restoration Width');

(c) = Restoration stream length available after being used in assessment and calculated by (('Area available' – 'ECR x Area') / restoration reach 'Width') with amount transferred to 'Restoration reach Length available' in the next row if applicable;

(d) = Amount of streambed area that has not been offset and is transferred to 'Impact reach Area' on the next row if applicable for additional offset calculation using next available restoration reach. The outstanding amount is determined by ('Restoration reach Area available' – 'ECR x Area') / ECR value. The squares in orange are the outstanding amounts that have been transferred to the next row in the 'Impact reach Area' column (a).

(*) Culvert lengths shown in table are the proposed culverts minus the length of proposed daylighted stream by removing the existing farm culverts (i.e., S2 perennial culvert to offset is 45 m – 18 m = 27 m; S2 ephemeral culvert to offset is 31 m – 13 m = 18 m; S3 ephemeral culvert to offset is 39 m – 10.5 m = 28.5 m)

Figure 14: Proposed stream reclamation and restoration required as an offset.

10.0 Proposed Restoration Planting

10.1 Plant Species Selection

The site is located just within the Hinuera Ecological District (E.D.) within the Waikato Ecological Region (McEwen 1987). It nears the converging point of Hamilton E.D., Maungatautari E.D., and Hapuakohe E.D., but is most similar in terms of topography and former vegetation to Hamilton E.D. The Hinuera E.D. covers the alluvial flats of the Thames basin. Vegetation in the Hinuera E.D. comprised mainly fernland and local swamps with pockets of forest (McEwen 1987). Forest would have comprised dense lowland podocarp forest, with rimu-tawa forest along the eastern edge of the district along the lower slopes of the Kaimai Range. Some remnants of kahikatea and totara forest still exist in the district however most vegetation has been cleared for farming.

The species recommended for restoration within the site include a number of species reflective of the former forest type as noted above, mixed with high proportions of pioneer shrubs. The choice of pioneer shrubs selected for revegetation planting is limited by plants that are suited to artificial propagation. Mānuka (*Leptospermum scoparium* agg.) and kānuka (*Kunzea* spp.) are common New Zealand pioneer species that propagate well and specialise in growing in open exposed sites that lack shading from other trees and are hotter and drier as a result. The natural function of these species is to act as a seral nurse crop, which is subsequently replaced by other species within 30–50 years. For these reasons, a high proportion of both mānuka and kānuka is recommended for these plantings. Birds will play a key role in future succession at the site and for that reason a range of species attractive to birds such as New Zealand flax (*Phormium tenax*) and fruiting *Coprosma* spp. have been included in the recommended species list.

10.2 Planting Recommendations

Plants should be equivalent (or no smaller) to those specified including: PB3/4, 1/2L, PB2, PB3 or PB5 (i.e., 20–60 cm tall at the time of planting) with no visible weed contamination. Plants of this size have been selected as they can typically recover more rapidly from the stress of planting than larger plants and are easier to source in high quantities from nurseries due to their ease of propagation and transport.

Plants should be planted in the appropriate microclimate to reflect soil moisture and inundation along with exposure. Two zones are recommended, one zone to capture the stream edge and flood plain (species tolerant of regular inundation and flooding) and one zone to capture those more suited to drier soils without inundation i.e., drier slope areas) (refer to Figure 15).

Ideally plants along the stream edge and within the flood plain (e.g., sedges) will be planted at 1.0 m centres to ensure rapid coverage, while drier slope areas should be planted at 1.4 m centres with trees and shrubs (refer to Figure 16). Species recommended for restoration within the site are presented in Table 9.

Figure 15: Indication of proposed planting when mature.

Table 9: Recommended plant species list.

	Scientific name	Common name	Location	Grade	Proportion (%)
Species recommended for Stream edge a planting along the stream edge and floodplain	*Austroderia fulvida*	Toetoe	Upper floodplain and lower slopes	1/2L or PB2	15
	Carex geminata	Rautahi	Tolerant, stream edge, floodplain.	1/2L or PB2	15
	Carex secta	Purei	Fluctuating water, stream edge, floodplain.	1/2L or PB2	12
	Carex virgata	Pūkio	Tolerant, stream edge, floodplain	1/2L or PB2	16
	Cyperus ustulatus	Umbrella sedge	Tolerant, stream edge and floodplain.	1/2L or PB2	12
	Carpodetus serratus	Putaputawētā	Fluctuating water, stream edge and floodplain	1/2L or PB2	7
	Cordyline australis	Tī kōuka	Tolerant, stream edge, floodplain, slopes.	1/2L or PB2	7
	Dacrycarpus dacrydioides	Kahikatea	Outer floodplain and lower slopes, waterlogged soils	PB3 or PB5	5
	Phormium tenax	NZ Flax	Tolerant, upper floodplain and base of toe slope	1/2L or PB2	13
Species recommended for planting in drier slope areas (not inundated with water).	*Austroderia fulvida*	Toetoe	Throughout, concentrated along edges of planting	1/2L or PB2	8
	Coprosma robusta	Karamū	Throughout	1/2L or PB2	15
	Cordyline australis	Tī kōuka	Throughout	1/2L or PB2	10
	Hebe stricta	Koromiko	Throughout	1/2L or PB2	9
	Kunzea robusta	Kānuka	Upper slopes	1/2L or PB2	8
	Leptospermum scoparium agg.	Mānuka	Throughout	1/2L or PB2	14
	Melicytus ramiflorus	Māhoe	Throughout	1/2L or PB2	10
	Myrsine australis	Māpou	Throughout	1/2L or PB2	7
	Phormium tenax	NZ Flax	Throughout, concentrated along edges	1/2L or PB2	8
	Alectryon excelsus	Titoki	Sheltered areas throughout		2
	Dacrycarpus dacrydioides	Kahikatea	Lower slopes, especially waterlogged soils	PB3 or PB5	2
	Laurelia novae-zelandiae	Pukatea	Sheltered areas throughout	PB3 or PB5	2
	Podocarpus totara	Totara	Throughout	PB3 or PB5	2
	Prumnopitys ferruginea	Miro	Throughout	PB3 or PB5	1
	Vitex lucens	Pūriri	Throughout, prefers lower slopes sheltered from frost	PB3 or PB5	2

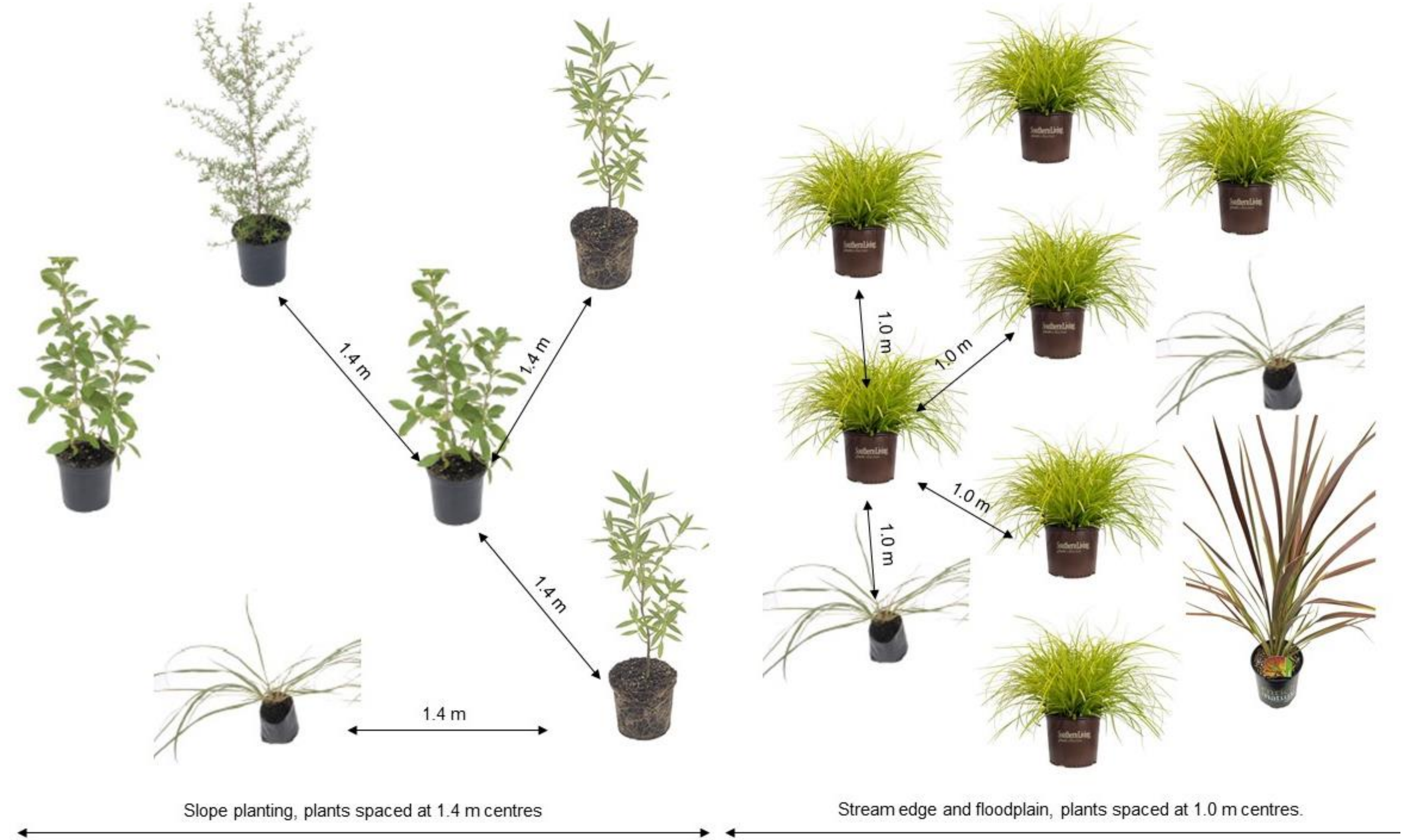


Figure 16: Proposed planting – showing spacing in each zone.

11.0 Summary

Lockerbie Estates Ltd are proposing to develop a residential subdivision at 162 Studholme Street, Morrinsville, that will deliver 900 residential lots, a 120-unit retirement village and a neighbourhood commercial centre. The site is approximately 80 ha and currently an operational dairy farm with vegetation comprising grazed pasture, hedges, shelterbelts and occasional exotic trees and shrubs along watercourses. There are four main watercourses draining the site (S1, S2, S3 and S4) and three smaller side branches or farm drains that feed into Watercourse S2 (referred to as S2a, S2b, S2c). All watercourses within the site are in the wider Piako River catchment.

Ecological surveys were carried out on 28 August 2019 and 10 October 2019 to classify watercourses in accordance with WRC criteria, describe the habitat characteristics and collect Stream Ecological Valuation (SEV) data from each watercourse. Watercourses S1, S2 and S3 are highly modified streams with ephemeral and perennial reaches but are natural drainage systems. Watercourse S2a is a modified overland flow path whilst Watercourses S2b, S2c and S4 are artificial farm drains.

All watercourses within the site have silt beds, have artificially widened floodplains and channels due to a long history of weed/macrophyte clearance and direct stock grazing damage, lacked riparian vegetation, were poorly shaded, were choked with emergent aquatic plants (e.g., watercress, willow weed, *Glyceria*) and provided aquatic habitat of poor quality for invertebrates and fish. Invertebrate communities recorded from Watercourses S1, S2 and S3 were dominated by Oligochaeta, did not support EPT taxa and had MCI-sb and QMCI-sb scores indicative of poor stream health. Of the fish species found in the Piako River in the vicinity of Morrinsville, only shortfin eel and the exotic pest fish *Gambusia* are likely to occur in watercourses draining the site based on the degraded instream conditions and ephemeral nature of the upper catchment environments. Black mudfish have not been recorded in the vicinity of the site and are unlikely to be present due to habitat constraints and the long history of direct grazing damage and channel disturbance.

