Biodiversity Topic Report

Silverdale West Dairy Flat
Business Area Structure Plan

December 2017

Auckland Council
Te Kaunihera o Tāmaki Makaurau

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Attachment 1 Ecological Constraints Analysis - Silverdale West Structure Plan, 2009.

1 Executive Summary

The Silverdale West Dairy Flat Business Area is a highly modified landscape, with predominantly arable livestock / pastoral and rural lifestyle activities.

Very little native vegetation remains and freshwater habitats are degraded.

Formulation of the structure plan provides an opportunity to maintain and improve ecological values, set objectives for ecological enhancement, guide the placement of reserves and align community recreation corridors with these.

Ecological constraints for development include:

- proximity of development in relation to watercourses
- proximity and scale of development in relation to floodplains
- avoidance of watercourse loss i.e. no permanent loss with reclamation
- avoidance of vegetation loss, especially Significant Ecological Areas.

Key ecological opportunities include:

- retaining and enhancing remaining native vegetation to improve wildlife habitat
- retaining and buffering natural watercourses to improve water quality and increase numbers and diversity of instream biota
- aligning reserves and recreational connections with existing natural watercourse corridors to provide user integration with nature and wider buffering for wildlife movement
- retaining natural topography to ensure watercourses can maintain natural form and function
- reintroducing riverine wetlands to natural floodplains
- restoration of modified watercourses to reinstate a meandering form and habitat diversity.

Implementing these opportunities will contribute to the implementation of national and regional environmental policies and strategies (such as the National Policy Statement for Freshwater Management) and implementation of the Auckland Growing Greener principles related to urban transformation, restoring nature and healthy waterways.

In the context of the wider landscape, the Silverdale West Dairy Flat Business Area currently represents a spatial gap in native vegetation and other areas of ecological value. This means that restoration of ecological values in the Silverdale West Dairy Flat Business Area structure plan area will help bridge this gap and is thus expected

to yield ecological benefits of a larger scale and across a much larger area of the Auckland region.

2 Introduction

2.1 Purpose and scope of the report

The purpose of this report is to identify and describe the ecological values present in the Silverdale West Dairy Flat Business Area structure plan area and provide guidance for development that ensures that these values are enhanced and protected in the long term.

Both constraints and opportunities relating to the area's ecological values are identified and discussed.

Formulation of this report has drawn on relevant historical reports, Auckland Council databases, external databases, aerial imagery, and internal Auckland Council expertise.

The scope of works undertaken during this assessment includes:

- review of historical investigation reports
- review all existing Auckland Council-held ecosystem and biodiversity records
- identification of ecological constraints and opportunities across the structure plan area, including summarising ecological outcomes which could be sought via the structure plan process and subsequent plan changes
- identification of actual or potential areas of absent information
- provision of recommendations for further environmental investigations required to support future applications for resource consent for site subdivision and redevelopment works.

Sustainability initiatives and other factors which can indirectly contribute to the protection or enhancement of ecological or biodiversity values are outside the scope of this report.

3 Strategic context - statutory and non-statutory

This section contains excerpts from relevant policy documents at both an Auckland and national level which support the need to achieve the ecological outcomes described in this document. This provides existing mandates that Auckland Council is responsible for delivering and which can be enabled via the structure planning process. Where bold text occurs this has been added for the purposes of this document to emphasise particularly important points or concepts.

The Auckland Unitary Plan became operative in part (AUPOP) in November 2016 and details new land use policy, rules and zoning for Auckland, along with overlays which identify important natural and historic values and characteristics which must be taken into account when making decisions about land use. Included in the Unitary Plan are provisions to protect and enhance ecological values across the Auckland region. In addition to the Unitary Plan, Auckland Council has other ecological obligations and commitments it is responsible for delivering on, including those found in policy and strategy documents at both the Auckland and national level. These other obligations and commitments can also be incorporated into and enabled via the structure planning process.

3.1 National policy documents

3.1.1 National Policy Statement for Freshwater Management (2014)

This policy statement sets out the objectives and policies for freshwater management under the RMA.

The objectives relevant to this report area set out below.

Objective A1

To safeguard:

a) the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of fresh water; and

b) the health of people and communities, at least as affected by secondary contact with fresh water;

in sustainably managing the use and development of land, and of discharges of contaminants.

Objective A2

The overall quality of fresh water within a region is maintained or improved while:

a) protecting the significant values of outstanding freshwater bodies;

b) protecting the significant values of wetlands; and

c) *improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated….*

Objective B4

To protect significant values of wetlands and of outstanding freshwater bodies….

Objective C1

To improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment.

3.1.2 New Zealand Coastal Policy Statement (2010)

This policy statement is relevant to the structure plan area but in a more limited way as it does not directly border the coastal environment but clearly the coastal environment is impacted by the stream that drain the area.

The relevant objectives and policies in this context therefore relate to protecting the water quality of coastal environment from discharges of sediment and contaminants resulting from development of the catchment. In particular the following are relevant:

Policy 22 Sedimentation

…(2) Require that subdivision, use, or development will not result in a significant increase in sedimentation in the coastal marine area, or other coastal water….

(4) Reduce sediment loadings in runoff and in stormwater systems through controls on land use activities.