SEV scores for the perennial sections of S1, S2 and S3 were 0.380, 0.328 and 0.304 and indicative of low ecological value. The ephemeral sections of S2 and S3 were 0.292 and 0.222 and indicative of very low ecological value.

An assessment of effects was undertaken in general accordance with the EcIAG produced by EIANZ (Roper-Lindsay et al. 2018). The proposed development will see the retention and enhancement of Watercourses S2 and S3, reclamation of Watercourse S1, construction of stormwater treatment wetlands, daylighting farm culverts and construction of four new culverts (S2 and S3). The overall level of effect for proposed activities was assessed as ‘moderate to very-low’ with the implementation of proposed mitigation measures (e.g., sediment and erosion control, SMP). The daylighting of existing farm culverts and reinstatement of natural channels is a positive effect resulting in a net gain. The reclamation of Watercourse S1 and construction of new culverts cannot be mitigated so offsetting habitat loss through the restoration of other stream sections was required.

The SEV/ECR method was used to provide an indication of the amount of restoration required to offset the reclamation of 311 m of Watercourse S1 and construction of four culverts on Watercourses S2 and S3 (total culvert length to offset = 73.5 m). The offset assessment determined the restoration of 755.6 m of perennial and ephemeral habitat along Watercourses S2 and S3 would result in ‘no net loss’ of biodiversity. An additional 35.4 m of ephemeral habitat along Watercourse S3 will be enhanced and represents an overall net gain. Some of the proposed offline stormwater treatment wetlands will be connected with retained and enhanced Watercourses S2 and S3 and are expected to

increase the diversity of aquatic habitats within the site and assessed as likely having an additional positive effect on the ecological values within the site.

Watercourse S1, S2 and S3 support shortfin eels so it is recommended that fish capture and relocation be undertaken prior to any instream disturbance in accordance with the Fish Relocation Plan (FRP) presented in Appendix C of this report.

12.0 References

Dunn N.R., Allibone R.M., Closs G.P., Crow S.K., David B.O., Goodman J.M., Griffiths M., Jack D.C., Ling N., Waters J.M., Rolfe J.R. 2018: Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

Maseyk, F., Maron, M., Dutson, G., Possingham, H., Seaton, R., Carlyon, G., Beveridge, A. 2015: A Biodiversity Offsets Accounting Model for New Zealand. Report prepared for department of Conservation. March 2015.

Maven Associates 2019: Stormwater Management Plan. Prepared for Lockerbie Estates. November 2019.

McEwen, W.M. 1987. (Editor). Ecological Regions and Districts of New Zealand (third revised edition in four 1:500,000 maps). New Zealand Biological Resources Centre publication no. 5. Department of Conservation, Wellington.

Neale, M. W., Storey, R. G., and Quinn, J.M. 2016. Stream Ecological Valuation (SEV): Application to Intermittent Streams. Auckland Council Technical Report 2016/023.

Roper-Lindsay, J., Fuller, S.A., Hooson, S., Sanders, M.D., and Ussher, G.T. 2018: Ecological Impact Assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Storey, R. G., Neale, M. W., Rowe, D. K., Collier, K. J., Hatton, C., Joy, M. K., Maxted, J. R., Moore, S., Parkyn, S. M., Phillips, N. and Quinn, J.M. 2011. Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland streams. Auckland Council Technical Report 2011/009.

APPENDIX A

Stream Ecological Valuation Data

			S1	S2	S3
Hydraulic		Vchann	0.390	0.420	0.420
		Vlining	0.74	0.72	0.80
		Vpipe	1.00	1.00	1.00
	NFR	=	0.51	0.52	0.55
		Vbank	1.00	1.00	1.00
		Vrough	0.34	0.24	0.20
	FLE	=	0.34	0.24	0.20
		Vbarr	1.00	1.00	1.00
	CSM	=	1.00	1.00	1.00
		Vchanshape	0.78	0.78	0.84
		Vlining	0.74	0.72	0.80
	CGW	=	0.75	0.74	0.81
Hydraulic function mean score			0.65	0.63	0.64
biogeochemical		Vshade	0.12	0.00	0.00
	WTC	=	0.12	0.00	0.00
		Vdod	0.40	0.40	0.40
	DOM	=	0.40	0.40	0.40
		Vripar	0.20	0.10	0.00
		Vdecid	0.70	1.00	1.00
	OMI	=	0.17	0.10	0.00
		Vmacro	0.49	0.70	0.29
		Vretain	0.36	0.36	0.28
	IPR	=	0.36	0.36	0.28
		Vsurf	0.62	0.41	0.60
		Vripfilt	0.30	0.32	0.20
	DOP	=	0.46	0.36	0.40
Biogeochemical function mean score			0.30	0.24	0.22
habitat provision		Vgalspwn	1.00	1.00	1.00
		Vgalqual	0.00	0.00	0.00
		Vgobspwn	0.10	0.10	0.10
	FSH	=	0.05	0.05	0.05
		Vphyshab	0.25	0.15	0.12
		Vwatqual	0.04	0.02	0.02
		Vimperv	1.00	1.00	1.00
	HAF	=	0.38	0.33	0.31
Habitat provision function mean score			0.22	0.19	0.18
Biodiversity		Vfish	0.23	0.23	0.00
	FFI	=	0.23	0.23	0.00
		Vmci	0.45	0.45	0.33
		Vept	0.17	0.00	0.17
		Vinvert	0.35	0.00	0.00
	IFI	=	0.32	0.15	0.17
		Vripcond	0.24	0.12	0.10
		Vripconn	0.90	0.90	0.90
	RVI	=	0.22	0.11	0.09
Biodiversity function mean score			0.257	0.164	0.085
SEV score			**0.380**	**0.328**	**0.304**

APPENDIX B

Assumptions and SEV Data for Offset Assessment

Assumptions applied in scoring potential values of impact section of Watercourse S1 (SEVi-P)

Variable (code)	Watercourse S1 (impact)
Hydraulic	
Vchann	Enhanced riparian vegetation and removal of grazing stock would increase channel definition and shade that will reduce macrophyte/grass growth in the existing damaged channels.
Vlining	Removal of grazing stock and riparian planting would reduce direct channel disturbance and fine sediment mobilisation and inputs
Vpipe	No change
Vbank	No change or improvements associated with stock removal, riparian planting and removing culverts/pipes
Vrough	Assumes average riparian widths of 10 m on each bank with planting comprising 'low diversity regenerating bush with stock excluded' and 'mature flax, long grasses and sedges'
Vbarr	Potential improvements through removal of blocked or perched culverts
Vchanshape	Auto-populated
Biogeochemical	
Vshade	Potential planting on both banks would increase shade from 'no effective-low' shading in their current state to variable shade ranging from 'low-high' and influenced by channel widths
Vdod	Increases from 'marginal' to 'sub-optimal' to reflect riparian planting increasing shade and therefore reducing macrophyte growth and removal of grazing reducing sediment inputs
Vveloc	No change because estimating potential future velocities is difficult to predict
Vdepth	No change because estimating potential future depths is difficult to predict
Vripar	Increases from 0.1–0.3 to 0.5 to reflect potential future riparian planting of 10 m wide on each bank as would be expected in areas zoned as 'Light Industrial' (AUPOP)
Vdecid	No change
Vmacro	Increase in channel shade due to potential riparian planting would reduce macrophyte cover
Vretain	Auto-populated
Vsurf	Inorganic streambed substrate would remain the same and comprise sand/silt. Increase in woody debris (small-medium) and leaf litter. Increase in shade would reduce macrophyte cover.
Vripfilt	Planting on both banks would see an increase in current floodplain filtering from 'none-low' filtering to 'low-high' filtering based on potential increase in planting (10 m wide on each bank).
Habitat Provision	
Vgalspwn	No change
Vgalqual	Riparian planting could improve channel definition (bank and floodplain formation), overhead cover and water retention in the water short channel that could result in an improvement from 'unsuitable' to between 'low-medium'. Spawning habitat quality may always be constrained by surface water quality in watercourses within the site.
Vgobspwn	Auto-populated
Vphyshab	Removal of grazing stock and increase riparian planting has the potential to improve channel definition, alter water depths, enhance habitat formation so there is potential for small increases habitat diversity and abundance and hydrological heterogeneity. Riparian planting would increase channel shade and integrity from low to moderate-high quality.
Vwatqual	Assumed no change
Vimperv	Assumed no change
Biodiversity	
Vfish	Excluded
Vmci	Excluded
Vept	Excluded
Vinvert	Excluded
Vripcond	Auto-populated
Vripconn	No change on some watercourses but improvements in others where culverts could be removed

Assumptions applied in scoring potential values of intermittent restoration sections (SEVm-P)

Variable (code)	Watercourse S2 and S3
Hydraulic	
Vchann	Enhanced riparian vegetation and removal of grazing stock would increase channel definition and shade that will reduce macrophyte/grass growth in the existing damaged channels. Removal of farm culverts will increase naturalness of channels and reduce upstream ponding
Vlining	Removal of grazing stock and riparian planting will reduce direct channel disturbance and fine sediment mobilisation and inputs
Vpipe	No change assumed
Vbank	Assumed improvements over time associated with removal of stock grazing and increase in riparian planting
Vrough	Applied average riparian widths of 10 m on each bank with planting comprising 'low diversity regenerating bush with stock excluded' and 'mature flax, long grasses and sedges'
Vbarr	Improvements associated with removal of blocked/perched culverts and removal of pond in upper Golf Course Creek
Vchanshape	Auto-populated
Biogeochemical	
Vshade	Planting on both banks will increase shade from 'no effective-low' shading in their current state to variable shade ranging from 'low-high' and influenced by channel widths
Vdod	Increases from 'marginal' to 'sub-optimal' to reflect riparian planting increasing shade and therefore reducing macrophyte growth and removal of grazing reducing sediment inputs
Vveloc	No change because estimating potential future velocities is difficult to predict
Vdepth	No change because estimating potential future depths is difficult to predict
Vripar	Increases from 0.1–0.3 to 0.5 to reflect future riparian planting (10 m wide on each bank). Widths used match those applied when scoring SEVi-P scores but will be wider
Vdecid	No change
Vmacro	Increase in channel shade due to potential riparian planting will reduce macrophyte cover
Vretain	Auto-populated
Vsurf	Inorganic streambed substrate will remain the same and comprise sand/silt. Increase in woody debris (small-medium) and leaf litter. Increase in shade will reduce macrophyte cover.
Vripfilt	Planting on both banks will see an increase in current floodplain filtering from 'none-low' filtering to 'low-high' filtering based on increase in planting (applied 10 m wide on each bank).
Habitat Provision	
Vgalspwn	No change
Vgalqual	Riparian planting will improve channel definition (bank and floodplain formation), overhead cover and water retention in the water short channel that could result in an improvement from 'unsuitable' to between 'low-medium'. Spawning habitat quality may always be constrained by surface water quality in watercourses within the site.
Vgobspwn	Auto-populated
Vphyshab	Removal of grazing stock and increase riparian planting will improve channel definition, alter water depths, enhance habitat formation so there is likely to be small increases in habitat diversity, habitat abundance and hydrological heterogeneity. Riparian planting will increase channel shade and integrity from low to moderate-high quality.
Vwatqual	Assumed no change
Vimperv	Changes according to future development (i.e., high % catchment imperviousness and high control)
Biodiversity	
Vfish	Excluded
Vmci	Excluded
Vept	Excluded
Vinvert	Excluded
Vripcond	Auto-populated
Vripconn	Small improvements in riparian connectivity due to removal of farm culverts

Function category	Function	Variable	Impact		Restoration							
			Watercourse A		S2 (perennial)		S2 (ephemeral)		S3 (perennial)		S3 (ephemeral)	
			(SEVi-I)	(SEVi-P)	(SEVm-C)	(SEVm-P)	(SEVm-C)	(SEVm-P)	(SEVm-C)	(SEVm-P)	(SEVm-C)	(SEVm-P)
Hydraulic		Vchann	0.000	0.750	0.420	0.75	0.310	0.76	0.420	0.84	0.430	0.76
		Vlining	0.00	0.880	0.72	0.94	0.72	0.94	0.80	0.94	0.72	0.94
		Vpipe	0.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	NFR	=	0.00	0.793	0.52	0.81	0.45	0.82	0.55	0.87	0.53	0.82
		Vbank	0.00	1.000	1.00	1.00	0.84	0.84	1.00	1.00	1.00	1.00
		Vrough	0.00	0.540	0.24	0.90	0.20	0.66	0.20	0.90	0.20	0.90
	FLE	=	0.00	0.540	0.24	0.90	0.17	0.55	0.20	0.90	0.20	0.90
		Vbarr	0.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
	CSM	=	0.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
		Vchanshape	0.00	0.830	0.78	0.83	0.76	0.83	0.84	0.91	0.91	0.90
		Vlining	0.00	0.880	0.72	0.94	0.72	0.94	0.80	0.94	0.72	0.94
	CGW	=	0.00	0.863	0.74	0.90	0.73	0.90	0.81	0.93	0.78	0.93
Hydraulic function mean score			0.00	0.799	0.63	0.90	0.59	0.82	0.64	0.93	0.38	0.91
biogeochemical		Vshade	0.00	0.620	0.00	0.62	0.00	0.66	0.00	0.62	0.00	0.66
	WTC	=	0.00	0.620	0.00	0.62	0.00	0.66	0.00	0.62	0.00	0.66
		Vdod	0.00	0.675	0.40	0.68	0.40	0.60	0.40	0.68	0.40	0.68
	DOM	=	0.00	0.675	0.40	0.68	0.40	0.60	0.40	0.68	0.40	0.68
		Vripar	0.00	0.500	0.10	1.00	0.00	0.70	0.00	1.00	0.00	1.00
		Vdecid	0.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	OMI	=	0.00	0.500	0.10	1.00	0.00	0.70	0.00	1.00	0.00	1.00
		Vmacro	0.00	0.950	0.70	0.95	0.17	0.93	0.29	0.95	0.00	0.93
		Vretain	0.00	0.760	0.36	0.76	0.20	0.76	0.28	0.84	0.28	0.76
	IPR	=	0.00	0.760	0.36	0.76	0.17	0.76	0.28	0.84	0.00	0.76
		Vsurf	0.00	0.292	0.41	0.29	0.75	0.32	0.60	0.29	0.88	0.32
		Vripfilt	0.00	0.600	0.32	0.68	0.20	0.68	0.20	0.68	0.06	0.68
	DOP	=	0.00	0.446	0.36	0.49	0.47	0.50	0.40	0.49	0.47	0.50
Biogeochemical function mean score			0.00	0.600	0.24	0.71	0.21	0.64	0.22	0.72	0.17	0.72
habitat provision		Vgalspwn	0.00	1.000	1.00	1.00	0.85	0.85	1.00	1.00	1.00	1.00
		Vgalqual	0.00	0.250	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.25
		Vgobspwn	0.00	0.200	0.10	0.20	0.10	0.20	0.10	0.20	0.10	0.20
	FSH	=	0.00	0.225	0.05	0.23	0.05	0.21	0.05	0.23	0.05	0.23
		Vphyshab	0.00	0.576	0.15	0.60	0.09	0.49	0.12	0.59	0.09	0.49
		Vwatqual	0.00	0.243	0.02	0.24	0.02	0.23	0.02	0.24	0.02	0.26
		Vimperv	0.00	1.000	1.00	0.30	1.00	0.30	1.00	0.30	1.00	0.30
	HAF	=	0.00	0.599	0.33	0.44	0.30	0.38	0.31	0.43	0.30	0.38
Habitat provision function mean score			0.00	0.412	0.19	0.33	0.18	0.29	0.18	0.33	0.18	0.30
Biodiversity		Vfish										
	FFI	=										
		Vmci										
		Vept										
		Vinvert										
	IFI	=										
		Vripcond	0.00	0.330	0.12	0.52	0.10	0.43	0.10	0.52	0.10	0.52
		Vripconn	0.00	0.900	0.90	1.00	0.90	1.00	0.90	1.00	0.90	1.00
	RVI	=	0.00	0.297	0.11	0.52	0.09	0.43	0.09	0.52	0.09	0.52
Biodiversity function mean score			0.000	0.297	0.108	0.520	0.090	0.430	0.090	0.520	0.090	0.520
SEV score			**0.000**	**0.610**	**0.351**	**0.695**	**0.319**	**0.626**	**0.341**	**0.708**	**0.235**	**0.698**

APPENDIX C

Fish Relocation Plan

Fish Relocation Plan

Purpose

The following outlines the Fish Relocation Plan (FRP) for the reclamation of Watercourse S1 and construction of culverts on Watercourse S2 (three culverts) and Watercourse S3 (one culvert) at the development at 162 Studholme Street. The FRP includes details regarding the methodology at each phase of construction, timing of fish removal, transportation of fish and the selection of relocation sites.

Considerations in Preparing the Plan

Key requirements for fish relocation plans are:

- Confirmation of the methodology for capturing native fish and pest fish (timing, number of nets, use of electric fishing).
- Confirmation of the method for disposing of pest fish.
- Confirmation of the exact location of translocations of native fish (preference is for translocations within the same catchment).
- Assessment of the suitability of the habitat for relocations (amount and quality of habitat, water quality, food sources).
- Consideration of any barriers to fish passage when selecting suitable habitat for relocations.

Permits

The trapping and transfer of fish will need to be done under a 'Special Permit' from the Ministry for Primary Industry (MPI) and Department of Conservation (DOC) permit to operate an electric fishing device.

Existing Fish Community

Watercourses S1, S2 and S3 are known to support at least shortfin eel and potentially the pest fish *Gambusia*. Habitat and water quality limitations is likely to limit the presence of other fish species.

Methodology for Works in Streams

Instream Works Plan

The proposed methods are based on the premise that development of the site will be in stages including vegetation removal, stream de-watering, excavation and infilling.

Stages of Fish Relocation Plan

Fish relocations will be implemented in the following stages:

Stage 1: Pre-works inspection of habitat.

Stage 2: Pre-works fishing (electric fishing).

Stage 3: Stream de-watering and excavation (electric fishing, hand-held nets).

Stage 1: Pre-works Inspection of Habitat

An inspection of impact reaches will be carried out prior to streamworks.

- The ephemeral section of Watercourse S1 proposed to be reclaimed and the ephemeral sections of Watercourse S2 and S3 where two culverts will be constructed are likely to be dry at the time of earthworks, or only hold small amounts of surface water, so are unlikely to support native fish when works will be carried out.
- If reaches hold no surface water then *no further fish relocation work is necessary*.
- The lower perennial section of Watercourse S1 and the perennial section of Watercourse S3 where three culverts are proposed are likely to hold surface water during works and requires Stages 2–4 of the FRP to be implemented.

Stage 2: Pre-works Electric Fishing (if required)

- A fine mesh exclusion net will be installed at the downstream extent (e.g., near culvert at Studholme Street, below culvert works areas) to prevent fish from potentially moving into the works area if bunds or other exclusion measures have not be constructed prior to fishing.
- An upstream exclusion net is not required on Watercourse S1 as there is no upstream habitat.
- Upstream exclusions nets will be installed at the upstream extent of culvert works areas if required and if a bund has not been created prior to fishing.
- Any sections holding surface water will be electric fished.
- Electric fishing will be undertaken by a certified electric fisher with streamside assistance and carried out in short sections involving multiple passes.
- Each reach will be fished until no additional fish are captured.
- Any fish captured will be placed into a bucket and transferred to a fish bin (refer to Fish Capture and Handling section below).

Stage 3: Stream De-watering and Excavation Fish Capture (if required)

Experience has shown eels can remain in watercourses after electric fishing. If reaches hold surface water then de-watering using a pump may be required:

- Fish will be salvaged during any pumping and prior to any instream disturbance.
- Pump to be operated to minimise water velocities around the pump inlet
- Pump inlet screened using a 5 mm mesh to prevent fish getting sucked into the pump.
- Any fish observed moving within the channel during the de-watering stage will be captured using hand-held nets.
- After de-watering, there is still potential for eels to be present within the channel as they can burrow into streambanks or the soft-bottomed silt/mud streambed.
- During the excavation stage, any instream sediment that is removed from the channel and deposited into the designated holding area will be inspected.
- Any fish observed will be captured using hand-held nets and handled in the same manner as during previous stages of the fish relocation.

Fish Capture and Handling

- All fish captured will be immediately transferred into a bucket or fish bin of stream water and placed in a well-shaded location.
- Multiple fish bins will be used if there are large numbers of fish captured to reduce stress on captured fish.
- Species other than eels will be kept in separate fish bins to minimise stress and potential predation by eels.
- Battery powered aquarium pumps will be used to maintain oxygen in fish bins.
- Non-pest fish will be transported to the designated release point and released within an hour of capture or if fish are displaying signs of stress.
- Pest fish will be euthanised by placing them in an appropriately concentrated solution of AQUI-S Anaesthetic.

Fish Release Location

Fish captured from Watercourse S1 will be released into the lower reaches of Watercourse S1 to the immediate south of Snell Street where it flows for ~250 m before discharging into Morrinsville Stream. Fish captured from Watercourses S2 or S3 during culvert construction will be released in a downstream section of the streams to the north of Taukoro Road. Releasing captured fish in the above stated locations will keep them in the same sub-catchments from which they were captured.

Reporting

Results including the number and species of fish captured and released during each phase of works will be provided within the required timeframe stipulated in the resource consent.

report

August 2021

182 Studholme Street
Plan Change Ecological Assessment

Submitted to:
Maven

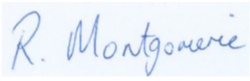
freshwater solutions
environmental consultants

Quality Assurance

This report has been prepared and reviewed by the following:

Prepared by: Phil Taylor
Freshwater Ecologist

Reviewed by: Richard Montgomerie



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1.0 Introduction

Lockerbie Estates Ltd are proposing to expand their residential subdivision at 162 Studholme Street (the site) into the adjacent property at 182 Studholme Street, Morrinsville (the site) (Figure 1) through a plan change application.

A Development Concept Plan for the wider site has been provided by Maven (Figure 2) that will inform the plan change application.

The site is approximately 40 ha and currently an operational dairy farm with vegetation comprising grazed pasture, hedges, shelterbelts and occasional exotic species. The site is bordered by Taukoro Road to the north and Studholme Street to the west. Land to the south of the site is zoned as residential and north of Taukoro Road the land is zoned as rural. The site itself is currently zoned rural under the MPDC but is identified as a future residential policy area (i.e. future urban growth).