Policy 23 Discharge of contaminants

1) In managing discharges to water in the coastal environment, have particular regard to:
d) avoid significant adverse effects on ecosystems and habitats after reasonable mixing;…

4) In managing discharges of stormwater take steps to avoid adverse effects of stormwater discharge to water in the coastal environment, on a catchment by catchment basis, by:…
(a)
(b) reducing contaminant and sediment loadings in stormwater at source, through contaminant treatment and by controls on land use activities;
(c) promoting integrated management of catchments and stormwater networks; and

(d) *promoting design options that reduce flows to stormwater reticulation systems at source.*

3.1.3 New Zealand Biodiversity Strategy (2000)

The New Zealand Biodiversity Strategy has been prepared in response to the state of decline of New Zealand's indigenous biodiversity. It sets out a number of themes and outcomes. Those relevant in relation to the structure plan area are set out below.

THEME 1: Biodiversity on Land

Scope

New Zealand's terrestrial ecosystems (including natural and modified habitats within and outside of protected areas, rural production landscapes and urban environments) and the indigenous species inhabiting these areas.

Desired outcome for 2020

A net gain has been made in the extent and condition of natural habitats and ecosystems important for indigenous biodiversity. Scarce and fragmented habitats (such as lowland forests and grasslands, wetlands and dunelands) have increased in area and are in better ecological health due to improved connections and the sustainable management of surrounding areas. Some modified habitats are restored…..

Threats to indigenous biodiversity from the activities of people are avoided or mitigated through sustainable use regimes and the sustainable management of production landscapes and urban areas.

THEME 2: Freshwater Biodiversity

Scope

All freshwater ecosystems (such as streams, lakes, wetlands, geothermal systems and underground aquifers) and the freshwater species within them. These waterbodies and ecosystems are interconnected with both land and estuarine and coastal ecosystems.

Desired outcome for 2020

The extent and condition of remaining natural freshwater ecosystems and habitats are maintained. Some degraded or scarce habitats, such as lowland river systems, important wetlands and riparian areas, are restored or increased in area…

Human activities in catchments are managed in an integrated way, avoiding, remedying or mitigating the adverse effects of land and water use (including pollution and sedimentation) on freshwater ecosystems. All freshwater ecosystems support biological communities largely comprising indigenous species…..

Land managers and communities continue to be actively involved in protecting and restoring freshwater bodies and habitats of special value to them.

THEME 3: Coastal and Marine Biodiversity

Scope

Coastal and marine environments including estuaries, inshore coastal ….the resident and migratory marine species (plants, benthic organisms, fish, marine mammals, birds and other organisms) inhabiting these areas.

Desired outcome for 2020

New Zealand's natural marine habitats and ecosystems are maintained in a healthy functioning state. Degraded marine habitats are recovering. A full range of marine habitats and ecosystems representative of New Zealand's indigenous marine biodiversity is protected.

3.1.4 National Policy Statement for Indigenous Biodiversity (proposed)

This proposed National Policy Statement sets out the objective and policies to manage natural and physical resources so as to maintain indigenous biological diversity (biodiversity) under the Resource Management Act 1991.

This also sets out a number of proposed policies and of particular relevance to the structure plan area is the following:

POLICY 6

To promote the maintenance of biodiversity outside of identified areas of significant indigenous vegetation and significant habitats of indigenous fauna, and to support the resilience and viability of populations and species assemblages within identified areas and habitats, decision-makers should:

a. *recognise the contribution that all remaining areas of indigenous vegetation make to the maintenance of indigenous biodiversity and encourage the retention of as many elements as possible*

b. *recognise the full range of potential adverse effects on indigenous biodiversity including, but not limited to, population fragmentation, degradation of non-living components (eg, water and soil), interruption to breeding cycles and migratory pathways, and increased exposure to invasive introduced plant and animal species that pose a threat to indigenous biodiversity.*

c. *encourage the retention of existing vegetation, whether indigenous or not (but not including recognised pest plants), that provides:*

    i. *habitat for indigenous species*

ii. *seasonal food sources for indigenous species*

iii. *ecological linkage between areas and habitats identified in accordance with Policy 4*

iv. *a buffer to indigenous vegetation for areas and habitats identified in accordance with Policy 4*

d. *when the retention of existing vegetation and habitat will not achieve sustainable management, encourage measures that mitigate and offset adverse effects on indigenous species during, and subsequent to, removal or modification of that vegetation or habitat through harvest or clearance or other activity that may threaten the survival of affected species populations*

e. *encourage the planting of naturally occurring, locally sourced indigenous species and the creation of habitats for indigenous species as well as plant and animal pest control*

f. *encourage the establishment of additional indigenous riparian vegetation as a means of increasing connectivity and enhancing freshwater habitat for indigenous species*

g. *ensure human-made structures do not adversely impact on indigenous species by interfering with their natural migratory movements*

h. *consider both regulatory incentives (such as bonus development rights in exchange for protection and enhancement of vegetation and habitats) and non-regulatory incentives, (such as technical advice and practical help) to support and encourage landowners to make appropriate land management decisions.*

3.2 Auckland Council policy documents

3.2.1 Auckland Plan

The Auckland Plan 2012 sets the overall strategy for Auckland. Key to the plan is the development strategy for accommodating future growth up to 2040, with up to 40 per cent of growth in greenfield areas, satellite towns, rural and coastal towns.