Freshwater Solutions prepared an ecological assessment of the site at 162 Studholme Street prior to the development of Lockerbie Estate. This report assesses freshwater ecological characteristics and values of 182 Studholme Street and assesses the ecological effects of the proposed change in land use.

2.0 Ecological Setting

The site is located on the northern boundary of Morrinsville and in the Hinuera Ecological District (ED). Soils are characterised by brown granular clays on old andesitic cones with peat soils on the margin of raised peat bogs (McEwan 1987). Historically, the entire site would have been covered with indigenous lowland forest, with large areas of swamp forest and peat wetlands on flatter, poorly drained land. There are two main watercourses draining the site (S1 and S3) and four smaller side branches, farm drains or flow paths that feed into Watercourses S3 (referred to as S3a, S3b and S3c) and S1. All watercourses draining the site are within the wider Piako River catchment.

Watercourse S1 flows in a southerly direction and exits the site via a pipe network that starts near the southwestern tip of the site. Watercourse S1 emerges from the pipe network under Morrinsville to the immediate south of Snell Street where it flows for ~250 m before discharging into Morrinsville Stream. Below this confluence, Morrinsville Stream flows for ~2.15 km downstream before converging with Waitakaruru Stream, which flows for a further 750 m till it joins the Piako River to the south of Morrinsville.

Watercourse S3 drain in a northerly direction and occur in the northern portion of the site. Watercourse S3 converge to the immediate north of Taukoro Road after flowing for approximately 300 m through the adjoining property at 162 Studholme Street. This watercourse flows northwards for ~3.9 km where it joins the Maungahaumia Stream, which flows for a further 2.9 km before joining the Piako River at Haumia Road between Mangateparu and Te Puninga.

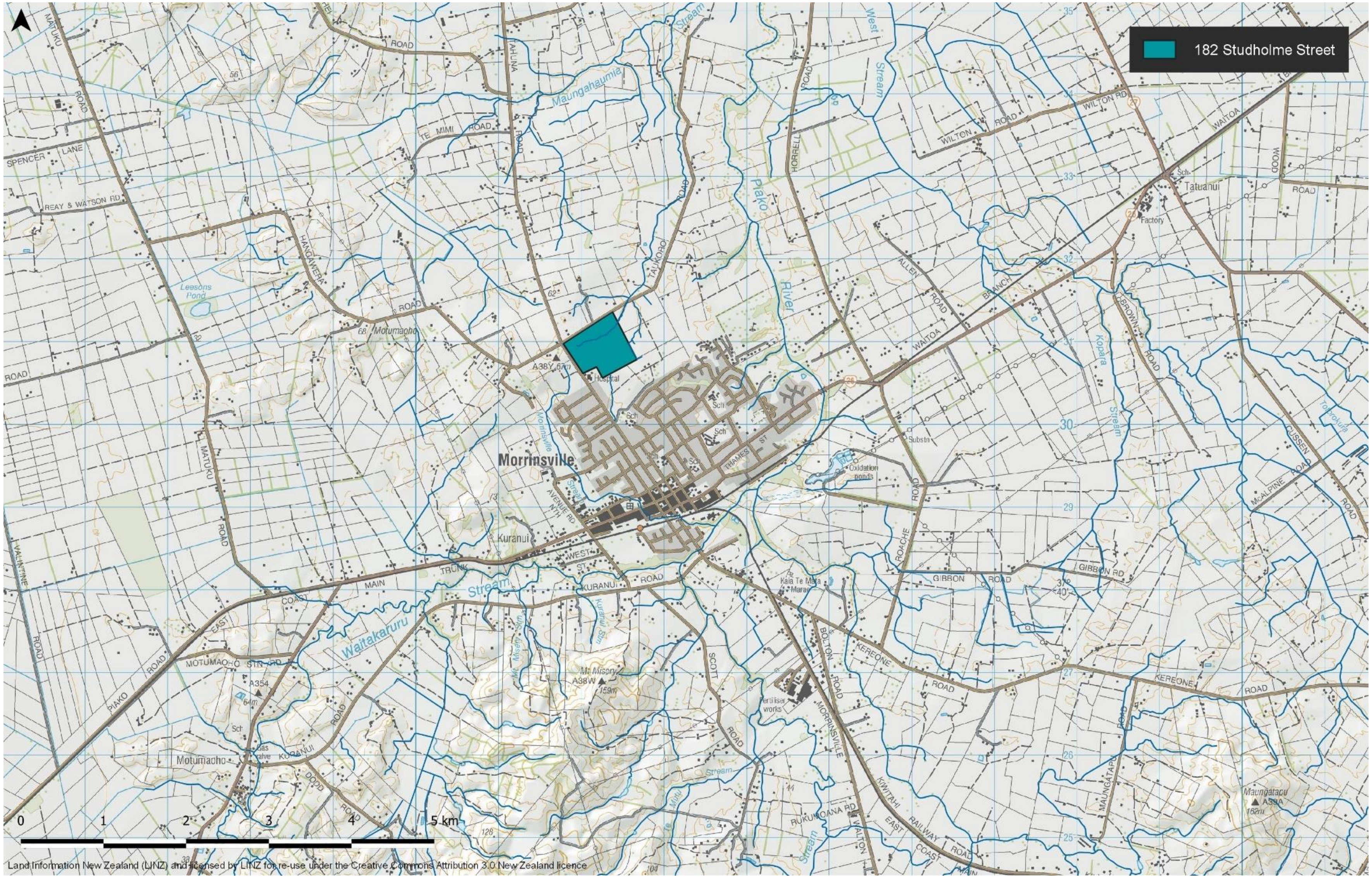

Figure 1: **Location of proposed development at 182 Studholme Street.**

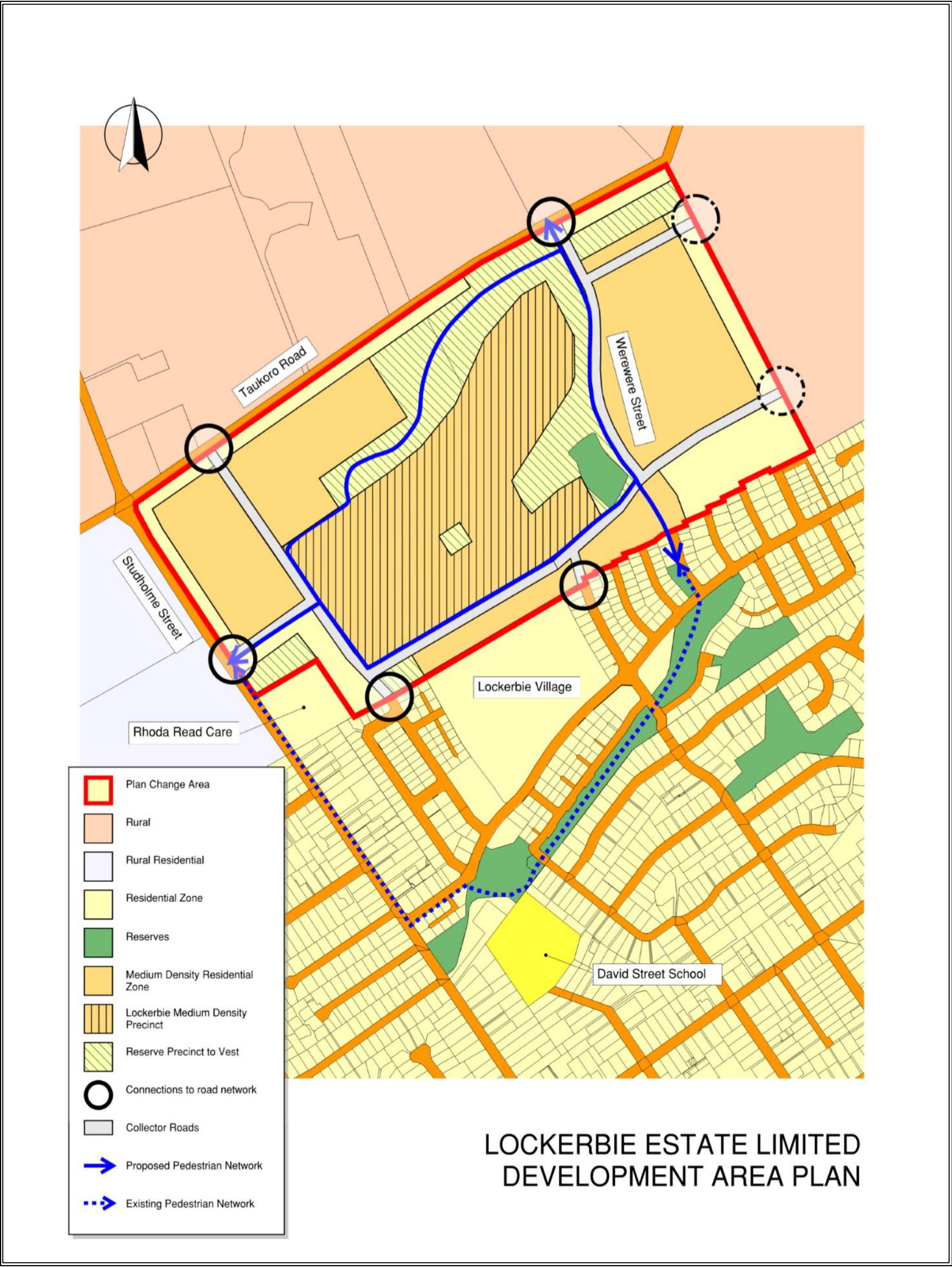

Figure 2: Development Concept Plan (from Maven 2021).

3.0 Methodology

3.1 Desktop Review

The Matamata-Piako District Plan and WRC plans, policies and maps were reviewed to determine if any significant freshwater resources occurred within the site. Aerial photographs from 1940, 1941 and 1948 were obtained from Retrolens and assisted with identifying historical stream alignments. The Development Concept Plan for the wider site was obtained from Maven Associates Limited to understand the likely development outcome.

3.2 Terrestrial Environment

A terrestrial survey was carried out on 17 April and 7 May 2019. Plant and fauna species encountered were recorded and terrestrial habitats described. Birds identified visually and audibly were recorded across the site, including native and introduced species. Field data was supplemented with herpetofauna records (Department of Conservation Bioweb database), bat records (Naturespace NZ) and bird records (New Zealand eBird). A desktop review of existing literature for the site and wider area was undertaken.

3.3 Watercourses

Surveys and Timing

Surveys were carried out on 10 June 2021. There was 7.8 mm of rainfall 2 days prior to the survey and 8.8 mm 10 days prior to the survey (National Climate Database 2021).

Stream Classification

Watercourses within the site were classified in accordance with the definitions outlined in the WRP for the Waikato Region (i.e., artificial, farm drainage canal, modified, ephemeral or perennial). The farmer whom had farmed the site for 10 years assisted by providing a plan that showed watercourses that flowed year-round and those that did 'not' flow continuously for at least three months between March and September. The WRP definitions are:

- *Artificial* – a watercourse that contains no natural portions from its confluence with a river or stream to its headwaters and includes irrigation canals, water supply races, canals for the supply of water for electricity power generation and farm drainage canals.
- *Farm drainage canal* - an artificial watercourse on a farm that contains no natural portions from its confluence with a river or stream to its headwaters, and includes a farm drain or a farm canal.
- *Modified watercourse* - an artificial or modified channel that may or may not be on the original watercourse alignment and which has a natural channel at its headwaters.
- *Ephemeral* – streams that flow continuously for at least three months between March and September but do not flow all year.
- *Perennial* – streams that flow year-round assuming average rainfall.

General Habitat Characteristics

Aquatic and riparian habitat characteristics along each of the watercourses were described and included the measurement or visual estimation of wetted width, floodplain width, water depth, habitat type, streambed substrate, shade, erosion, flow velocity, aquatic plant cover and periphyton cover.

Invertebrate and Fish Fauna

Freshwater Solutions did not survey invertebrates or fish using conventional methods as there was insufficient surface water in any of the watercourses on site at the time of the survey and information had been collected from watercourses in the adjacent site by Wildlands in 2019 (unpublished report). Drain S3a (Figure 5) was surveyed for fish by collecting environmental DNA samples. Fish data was supplemented with data held in the New Zealand Freshwater Fish Database (NZFFD) for watercourses within the wider site (162 Studholme Road) and wider catchment.

Stream Ecological Values

The Stream Ecological Valuation (SEV) assessment tool was originally developed for use in the Auckland Region where urban development resulted in significant pressures on streams (Storey et al. 2011, Neale et al. 2016). The SEV method was used to assist with the ecological values and effects assessment.

3.4 Wetlands

Wetlands were delineated in accordance with the NPS-FM at the time of the survey (September 2020). The approach applied in identifying wetlands within the site followed that outlined in the NPS-FM (MfE 2020) and involved applying the vegetation tool (Clarkson 2013), hydric soil tool (Fraser et al. 2018) and hydrology tool (USACE 1987).

Natural Inland Wetlands

The NPS-FM defines natural wetlands (i.e., wetland as defined in the Act[1]) that is not:
a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or,

b) a geothermal wetland; or,

c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain-derived water pooling.

The NPS-FM defines improved pasture as 'an area of land where exotic pasture species have been deliberately sown or maintained for the purpose of pasture production, and species composition and growth has been modified and is being managed for livestock grazing'. In our determination of which species should be included under the definition of 'improved pasture' we considered introduced grass and herb species that met all of the following criteria as improved pasture species:

i. Introduced grasses or herbs that were actively grazed by stock, and maintained (i.e., fertiliser application, pasture seed sowing, and weeding).

ii. Introduced grasses or herbs where historic evidence shows that they were introduced to New Zealand as pasture species (e.g., Levy (1970), Stewart et al. (2014)).

[1] Resource Management Act 1991. Wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

Hydrophytes (wetland vegetation)

Hydrophytes are plant species capable of growing in soils that are often or constantly saturated with water during the growing season. The hydrophyte wetland indicator status ratings outlined in Clarkson (2013) are:

- Obligate (OBL): occurs almost always in wetlands (est. probability >99% in wetlands).
- Facultative Wetland (FACW): occurs usually in wetlands (67–99%).
- Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66%).
- Facultative Upland (FACU): occurs occasionally in wetlands (1–33%).
- Upland (UPL): rarely occurs in wetlands (<1%), almost always in uplands (non-wetlands).

Hydrology

The NPS-FM wetland hydrology tool is under development. The U.S. Army Corps of Engineers (USACE 1987) was applied in the interim. To meet the standard for wetland hydrology, an area must be inundated for at least seven consecutive days during the growing season most years (50% probability of inundation recurrence) or saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50% probability of recurrence). Soils may be considered saturated if the water table is within 15 cm of the surface for sands and 30 cm of the surface for other soils. If an area is inundated other than indicated above, it can be considered temporary rain-derived pooling.

3.5 Assessment of Ecological Values

An assessment of ecological value for both terrestrial and freshwater systems was made broadly following the Ecological Impact Assessment Guidelines (EcIAG) (Roper-Lindsay et al. 2018) published by the Environment Institute of Australia and New Zealand (EIANZ). Ecological values are based on the following criteria (refer to guidance in Section 5 and Tables 4 and 7 of the EIANZ guidelines):

- Representativeness.
- Rarity/ Distinctiveness.
- Diversity and pattern.
- Ecological context.

4.0 Terrestrial Environment

4.1 Site Vegetation

The site is dominated by pasture grasses for grazing stock (Figure 3). Shelterbelt trees, dominated by *Cassuarina* sp. (she-oak), are present in the paddocks north of the milking yard and to the south of the residence. A small stand of exotic trees including tree privet (*Ligustrum lucidum*), oak (*Quercus robur*), willow (*Salix* sp.) and she-oak are located in the artificially induced basin towards the western site boundary on watercourse S3.

A mixture of native plants were identified riparian zone of the upper section of Watercourse S3. *Carex germinata* (cutty grass) was dominant towards the very top of Watercourse S3, with occasional individuals of *Phorium tenax* (flax) and unidentified, tree ferns in a small cluster near the head of the watercourse.

Figure 3: View of typical pastural vegetation on the site.

4.2 Avifauna

Birds observed on the site during the 10 June 2021 survey are presented in Table 1. Three of the four species encountered are native species. The swamp harrier (harrier hawk) was observed overhead in the vicinity of the cropped field to the east of the site. Pukeko were seen near the upper section of Watercourse S3 and Tui were observed near the shelterbelt at the eastern border of 162 and 182 Studholme Street. There were a number of sightings of the introduced house sparrow across the site.

Table 1: Bird species identified within the site.

Common name	Scientific name	NZ status	Conservation status
House sparrow	*Passer domesticus*	Introduced	-
Swamp harrier	*Circus approximans*	Native	Not threatened
Tūī	*Prosthemadera novaeseelandiae*	Endemic	Not threatened
Pūkeko	*Porphyrio melanotus*	Native	Not threatened

eBird Database Records

A total of 75 species have been recorded within the Matamata – Piako District[2]. Within the district, the Morrinsville WTP, the Morrinsville River Walk, the Morrinsville Holmwood Park and Lockerbie Park are listed as hotspots within the district (Table 2).

Of the species identified within a 10 km radius of the site, the most common include introduced species such as the common myna (*Acridotheres tristis*), house sparrow (*Passer domesticus*) and Eurasian blackbird (*Turdus merula*). The most common native species are: Tūī (*Prosthemadera novaeseelandiae*), Welcome swallow (*Hirundo neoxena*) and the endemic fantail (*Rhipidura fuliginosa*). There is one record of Kaka (*Nestor meridionalis*) which was observed on River walk (Avenue Road).

The site is most likely utilised by common native and introduced species typical of urban and rural habitats, but is unlikely to provide suitable habitat for any of the threatened or at-risk native species (Robertson et al. 2017).

Table 2: eBird database locations with more than 20 species recorded with 10 km of the site.

Location	Number of species	Distance from the site
Morrinsville WTP	41	5 km
Morrinsville River Walk	28	2.5 km
Morrinsville Holmwood Park	27	2.5 km
Morrinsville Lockerbie Park	21	1 km

4.3 Herpetofauna

No lizards were encountered during the site survey, although a specific survey was not conducted. All lizards, except for the introduced rainbow skink are legally protected under an amendment to the Wildlife Act 1953 and their habitats by the Resource Management Act 1991 (Anderson et al. 2012). A significant component of our lizard fauna (~85%) are recognised as 'Threatened' or 'At Risk' in Threat Ranking Lists (Hitchmough et al. 2015).

Herpetofauna records held in the DOC Bioweb Herpetofauna Database within 5 km of the site show that the only record is of the native copper skink *(Oligosoma aeneum*), located between Lorne Street and Studholme Street, approximately 1.2 km to the south of the site.

The native copper skink is an adaptable ground dwelling skink that prefers habitat such as wood and debris piles, vegetated bush/shrub areas and their interfaces (i.e., adjacent rank grass). The site is dominated by grazed pasture and small areas of exotic trees that lacks groundcover and therefore does do not provide suitable habitat for copper skink.

[2] https://ebird.org/newzealand/region/NZ-WKO-015/hotspots?yr=all&m=

4.4 Bats

The long-tailed bat is classified as 'Threatened – Nationally Critical' (O'Donnell et al. 2017) due to predation, habitat degradation and/or habitat loss and protected' under the Wildlife Act (1953).

Long-tailed bat forage over farmland and urban areas favouring forest edges, gully systems and riparian habitats, where they feed on aquatic and terrestrial insects. These habitats provide:

- mature exotic and native vegetation for roosting;
- emergent aquatic insect prey (e.g. mosquitos) for foraging;
- freshwater for drinking, and;
- linear landscape corridors for movement and navigation.

The long-tailed bat can cover up to 50 km in a single night and have home ranges extending >100 km^2 (Sedgeley and O'Donnell 2004). Long-tailed bats usually find roosts in large old native canopy trees either beneath the bark or in cavities where they rest during the day and breed but also find suitable roosts in mature exotic trees such as pine and macrocarpa.

Bats within the home range of the site have been recorded by various organisations between 1998 and 2020 and in all directions around the site (Figure 4). Naturespace NZ (2021) places the nearest bat record (unknown species) within a 10 km radius of the site, which is within the foraging range.

Until recently it was thought that the long-tailed bat was locally extinct as bats were not detected in the area since a survey was undertaken by DOC in 1998. In 2020, bats were detected in and around Morrinsville in both the Piako and Waitoa Catchments and some were detected on the fringes of the city limits from a community monitoring programme lead by Landcare[3].

During the site survey, it was determined that there was minimal suitable bat habitat on the site due to the absence of water in the watercourses, discontinuous stands of non-native shelter belt trees which appeared not to have suitable hollows for roosting.

4.5 Summary of Terrestrial Values

Terrestrial ecological habitat values discussed according to EIANZ (2018) guidelines are summarised in Table 3 and Table 4. The site is currently an operational dairy farm and is characterised by pastural land (predominately perennial rye and white clover), with some exotic weedy hedging and mature exotic trees. There are some individual tree ferns along the riparian margin of Watercourse S3 on the property but the majority of the tree flora are exotics – in particular, She-oak, oak and willow.

Bird species identified within the site and most historic records in the local area comprise common species typical of rural and urban areas so are unlikely to be a constraint to developing the site. The site contains poor habitat for native skinks and native gecko. It seems unlikely even the common copper skink is present within the site, due to its historical and present-day grazing and cropping and general lack of refugia. It is unlikely that the trees on the site have roost features used by long-tailed bats.

[3]https://www.landcareresearch.co.nz/news/nationally-threatened-bat-species-discovered-in-morrinsville/

Table 3: Summary of ecological values of pasture land.

Matters	Value	Summary
Representativeness	Negligible	The pasture and are bare soil habitat is a highly modified unnatural habitat that provides poor habitat for native species and has negligible botanical values.
Rarity/ Distinctiveness	Negligible	
Diversity and pattern	Low	
Ecological Context	Low	
Overall	**Low**	

Table 4: Summary of ecological values of shelterbelt hedging and clusters of predominantly exotic trees.