In the broader context it deals with the natural environment and has a number of priorities and directions relating to it. These are outlined below.

C1 Auckland's Strategic Framework

The outcome sought is "*A green Auckland".*

Para 63_states:

> *Our waterways and coastlines are clean and full of life… Biodiversity is abundant on private land, in our network of parks, and in protected areas of native bush and wetlands…..*

The transformational shift to achieve the vision is:

> *Strongly commit to environmental action and green growth.*

Para 71_states:

> *Our stunning natural environment and our ability to access it relatively easily, is one of the reasons Auckland ranks so highly on international quality of life surveys. But the health of that environment, and its biodiversity, is deteriorating…. the poor state of many of our waterways, and declining fish stocks are some of the pressing environmental problems we face. A fundamentally different approach to the way Auckland will grow and develop is required. We will protect and restore our environment, and respect its values…..*

Chapter 7 addresses Auckland's Environment.

Strategic Direction 7 is:

> *Acknowledge that nature and people are inseparable.*

Targets set include:

> *Ensure no loss in the area of significant landscape, natural character and natural features*
>
> *Reduce the overall yield of suspended sediment to priority marine receiving environments from 2012 levels by 15% by 2040*
>
> *Ensure no regional extinctions of indigenous species and a reduction in the number of 'threatened' or 'at risk' species from 2010 levels by 50% by 2040*

Environmental Principles are set out and are:

> *Auckland's environment must be healthy and resilient in order to support life and lifestyles. To ensure this we must recognise that:*
>
> 1. *The environment supports us - the natural resources provided by our environment have limits, and must be protected and restored to ensure our future wellbeing.*
> 2. *We need to consider environmental values in all that we do – the interaction between the environment and people is understood and considered in our everyday behaviour and choices.*
> 3. *Everything is connected – human activities affect the air, sea, land and freshwater systems. Understanding the connections between environments in the way we manage them is critical.*

4. *Biodiversity is everywhere – our flora and fauna, and their habitats, occur on both public and private spaces, and in urban, rural, freshwater and coastal areas. To maintain biodiversity values we must all work together…..*

6. *We are environmental stewards – future generations will depend on how well we manage the natural environment.*

The following Directives are relevant:

7.1 *Acknowledge and account for ecosystem services when making decisions for Auckland.*

7.2 *Recognise and promote:*

- *the contribution of natural heritage to urban character, quality, amenity and sense of place*
- *natural heritage as part of sustainable rural land management*
- *opportunities for conservation of natural heritage on public open space and private land.*

Para 439_states that:

> *Protecting Auckland's irreplaceable natural areas against poorly located or designed development is essential to maintaining and improving the quality of the environment. In particular, development should be carefully managed or avoided in significant landscapes as shown in Map 7.3 and significant ecological areas as shown in Map 7.4. As Auckland continues to develop, our challenge is to do so in sympathy with the scale and character of existing landscapes. We must manage the increased pressure on ecosystem services to ensure our natural heritage is protected for future generations.*

Directive 7.3 is:

> *Identify significant landscapes, landscape character, natural character and natural features, and appropriately manage these to protect and enhance their biophysical and sensory qualities, and associated values.*

Directive 7.4 is:

> *Identify places of high natural heritage value, and where appropriate, protect, manage and expand public open space areas so they can be enjoyed by everyone.*

Para 442 states:

> *Maintaining biodiversity means continuing to control pest plants, fish and animals; managing development on both public and private land; and ensuring that this development is located away from ecological areas of high value.*

The following Directives are also relevant:

7.5 Protect ecological areas, ecosystems and areas of significant indigenous biodiversity from inappropriate use and development, and ensure ecosystems and indigenous biodiversity on public and private land are protected and restored…..

7.10 Manage land to support the values of waterbodies by protecting them where they are high and reviving them where they are degraded. 7.12 – Protect coastal areas, particularly those with high values – including special natural character, significant marine habitats and recreational importance – from the impacts of use and development, and enhance degraded areas….

7.14 Take account of environmental constraints as identified on Map 7.6 and Figure 7.1 when considering the location and nature of any future development.

7.15 Avoid placing communities and critical infrastructure and lifeline utilities in locations at risk from natural hazards, unless the risks are manageable and acceptable.

3.2.2 The Auckland Unitary Plan (Operative in Part)

Regional Policy Statement

Section B2.2. on Urban growth and form sets out the following objective:

In section B2.3.1. Objective (1) is:

A quality built environment where subdivision, use and development do all of the following:

(a) respond to the intrinsic qualities and physical characteristics of the site and area, including its setting; ….

Objective (2) is:

Innovative design to address environmental effects is encouraged.

Part B7 addresses Natural Resources and many of the objectives and policies are relevant to varying degrees. The following are particularly relevant:

B7.2.1. Objectives

(2) Indigenous biodiversity is maintained through protection, restoration and enhancement in areas where ecological values are degraded, or where development is occurring.

B7.3. Freshwater systems

B7.3.1. Objectives

(1) Degraded freshwater systems are enhanced.

(2) Loss of freshwater systems is minimised.

(3) The adverse effects of changes in land use on freshwater are avoided, remedied or mitigated.