Matters	Value	Summary
Representativeness	Low	The exotic shelterbelt trees and hedges are not representative of natural native habitat, but some native vegetation are represented in the upper reaches of Watercourse S3, which might provide habitat for birds.
Rarity/ Distinctiveness	Negligible	Shelterbelts, hedges and clusters of trees comprised common native/exotic species none of which are of conservation interest. Fauna identified within the site (birds) was neither threatened nor rare and instead comprised common native and exotic species. The site is not expected to hold detectable populations of lizards. Bats are located within foraging range of the site, but due to the type of trees and the lack of water on site it is expected that bat are unlikely to utilise the property.
Diversity and pattern	Low	Vegetation (trees and shrubs) within the site have a low level of natural diversity due to the sites highly modified nature. Biodiversity within the site is low, and only a low number of common species are supported (i.e., common native and introduced birds).
Ecological Context	Low	The vegetation (trees and shrubs) within the site reflect the highly modified nature of the land use and comprise mainly common exotic species. However, the mature trees do provide habitat in the local rural landscape that aids the distribution of birds.
Overall	**Low**	**Note: this could be elevated to moderate if bats were found to be using trees within the site as intermittent roosts.**

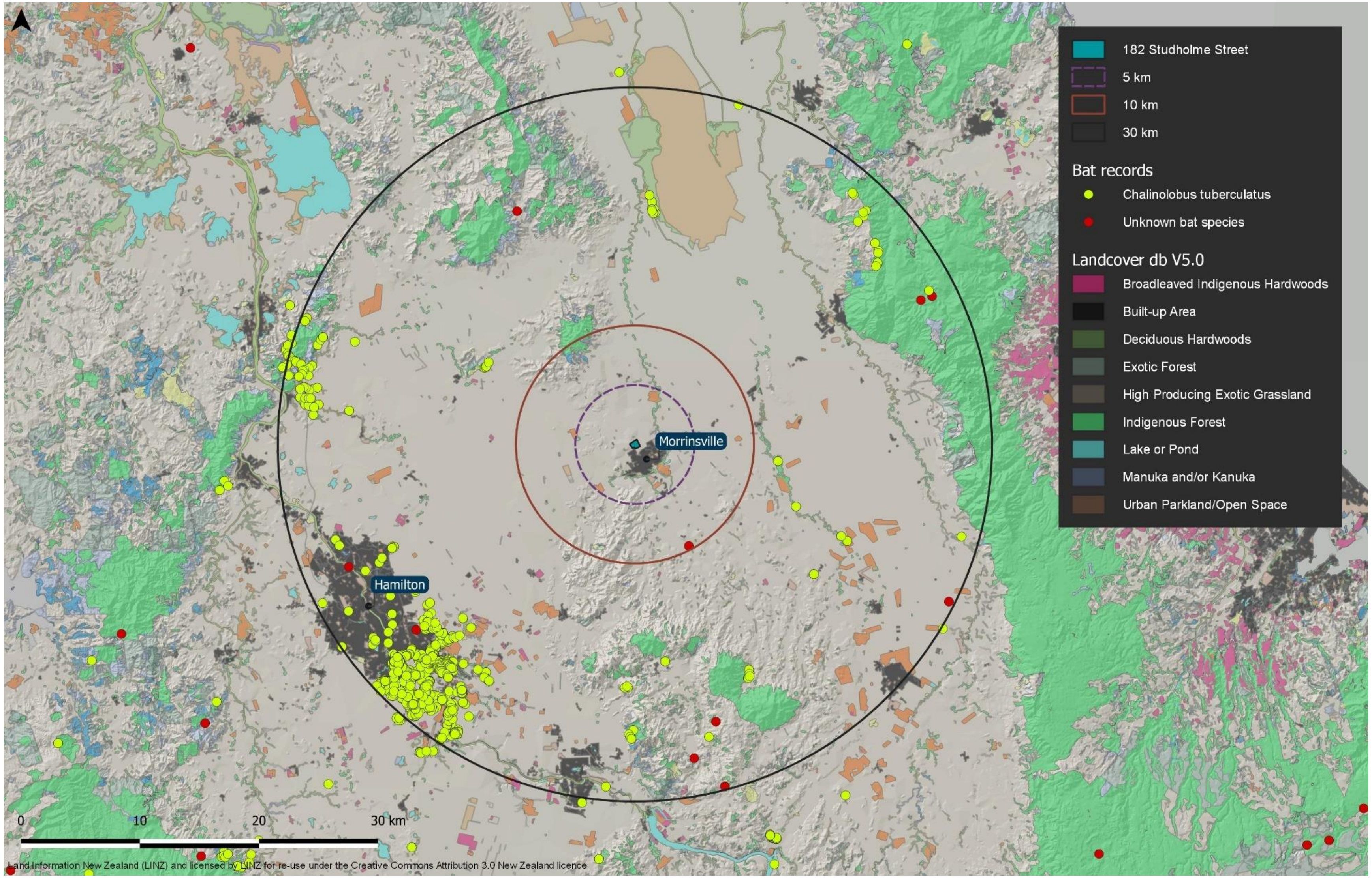

Figure 4: **Bat records in the vicinity of the site (Naturespace NZ 2021).**

5.0 Freshwater Habitat

5.1 Stream Classification

Watercourses within the site were classified in accordance with definitions outlined in the WRP (see Section 3.0). Aerial photographs from 1940 and 1941 were inspected to check historical and current channel alignments. Overall, watercourses within the site and shown on historical photographs matched up with present-day alignments. Stream classifications based on WRP definitions are shown on Figure 5 and summarised in Table 5.

Watercourse S1 has a total length of 55 m of headwater flow path within the site. Watercourse S1 flows in a southerly direction through the adjoining 162 Studholme Street site and has a total length of 610 m (within the adjoining site), which comprises 300 m of headwater flow path, 31 m of ephemeral stream and 280 m of perennial stream (33 m of which occurs on 280 Studholme Street).

Watercourse S3 is a modified watercourse which flows for approximately 512 m within the site, before joining the ephemeral section of the stream at the adjoining site. Watercourse S3a, S3c and S3d are artificial farm drainage channels.

Table 5: Stream classifications according to WRP definitions.

Watercourse	WRP status	Length (m)	Comment
S1	Flow path*	55 m	Flow path that is fed by a small spring. The flow path lies in a shallow gully.
S3a	Artificial	121 m	Short flow path branch that drains into S3 mainstem, in the adjoining property - has been artificially widened and deepened, farm drain characteristics. Pipe at the head of the drain and a perched culvert in the middle section.
S3b	Flow path*	43 m	Flow path that was historically fed by a small spring.
S3c	Artificial	118 m	Farm drain that feeds into the head of S3 mainstem, extends beyond the western shelterbelt and to the south of a spring head.
S3d	Artificial	77 m	Farm drain that feeds into S3c.
S3	Modified Stream	512 m	Lower section, wider channel, formally stable surface water for 3-5 months per year. Moderate emergent macrophyte cover, channel widened and deepened in places. No water in channel at the time of the survey. Some substrate sorting in the upper reaches.

Note: * = not a WRP watercourse definition but a term used in this report to account for overland flow paths within the site.

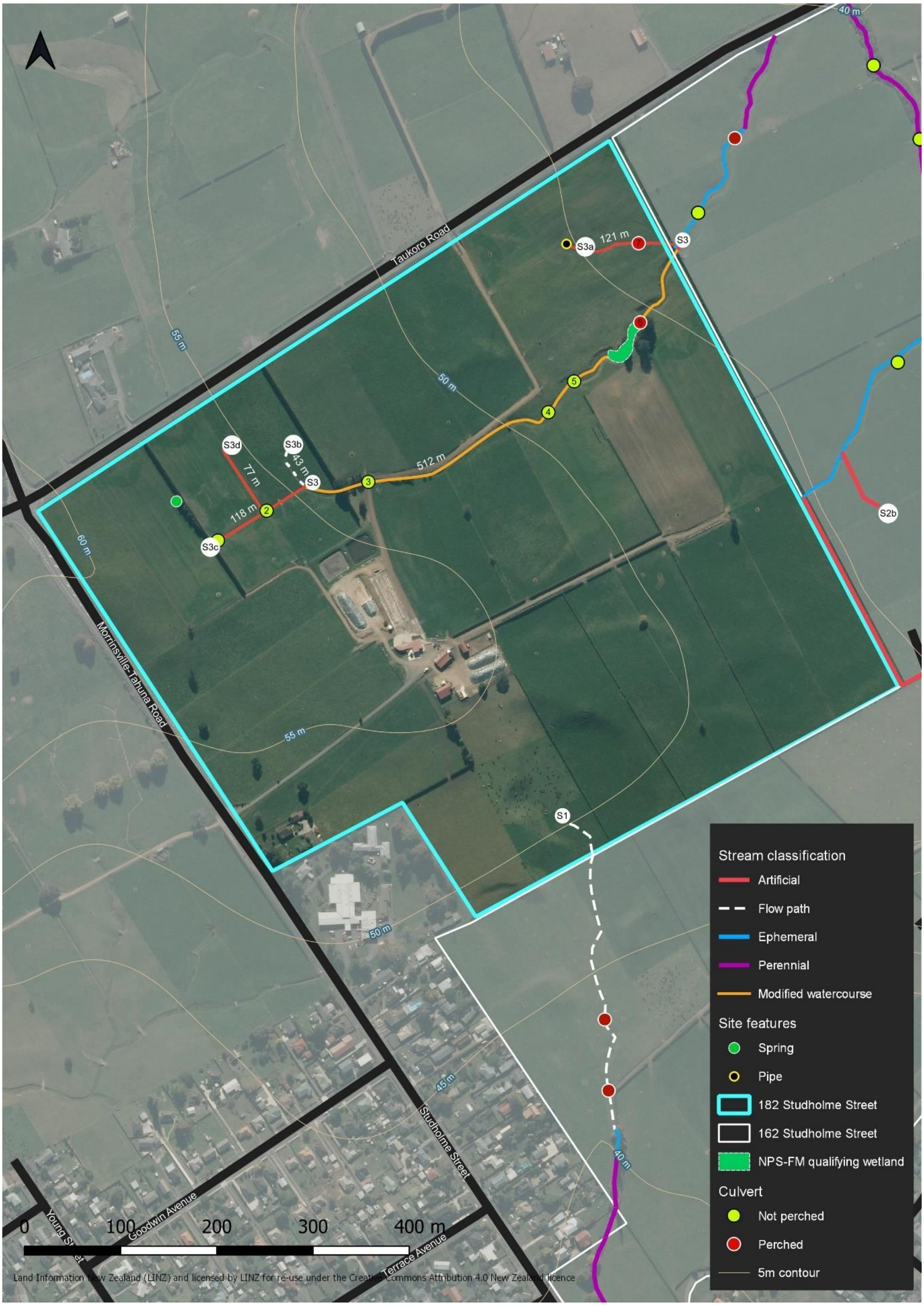

Figure 5: Stream classifications based on WRC definitions.

5.2 Stream Habitat

Watercourse S1

Watercourse S1 flows in a southerly direction through the southwestern corner of the site (Figure 5). The watercourse leaves the site via a pipe network under Morrinsville and emerges as an open channel to the immediate south of Snell Street some 600 m to the southwest.

The flow path originates at the base of a gully in a low-lying depression (Figure 6). There are two perched culverts (1 and 2) on the off-site section of the flow path.

The ephemeral and perennial sections of Watercourse S1, are located off-site to the south. These sections are discussed in the Freshwater Solutions ecology assessment of 162 Studholme Street (Freshwater Solutions 2019).

Figure 6: Flow path in upper reaches of Watercourse S1.

Watercourse S3

Watercourse S3 is 512 m in length and continues to flow through the neighbouring property to the north east. The sections running through the neighbouring property are classified as ephemeral (157 m) and perennial (106 m). These sections are discussed in the Freshwater Solutions ecology assessment of 162 Studholme Street (Freshwater Solutions 2019).

The section of Watercourse S3 within the site is classified as a modified watercourse. Watercourse S3 is unfenced in the lower 250 m section. This area is grazed, lacks riparian vegetation and has been significantly widened and deepened. The width of the channel ranged between 9.5 m near the eastern boundary of the site to 1.2 m near the head of the stream.

At the time of the survey there was no water in the channel, which appeared to have been dry for some time due to the vegetation growth and low soil moisture (Figure 7). The banks of the channel are eroded and support mainly pasture grass and weed species.

Approximately 250 m upstream from the eastern site boundary, the stream changes character where it narrows and deepens significantly, following a fence line to the head of the stream where the Artificial Drains S3c and S3d and the Flow Path S3b connect to Watercourse S3.