B7.3.2. Policies Integrated management:

(1) Integrate the management of subdivision, use and development and freshwater systems by undertaking all of the following:…

(c) controlling the use of land and discharges to minimise the adverse effects of runoff on freshwater systems and progressively reduce existing adverse effects where those systems or water are degraded; and

(d) avoiding development where it will significantly increase adverse effects on freshwater systems, unless these adverse effects can be adequately mitigated

Management of freshwater systems:

(2) Identify degraded freshwater systems.

(3) Promote the enhancement of freshwater systems identified as being degraded to progressively reduce adverse effects.

(4) Avoid the permanent loss and significant modification or diversion of lakes, rivers, streams (excluding ephemeral streams), and wetlands and their margins,……

(5) Manage subdivision, use, development, including discharges and activities in the beds of lakes, rivers streams, and in wetlands, to do all of the following:…

(b) minimise erosion and modification of beds and banks of lakes, rivers, streams and wetlands;

(c) limit the establishment of structures within the beds of lakes, rivers and streams and in wetlands to those that have a functional need or operational requirement to be located there; and

(d) maintain or where appropriate enhance:

(i) freshwater systems not protected under under Policy B7.3.2(5)(a);…..

(iii) existing riparian vegetation located on the margins of lakes, rivers, streams and wetlands;….

(6) *Restore and enhance freshwater systems where practicable when development, change of land use, and subdivision occur.*

Section B7.4.deals with coastal water, freshwater and the objectives of particular relevance in this context are:

(4) *The adverse effects of point and non-point discharges, in particular stormwater runoff and wastewater discharges, on coastal waters, freshwater and geothermal water are minimised and existing adverse effects are progressively reduced.*

(5) *The adverse effects from changes in or intensification of land use on coastal water and freshwater quality are avoided, remedied or mitigated…*

(7) *Manage the discharges of contaminants into water from subdivision, use and development to avoid where practicable, and otherwise minimise, all of the following:*

(a) *significant bacterial contamination of freshwater and coastal water;*

(b) *adverse effects on the quality of freshwater and coastal water;*

(c) *adverse effects from contaminants,….; ..*

The stormwater report sets out objectives and policies relating to sediment and stormwater which also impact on biodiversity values.

The RPS also requires that the rezoning of future urban zoned land for urbanisation follow the structure plan guidelines in Appendix 1. These set out that a structure plan is to in this context identify, investigate and address:

1.4.2. Natural resources

(1) *The protection, maintenance and enhancement of natural resources, particularly those that have been scheduled in the Unitary Plan in relation to Mana Whenua, natural resources, and the coastal environment.*

(2) *Demonstrate how proposed subdivision, use, and development will protect, maintain and enhance the values of the resources identified in 1.4.2(1) above.*

(3) *The integration of green networks (such as freshwater and coastal water systems, and ecological corridors) with open space and pedestrian and cycle networks, showing how they reflect the underlying natural character values and provide opportunities for environmental restoration and biodiversity.*

3.2.3 Indigenous Biodiversity Strategy (2012)

Aucland Council has statutory obligations to maintain and sustainably manage biodiversity and must respond to the requirements of the proposed National Policy Statement on Biodiversity.

The State of the Auckland Region report (2010) describes the increasing pressures that a growing population continues to place on the biodiversity of our natural environment including new and existing biosecurity risks, the unsustainable use of natural resources, habitat fragmentation, the increasing demand for infrastructure and climate change. The objectives in the document address these.

The report sets out a vision of what the council values and wants to see this is:

> *Healthy and diverse ecosystems of plants and animals*
>
> - *Auckland's ecosystems are functioning and healthy*
> - *Priority ecosystems and species managed effectively*
> - *Threatened species flourishing in natural habitats*
> - *Significant sites of indigenous biodiversity protected*
> - *Nature connected across Auckland in linkages and sequences…Ecosystem services provided by indigenous biodiversity*
> - *Ecosystem service values are recognised and incorporated in plans and decision making*
> - *Policies in our plans that recognise the resilience that biodiversity provides to ecosystem services and functions by protecting what we currently have and enabling the uptake of opportunities to better manage and enhance our environments*
> - *Biodiversity maintained or enhanced to ensure that future environmental changes will not reduce ecosystem services or functions…*
> - Integrated management producing biodiversity gains
> - *Linkages and interactions between biodiversity across terrestrial, freshwater and marine ecosystems are recognised and provided for in planning documents and internal and external programmes.*

A number of objectives are set out and aspects of Objective 8 relevant in this context are to:

> *Improve implementation of council statutory responsibilities to support our biodiversity mandate.*
>
> *This means:*

- *The nature of provisions in council statutory documents, e.g.: the unitary plan, reserve management plan, and the degree to which these provisions are implemented in line with the strategy….*
- *No net loss of ecosystems functions and processes resulting from consented activities.*

A number of Principles are also set out and key here is to:

- *Manage the region as a network of protected habitats (including aquatic, terrestrial and marine) which are buffered, and linked to other habitats. Ideally these habitats sit in a matrix of land uses and actions which support the ecological function of these habitats.*

3.2.4 Auckland Growing Greener (2016)

Auckland Growing Greener describes Auckland Council's roles and commitments to deliver the environmental outcomes for Auckland that underpin the Auckland Plan vision.

The Elements of Growing greener relevant in this context are:

- *…..restoring and enhancing natural ecosystems to ensure their resilience and productivity*
- *using natural assets and green infrastructure to manage stormwater and flood risks ….*

The report recognises that Greenways could enhance biodiversity by acting as wildlife corridors or restoring ecological functions.

Under priorities it is stated that:

> *Natural habitats in urban areas act as stepping stones and corridors where indigenous species can rest, feed, roost and move across the landscape. They can also provide homes for rare and threatened species that prefer different types of habitat,….*

Priority initiatives relevant in this context include:

- *ecological connections programme (e.g. North-West Wildlink) linking biodiversity sites across the region*
- *supporting bigger and smaller-scale wetland restoration*
- *continued incorporation of biodiversity outcomes in urban design and transport infrastructure*
- *promote the use of water sensitive design in all developments*

- *improve water quality by reducing stormwater contaminants at source and local board driven industry pollution prevention programmes*
- *roll out improved stormwater catchpit maintenance practices which is likely to achieve 75 per cent more sediment being removed*
- *support community-based catchment initiatives such as Project Twin Streams, Te Auaunga Awa, and the Whau and Weiti restoration projects*
- *implement the Auckland Regional Water Demand Management Plan.*

3.2.5 Low Carbon Auckland (2014)

This document sets out how Auckland is to reduce its greenhouse gas emissions. It recognises that a network of green and open spaces, and, waterways provides a wide range of benefits including enhanced biodiversity and improved stormwater management, and can provide carbon 'sinks' that remove greenhouse gas from the atmosphere.

By 2020, in this context, it is planned that:

- *Significant ecological areas are identified and protected.*
- *Areas covered by the Ecological Corridors Plan achieve a 50 per cent increase in carbon sequestration (based on 2014 levels).*
- *Ecological 'corridors' are integrated into planning.*
- *Ecosystem services are valued.*

The report sets out what needs to be done in the next 10 years of relevance to this context, includes:

Element 1: Growing the extent of urban and regional forests

This involves creating a city within a forest by protecting existing forests and planting trees throughout Auckland, primarily natives, including on riparian/marginal land. It also involves protecting and expanding, where appropriate, saline ecosystems and coastal corridors.

This commitment includes… private land (including riparian planting, coastal zone), urban planting ….Such programmes will contribute to a range of environmental outcomes including:

- *carbon sequestration*
- *building community resilience to the effects of climate change, for example, riparian vegetation that reduces the effects of flooding…*
- *biodiversity protection and improved health of streams*

- *linking up existing remnants of vegetation to create green corridors for native animal life.*

Actions include:

Integrate and consider native forestry planning when undertaking local area plans and structure planning to expand Auckland's ecological corridors. For example:…

- *Establish tree-based ecological corridors and plans based on existing available land, e.g. transport routes, forest remnants, streamways, coastal zones and land acquisitions…..*
- *Apply low-impact design to establish ecological corridors through urban and newly developed areas.*
- *Develop a planting programme that implements the biodiversity strategy and delivers healthy green corridors.*

4 Site description

4.1 Study area

The structure planning process applies to the land shown in Figure 1. The area is about 607ha.

This land is located to the west of the State highway 1 motorway from Pine Valley in the north to south of the North Shore Airport and west to the Dairy Flat Highway.

It includes the Pine Valley East area in the north, Silverdale West in the centre and Postman Road to the south. The North Shore Airport is surrounded on three sides by the Postman Road part of the structure plan area.

The current land use is predominantly countryside living, rural production and some business uses such as a bus depot.

To the west of Silverdale West, south and to the east opposite the airport, the land is zoned Future Urban (Figure 2 – AUPOP zoning for Silverdale and Dairy Flat Business Area).

To the west of the Postman Road area the land is zone Mixed Rural and there is a small area of industrial land at the Dairy Flat Highway Kahikatea Flat Road intersection. This reflects a legacy local service area.

The wider Upper Orewa, Wainui, Silverdale and Dairy Flat Future Urban area is approximately 3,500ha extending from Upper Orewa in the north to Dairy Flat in the south. Immediately to the north of the structure plan area there is 300ha of "live' zoned land at Wainui.

Figure 1 – Land to be subject Silverdale West Dairy Flat Business Area Structure Plan

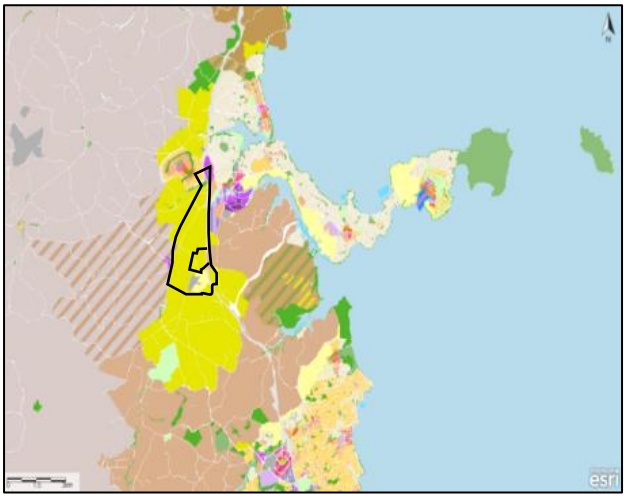


Figure 2 – AUPOP zoning for Silverdale and Dairy Flat Business Area

4.2 North-West Wildlink

The Silverdale West Dairy Flat Business Area represents an important ‘stepping stone’ in the North-West Wildlink (NWWL - Figure 3 - North West Wildlink), a corridor of ecosystems which extends from the Waitakere Ranges in the west to the Hauraki Gulf Islands in the north-east.