In the upper section, the narrower channel meant that shading was provided by the overhanging vegetation including *Glycera maxima* (Reed sweet grass), *Phormium tenax* (Flax) and Pampas (*Cortaderia sp.*) Carex, and the occasional tree fern (unident.) (Figure 8). Gorse, blackberry and Chinese privet (*Ligustrum sinense*) were also present.

There was some evidence of substrate sorting in the upper reaches, but in the lower reaches, the substrate was dominated by soil, indicating a significant amount of infilling in the lower 250 m of the watercourse.

There are four culverts on the modified section of Watercourse S3 (culvert 3, 4, 5 and 6Error! Reference source not found.). Culvert 6 is perched and is a total barrier to fish passage (Figure 9). Upstream of the perched culvert, the channel forms an unnatural basin where there is small stand of exotic trees including: she-oak (*Casuarina* sp.) and oak (*Quercus* sp.) (Figure 10).

Figure 7: View of the lower section of Watercourse S3.

Figure 8: View of culvert 6 on Watercourse S3.

Figure 9: View of the upper section of Watercourse S3.

Figure 10: View of 'basin' upstream of culvert on Watercourse S3.

Watercourse S3a

Watercourse S3a is an artificial drain that flows for approximately 121 m (mean width = 1.8 m) before entering the ephemeral section of the mainstem of Watercourse S3 on the adjoining property. There is a perched culvert at the downstream section of the drain and a pipe flowing in at the head of the drain.

The drain was the only watercourse on the site with water in the channel, which was pooling (Figure 11) between the perched downstream culvert and the pipe entering the drain upstream. Riparian vegetation along the drain was entirely in pasture and was open to grazing stock, resulting in trampling and pugging.

Watercourse S3b

Watercourse S3b originates in a broad gully in the centre of a paddock in the western section of the Site (Figure 12). The flow path has a poorly defined, heavily vegetated channel, which is dominated by a soil substrate.

The land owner indicated to Freshwater Solutions, that this area used to be subject to short period of flow through the channel particularly after rainfall, and was subject to runoff from Taukoro Road. In recent years, the flow path has generally been dry and would almost never contain water suggesting that the water table had deepened.

There was no surface water in Watercourse S3b at the time of the survey. The flow path is 43 m in length and has a mean width of 1.5 m, and connects to Watercourses S3c and S3d and appeared to be actively grazed. Riparian vegetation along the drain was entirely in pasture and was open to grazing stock, resulting in trampling and pugging.

Figure 11: View of Watercourse S3a.

Figure 12: View of Watercourse S3b.

Watercourse S3c

Watercourse S3c is an artificial watercourse that originates towards the western boundary of the site (Figure 13), and is 118 m in length and has a mean channel width of 1.8 m. At the time of the survey there was no surface water in the channel. The channel is vegetated with pasture and has been actively grazed as there is evidence of trampling throughout the length of the drain. Riparian vegetation along the drain was entirely in pasture and was open to grazing stock, resulting in trampling and pugging. Culvert number 1 as the head of the drain, and is unperched (Figure 4).

Watercourse S3d

Watercourse S3d is an artificial watercourse that originates towards the western boundary of the site (Figure 14), and is 77 m in length and has a mean channel width of 2.2 m. At the time of the survey there was no surface water in the channel The channel is vegetated with pasture and has been actively grazed as there is evidence of trampling throughout the length of the drain. Riparian vegetation along the drain was entirely in pasture and was open to grazing stock, resulting in trampling and pugging. Culvert number 1 is located at the head of the drain, and is unperched. Drain metal has been backfilled into the length of the drain.

Figure 13: View of Watercourse S3c.

Figure 14: View of Watercourse S3d.

5.3 Wetland

There is one qualifying induced NPS-FM wetland on the site (Figure 5), which is located in on Watercourse S3 (Figure 15). The approximate area of this wetland is 565 m^2. This wetland was classified based on the vegetation dominance test (100% Facultative, Obligate and Facultative wetland species) and the prevalence test. Soil cores were also taken, confirming its wetland status. Soils were hydric and pale, low chroma soils (chroma 2, value 5) from the Munsell colour chart. Mottling was also event from the soil cores.

Wetland species were mainly exotic and include: *Lolium perenne* (*Perennial ryegrass*), *Poa annua* (Annual bluegrass), *Trifolium repens* (White clover), *Ranunculus sceleratus* (Celeryleaved buttercup), *Persicaria hydropiper* (Water pepper), *Rumex conglomeratus* (dock) and *Juncus* sp. (rush) (Figure 15). The wetland has been induced by the culverts upstream and downstream of the area, is highly degraded and affected by regular grazing.

Figure 15: View of vegetation in NPS-FM wetland on Watercourse S3.

6.0 Biological Communities

6.1 Invertebrates

Invertebrate communities were not sampled on the day of the survey because there was insufficient surface water in the waterways on the site. However, invertebrates were collected in Watercourse S3 in 2019 by Wildlands (unpublished report). Results from that survey show that Invertebrate taxa richness was 15 and the MCI score was 70 which is on the threshold of 'poor-fair' stream health. Invertebrate communities recorded from Watercourse S3 were dominated by Oligochaeta (61–86%) and reflects the silt dominated streambed and degraded conditions. Watercourse S3 did not support water and habitat sensitive EPT taxa (mayfly, stonefly, caddisfly).

6.2 Fish Fauna

The fish fauna in Watercourses S1 and S3 was surveyed by Wildlands in 2019 in relation to 162 Studholme Street (unpublished report) using an electric fishing machine and recorded four shortfin eel from the lower reaches of Watercourse S1 (length 300–500 mm). Shortfin eel are typically common in rural soft-bottomed streams, can tolerate a wide range of water quality and habitat conditions and are not a threatened species (Dunn et al. 2018).

eDNA samples were collected from Watercourse S3a because it was the only watercourse with surface water at the time of the survey. There were no fish detected from the eDNA analysis. Black mudfish have not been recorded in the vicinity or within the site.

A search of the New Zealand Freshwater Fish Database (NZFFD) revealed no fish records for the Maungahaumia Stream and Morrinsville Stream catchments. The fish fauna in the mainstem of the Piako River in the vicinity of Morrinsville has been well surveyed between 1990 and 2008 with 63 records held in the NZFFD (shown on Figure 16). A total of seven native fish including shortfin eel, longfin eel, torrentfish, banded kōkopu, īnanga, common bully and common smelt and three exotic fish including catfish, goldfish and *Gambusia* have been recorded in the Piako River near Morrinsville.

Of the species found in the Piako River in the vicinity of Morrinsville, only shortfin eel and the exotic pest fish *Gambusia* are likely to occur within the watercourses draining the plan change site based on the degraded water quality and habitat conditions and ephemeral nature of the upper catchment environments.

7.0 Ecological Values

A summary of the freshwater values on the plan change site are presented in Table 6.

SEV's were not completed during the survey because of the absence of surface water in Watercourse S3. However, Freshwater Solutions (2019) undertook SEVs in the ephemeral and perennial sections of Watercourse S3 on the neighbouring 162 Studholme Street property. The SEV scores from freshwater Solutions survey in 2019 were used as an indication of the ecological and functional values of the watercourses draining the site. This is considered appropriate due to the close proximity and similarity of the 162 and 182 Studholme Road sites.

SEV scores for the perennial and ephemeral sections of Watercourse S3 were 0.304 and 0.222 respectively which are indicative of low to very low ecological value. The sections of Watercourse S3 upstream of the boundary are highly modified and almost entirely blocked off due to the creation of an artificial basin, therefore the SEV scores for the upper and lower sections of Watercourse S3 on the plan change site are likely to be lower than those previously reported.

All of the watercourses within the site have low to very low ecological value in their current state. Riparian vegetation is restricted to individual trees such as she-oak, oak and willow along some of the watercourses, although there is a section where native/exotic riparian vegetation is present, but restricted to one or more individuals in the uppermost reach of Watercourse S3, which provides shading and some habitat.

Instream habitat and water quality within the plan change site watercourses is generally poor, which is reflected in the results of benthic invertebrate samples and fish results from databases and previous surveys. The SEV scores in Watercourse S3 are indicative of low ecological values and function.

Table 6: Summary of freshwater ecological values.

Watercourse	Overall value	Summary
Watercourse S1	Low	Watercourse S1 is an overland flow path that comprises a very shallow depression in pasture, lacks a defined channel and streambed sorting processes, and contains no macrophytes or water adapted vegetation.
Watercourse S3	Low	**Rep. = Low**. Watercourse S3 is a modified watercourse typical of rural catchments. The SEV scores downstream of the site were indicative of low and very low ecological value and function. However, watercourse S3 does have restoration potential. **Rar. = Low.** Watercourse S3 provided poor seasonal habitat for native invertebrates and fish and did not support any species of conservation status. **Divs. = Low.** Watercourse S3 had a low level of natural diversity and an aquatic fauna and flora commonly observed in degraded rural watercourses. **Eco. = Low.** Watercourse S3 is a modified watercourse. It has poor instream habitat, little riparian habitat and a degraded freshwater community. Watercourse A drains the two artificial drains, which appears to be degraded but has the potential to form an ecological corridor in the local landscape if restored suitably.
Watercourses S3a, S3c, S3d	Negligible	Watercourse S3a, S3c and S3d are artificial watercourses used for draining farmland with negligible ecological value.
Watercourse S3b	Negligible	Watercourse S3b is an overland flow path that comprises a very shallow depression in pasture, lacks a defined channel and streambed sorting processes, and contains no macrophytes or water adapted vegetation.

Note: *rep. = representativeness, rar = rarity, distinctiveness, divs = diversity, eco = ecological context.