The NWWL aims to maintain and enhance natural habitat in the corridor to act as stepping stones for wildlife to move between conservation hotspots. The NWWL project is a collaborative effort between Auckland Council, Department of Conservation and Forest & Bird, and other stakeholders, and aims to connect with communities in achieving enhancement natural areas such as open spaces, stream banks, esplanades and reserves, and to restore migration routes.

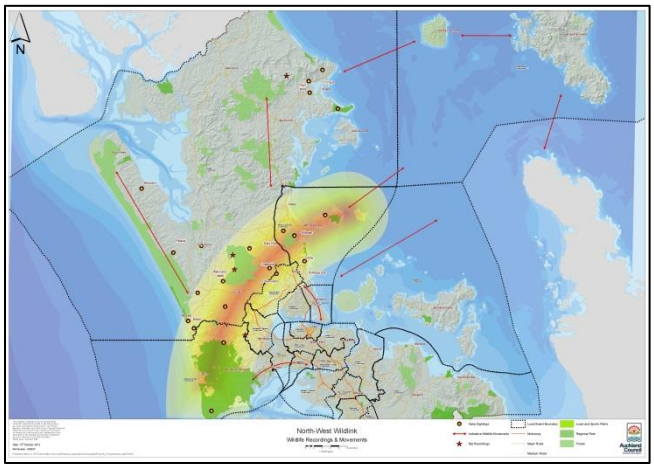


Figure 3 - North West Wildlink

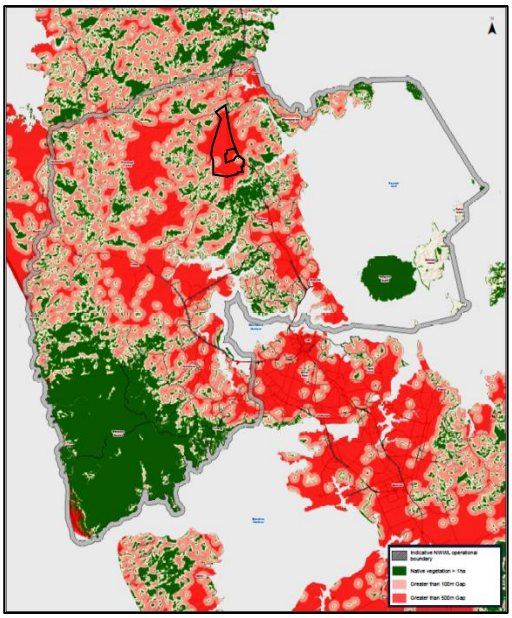


Figure 4 - North West Wildlink gap analysis

Whilst extensive work has been carried out since 2006 to link up regional biodiversity hotspots across Auckland, the gap analysis (Figure 4) shows the underlying lack of vegetation cover in the structure plan area. The paucity of native vegetation in the structure plan area (discussed under the heading terrestrial environment) is a large gap in the ecological corridor. The creation of stepping stones in the structure plan provides strategic opportunity to make significant contribution to biodiversity at the local and regional

NWWL restoration efforts within the Silverdale Dairy Flat area have included projects located between Albany Heights and the Whangaparaoa peninsular, including restoration of native forest and shrubland habitats, and replanting waterway buffers; initiatives have also included invasive weed and mammalian predator control.

4.3 Original vegetation cover

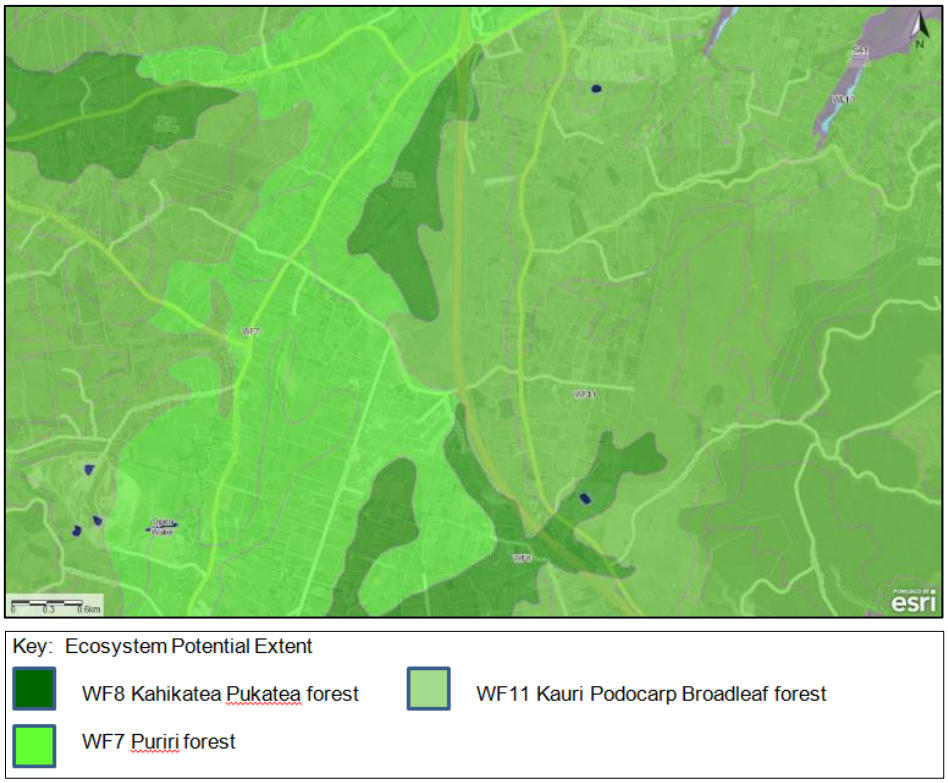
Originally the entire structure plan area would have been covered in native vegetation. Modelling suggests (Figure 5 – Ecosystems Potential Extent) that predominantly three forest ecosystem types occurred across the Silverdale Dairy Flat landscape; Puriri forest (WF7), Kahikatea Pukatea forest (WF8); Kauri Podocarp Broadleaf forest (WF11).

Puriri forest would have dominated most of the flattest and most fertile alluvial soils. Kahikatea, Pukatea forest would have formed corridors associated with the major streams and wettest lowland areas, especially in the wider catchments of John Creek, Weiti Stream and Rangitopuni Stream. Kauri Podocarp Broadleaf forest would have been found predominantly on hill-slopes, with acidic leached soils where kauri occurs; more fertile (granular) soils have broadleaved species in gullies.

Although not highlighted in the modelling, extent mapping of remaining remnant forests in the local area includes Kahikatea Forest (MF4) and Taraire Tawa Podocarp forest (WF9). The former has been found in the Auckland region to be interchangeable with WF8, dependant on site specific vegetation composition. Whilst WF9 has also been mapped locally, this remnant too is likely to be remaining gully vegetation of the found within the WF11 ecosystem type.

The coastal marine area downstream of the structure plan area would have consisted of mangrove forest and scrub (SA1), including both mangrove dominated areas as well as areas of various salt marsh communities. The various inland creeks the ecosystems would have graded into various freshwater wetland ecosystems, including oioi, restiad rushland (WL10).

Wetland and mangrove forest still can be found along the reaches of the Weiti Stream and Karepiro Estuary.



Key: Ecosystem Potential Extent

WF8 Kahikatea Pukatea forest

WF11 Kauri Podocarp Broadleaf forest

WF7 Puriri forest

Figure 5 - Ecosystems Potential Extent

4.3.1 Original native fauna

Kauri, podocarp, broadleaved forests would have supported a diverse range of invertebrates, amphibians, reptiles, birds and bats.

In forested areas, birds such as kereru, tomtit, fantail, grey warbler, whitehead, morepork, North Island robin, shining cuckoo, North Island brown kiwi, and weka would have been present. The mast fruiting of kahikatea would have provided an abundant food source for kākāpō, kākā, kākāriki, kererū, tūī, bellbird, huia, saddleback, kōkako and piopio

Arboreal native reptiles such as forest, elegant and Pacific gecko and ground dwelling skinks such as copper, ornate, and striped skink would have been common.

In the swampy areas, wetland birds such as banded rail, spotless crake, pukeko, pateke, and bittern would have been common, as would fern bird, Australasian harrier and kingfishers.

4.3.2 Original freshwater systems

Due to the gentle topography of the structure plan area, freshwater systems were characterised by low order, low energy watercourses connected to large wetlands and swamps ecosystems.

These wetland areas functioned to attenuate water flows and acted as slow release storage areas preventing any downstream channel scouring, and reducing sediment load.

As stated above, these wetland areas would have harboured a variety of native terrestrial flora and fauna. Instream and wetland biota would have included a high diversity of native macroinvertebrates and fish species. Fish species were likely to have included lowland galaxiid species such as banded kokopu, inanga, and giant kokopu, and also longfin eel, short fin eel, koura, Cran's bully, red fin bully, and black mudfish.

5 Current ecological values

Ecological values have been severely degraded by the removal of vegetation from the landscape.

Very little, if any, remnant native vegetation still exists, consisting mostly of small and isolated areas which are unlikely to sustain themselves long-term. Originally diverse and abundant fauna communities have also been severely reduced by near-complete removal of their habitat.

Watercourses remain, but the values of these have been degraded by the removal of vegetated buffer and canopy cover, compounded by inputs of sediments and nutrients from surrounding land use, channel modification, and draining or infilling of wetlands/swamps.

Instream and wetland fauna are likely to be in severe decline in line with this modification and degradation.

5.1 Terrestrial

Very little native vegetation cover remains, a reflection of the historic and current intensive agricultural, horticultural and pastoral activities undertaken on the fertile soils of the structure plan area. Removal of native vegetation from the entire area has had negative impacts on native ecosystems and functionality is all but lost. The small pockets of remaining vegetation will be providing limited refuge for native birds, invertebrates, lizards and possibly bats. However, these remaining vegetated pockets will be severely compromised in function.