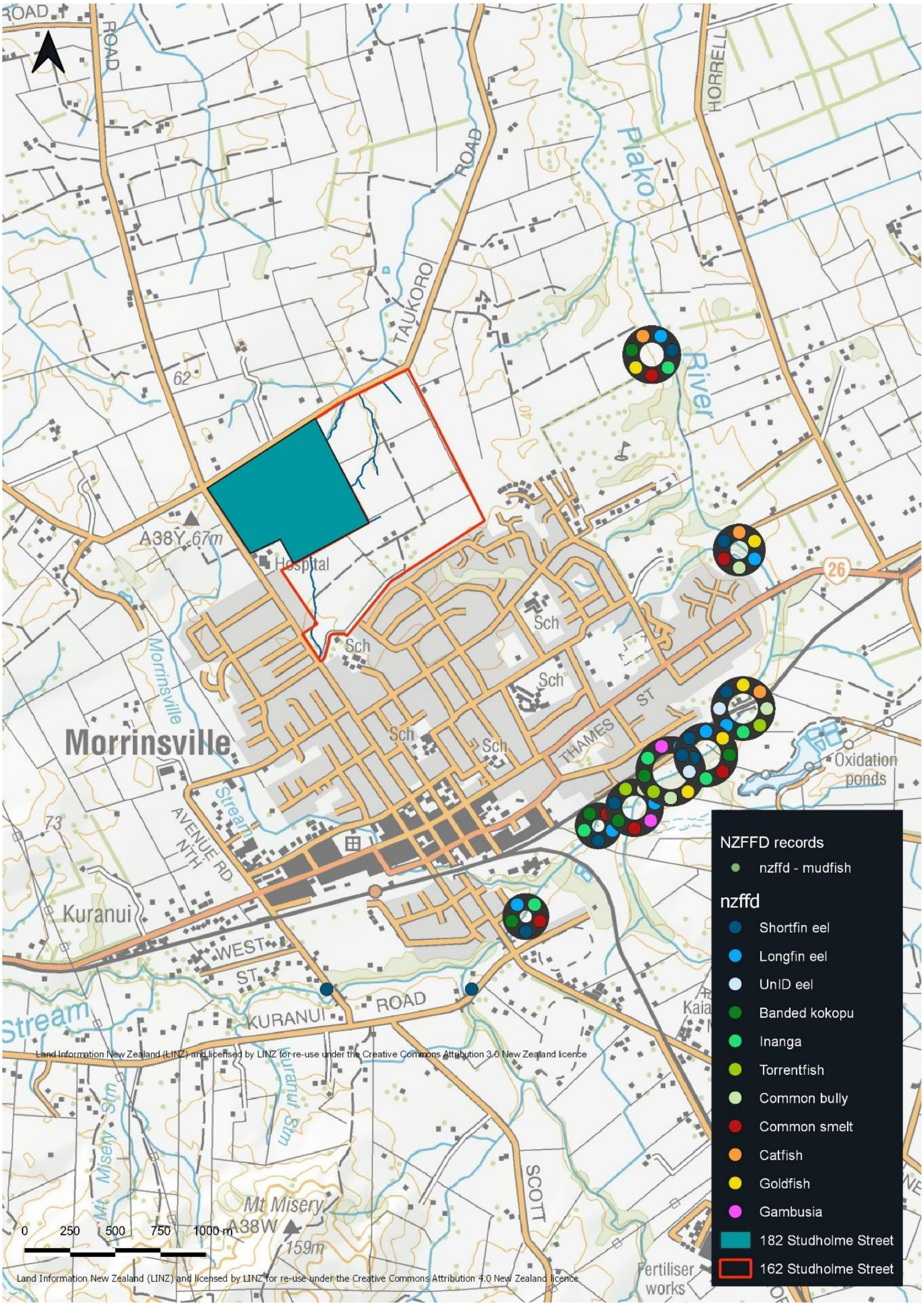

Figure 16: NZFFD fish records in the vicinity of the site.

8.0 Effects of Proposed Plan Change

8.1 Terrestrial Ecology

Habitat

There were no areas of terrestrial habitat or vegetation within the site that would warrant specific protection through the plan change process. Native fauna within the site was very limited due to the lack of habitat. Riparian areas in the upper reach of Watercourse S3 provide an opportunity to improve habitat conditions for native fauna.

Adverse effects should be avoided where possible, remedied or mitigated. Therefore, if the removal of Watercourse cannot be avoided, then there are opportunities for improvements of Watercourse S3 through remediation and/or mitigation options and by improving fish passage.

Avifauna

Bird species identified within the site are common species typical of rural and urban areas, all of which readily habituate to disturbance so are unlikely to be especially affected by development of the site. While the majority of birds within the site are expected to be common species of no conservation interest, vegetation clearance (particularly of mature trees) can adversely affect native species when completed over the breeding season (September-February inclusive).

Ideally vegetation clearance should occur within autumn-winter as to not impact the breeding season. However, if this is not practical, it is recommended that trees are surveyed prior to clearance, and if a nest of a native species is found, the tree is marked and left standing until such time as the nest is clear and chicks have successfully fledged.

Herpetofauna

There are very few areas within the site that would support native lizard species but it is possible that skinks are present in low densities within rank grass, shrubs, amenity vegetation around buildings and debris (e.g., wood and rubbish piles) and the mix native/exotic vegetation near Watercourse S3.

Riparian planting and enhancement along Watercourse S3 would create additional vegetated habitat for lizards. Other opportunities for enhancement include creating habitat (i.e., installing log stacks) with areas of suitable vegetation ensuring long rank grass areas (or dense low-growing native species) are retained.

A lizard management plan is not warranted for the site due to the lack of suitable habitat and the extensive modification of the site, which has likely removed populations of even common species such as copper skink.

Bats

Although there are a number of bat records within the vicinity of the site, the is a low probability that bats utilise the vegetation on site due to the non-continuous shelterbelt stands, and absence of roosting hollows and lack of water.

8.2 Freshwater Ecology

Wetlands

Freshwater Solutions understands that the induced wetland on Watercourse S3 will be retained and enhanced (Figure 2). This will be achieved through a programme of planting and will result in an increase in wetland ecological values within the site.

Modification or Reclamation of Natural Watercourses

Other than the main stem of Watercourse S3 and the Overland Flow Paths S1 and S3 there are no other natural watercourses within the site. Any reclamation or modification of natural streams will require offsetting through the enhancement of another section of stream within the site or offsite to ensure ‘no-net-loss’ of overall ecological function and values. Works in watercourses during reclamation should adhere to strict sediment controls to avoid the discharge of sediment to the downstream environment and spreading aquatic weed species. Mitigation or offsetting assessments should follow recommended WRC and Matamata-Piako District Council guidelines and methods (e.g. SEV) and adhere to best practice restoration guidelines (e.g., appropriate riparian widths, fish passage, etc.).

Modification of Overland Flow Paths and Artificial Channels

Overland flow paths occur within the site in areas of grazed pasture. Modification or infilling of overland flow paths does not require offsetting under rules in the Matamata-Piako District Plan. The Waikato Regional Council Policy Statement defines artificial watercourses as ‘a watercourse that contains no natural portions from its confluence with a river or stream to its headwaters and includes irrigation canals, water supply races, canals for the supply of water for electricity power generation and farm drainage canals. Artificial watercourses can be modified or infilled as a permitted activity.

Earthworks and Sedimentation Effects

Physical works associated with developing the site have the potential to result in fine sediment mobilisation and runoff into streams. The sections of Watercourses S3 have low ecological value in their current state. The addition of fine sediment to these stream environments has the potential to alter water chemistry, increase turbidity, decrease light penetration that affects primary production, smother instream surfaces and decrease habitat and food quality for benthic invertebrates.

All works will be carried out in accordance with erosion and sediment control plans prepared by Maven Associates and in accordance with Council guidelines. With the implementation of appropriate sediment control measures during construction the potential effects of earthworks on water quality, habitat and biota in the receiving environment will be avoided or minimised with the overall level of effect likely to be very low.

Stormwater Discharge Effects

Freshwater Solutions understands that the stormwater system for the site will be designed in accordance with best practice, the Waikato Regional Plan and in accordance the MPDC stormwater requirements (2016), Section 5.9.1 (Performance Standards).

Maintaining natural drainage and landform where possible will help to minimise a reduction in overland flow. Onsite detention and retention of stormwater should be considered as should the treatment of stormwater (i.e., swales, raingardens and offline wetlands). Stormwater treatment devices (i.e. stormwater wetlands or ponds) should be kept offline if possible. The development of residential housing areas results in an increase in catchment imperviousness that can alter hydrology and water quality in the downstream environment.

The proposed stormwater treatment system should be designed to ensure that the stormwater discharged from the site is of high quality and will meet relevant WRC standards.

The downstream receiving environment is within the neighbouring Lockerbie Estate Development. Maven Associates (2019) have already developed a detailed SMP for that site which sets out a process to mitigate the effects on the receiving environment, which consists of two distinctly different catchments that fall to the north and ultimately discharge into the Maungahaumia Stream. The stormwater plan for the proposed development should align with the existing plan since both sites (162 and 182 Studholme Street) drain into the same receiving environment.

With the appropriate level of stormwater treatment and management and given the highly modified nature and poor water quality of the receiving environments the stormwater related effects are expected to be very low.

9.0 Summary and Recommendations

The terrestrial and aquatic ecological values of the site and immediate environs reflect the highly-modified nature of the environment. The proposed plan change provides the opportunity to restore and enhance the current low ecological values.

The site is characterised by pastural land, with some exotic weedy hedging and mature exotic trees. Bird species identified within the site and most historic records in the local area comprise common species typical of rural and urban areas so are unlikely to be a constraint to developing the site. The site contains poor habitat for native skinks and native gecko. It is unlikely even the common copper skink is present within the site, due to its historical and present-day grazing and cropping and general lack of refugia. The proposed restoration of riparian areas associated with watercourse and the wetland will provide habitat for avifauna and lizards.

Watercourses within the site included a 512 m section of modified stream (S3), artificial watercourses forming part of the farm drainage network and two overland flow paths. One induced inland wetland occurs online in the lower section of the S3 watercourse. The Development Concept Plan indicates that this area will be retained and enhanced as part of a recreation precinct within the development, and will be done in accordance with the rules within the NPS-FM (2020), NES-FM (2020), or any consents obtained.

The development of the site has the potential to result in adverse effects on the freshwater environment through earthworks and sedimentation effects, stormwater discharge effects and reclamation of some stream habitat which will require mitigation and possibly offsetting measures to reduce the level of effect. With the currently low ecological values within the site, and the proposed ecological enhancements the proposed development will likely have a net positive effect on the ecology on the site.

References

Clarkson, BR., Champion, P., Rance, B., Johnson, P., Bodmin, K., Forester, L., Gerbeaux, P., Reeves, P. 2013. New Zealand wetland indicator status ratings. Hamilton: Landcare Research.

Dunn N.R., Allibone R.M., Closs G.P., Crow S.K., David B.O., Goodman J.M., Griffiths M., Jack D.C., Ling N., Waters J.M., Rolfe J.R. 2018: Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

Freshwater Solutions 2019. 162 Studholme Street Development Ecological Assessment. Report to Lockerbie Estates Limited.

Hitchmough R, Barr B, Monks J, Lettink M, Reardon J, Tocher M, Winkel, D.V., Rolfe, J. 2015. Conservation status of New Zealand reptiles, 2015. Department of Conservation, Wellington, New Zealand.

Maseyk, F., Maron, M., Dutson, G., Possingham, H., Seaton, R., Carlyon, G., Beveridge, A. 2015: A Biodiversity Offsets Accounting Model for New Zealand. Report prepared for department of Conservation. March 2015.

Maven Associates 2019: Stormwater Management Plan. Prepared for Lockerbie Estates. November 2019.

McEwen, W.M. 1987. (Editor). Ecological Regions and Districts of New Zealand (third revised edition in four 1:500,000 maps). New Zealand Biological Resources Centre publication no. 5. Department of Conservation, Wellington.

Ministry for the Environment (MfE). 2020. Wetland Delineation Protocols. Wellington: Ministry for the Environment.

MPDC 2016. Stormwater Requirements 2016.

Neale, M. W., Storey, R. G., and Quinn, J.M. 2016. Stream Ecological Valuation (SEV): Application to Intermittent Streams. Auckland Council Technical Report 2016/023.

National Policy Statement

O'Donnell, C.F.J., Borkin, K.M., Christie, J.E., Lloyd, B. Parsons, S. Hitchmough, R.A. 2017: Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington.

Roper-Lindsay, J., Fuller, S.A., Hooson, S., Sanders, M.D., and Ussher, G.T. 2018: Ecological Impact Assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Sedgeley, J.A, O'Donnell C.F.J. 2004: Roost use by long-tailed bats in South Canterbury: examining predictions of roost-site selection in a highly fragmented landscape. New Zealand Journal of Ecology 28(1): 1-18

Storey, R. G., Neale, M. W., Rowe, D. K., Collier, K. J., Hatton, C., Joy, M. K., Maxted, J. R., Moore, S., Parkyn, S. M., Phillips, N. and Quinn, J.M. 2011. Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland streams. Auckland Council Technical Report 2011/009.

US Army Corps of Engineers 1987: Wetland delineation manual. Wetlands Research Program Technical Report Y-87-1 (on-line edition). January 1987 - Final Report.