5.1.1 Terrestrial ecosystems

At present, the structure plan area is mainly un-vegetated (un-forested) and save the riparian SEA's, no native forest ecosystem areas remain in the structure plan area. Those wooded fragments that are present are small in size, lack variety, and spatially isolated from other remnant forest patches or larger areas of intact vegetation. As a consequence, the ecological value and long-term viability of these areas is severely compromised. This is because of low population sizes, low levels of reproductive and gene flow connectivity to other areas, high exposure to the damaging edge effects of high wind and light conditions and weed infestation, and the highly likely presence of pest animals and livestock.

The only area of semi-mature native vegetation has been identified to the north of the structure plan area, including an area lying just south of the Dairy Flat Highway, immediately west of the main Silverdale / SH1 interchange. This area is not well documented or described but is of some reasonable level of local significance given that they have been made subject to a conservation covenant protecting freshwater values and contributing to water quality outcomes.

As noted in a number of reports, prevalent across much of the structure plan area, are exotic shelterbelt plantings. Shelterbelts in this geography comprise mostly of exotic trees, including some species which are considered to be weeds. However, in the absence of significant native vegetation, they provide an important function as refuges for native fauna, while providing basic ecosystem services.

Riparian vegetation has been generally documented across the structure plan area but it appears that the majority of riparian corridor is either un-vegetated or weedy, or in places vegetated with exotic bank stabilising species (many weedy themselves). Native riparian vegetation appears to exist in some places; however these areas are small in number and size, located mostly to the north, and so relatively isolated and disconnected from the southern landscape.

5.1.2 Terrestrial Significant Ecological Areas

Significant ecological areas (SEAs - Figure 6) have been identified as a management overlay layer in the Auckland Unitary Plan (AUPOP) in order to protect and enhance existing areas of high ecological value. Background, objectives and policies relating to SEAs are contained in Chapter D9 of the AUPOP and rules relevant to terrestrial SEAs are found in chapters E3 (lakes, rivers, streams and wetlands), E15 (vegetation management & biodiversity), E11 (land disturbance - regional) and E26 infrastructure).

Figure 6 - Significant Ecological Areas

Only two terrestrial SEAs exist, and they boarder the north of the structure plan area (Figure 7); they consist of two remnant forest fragments and riparian vegetation associated with the Weiti Stream.

The two remnant fragments of kahikatea forest discussed in section 3.2 are identified as SEAs (SEA_T_2192 and SEA_T_2192a). SEA_T_2192a is, in part, protected through QEII Trust covenant.

Notwithstanding that these two SEA areas are small, the presence of the kahikatea forest ecosystem type qualify these remnants as significant ecological areas; each SEA has specific qualifiers that include: 'representativeness', 'diversity', 'threat status / rarity', and 'stepping-stones / migration pathways / buffers'. Also to note, this particular Kahikatea forest ecosystem has been classified as a critically endangered ecosystem type within the Auckland region.

For all the above qualifiers, these two forest fragments have also been identified as priority sites for protection and enhancement under the Auckland Council Biodiversity Focus Area ecosystem prioritisation framework. Remaining remnant forests in the local area includes Kahikatea Forest (MF4)[1]. Kahikatea forests are critically endangered in the Auckland region.

Kauri Podocarp Broadleaf forest (WF11) has also been mapped along the Weiti Stream, to the north of the structure plan area; an endangered ecosystem forest type.

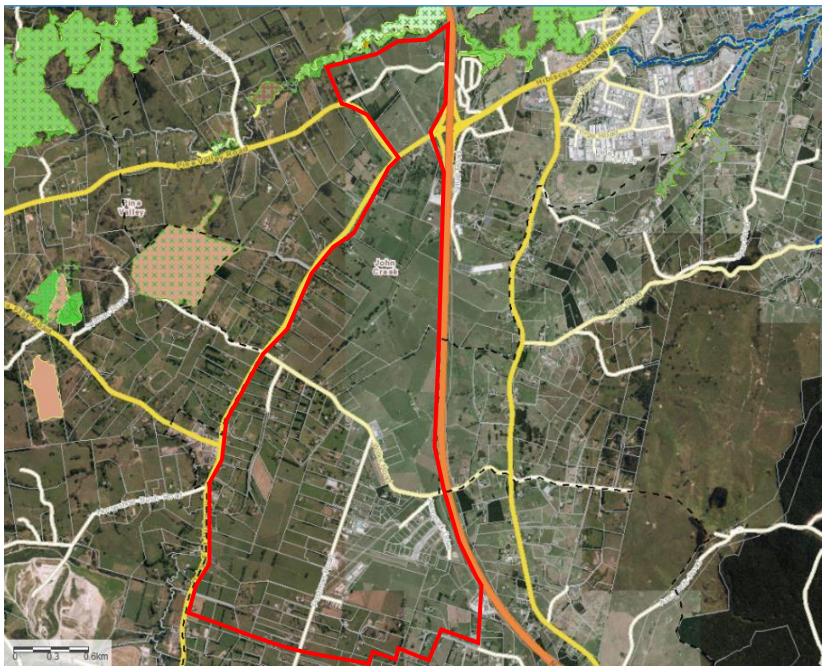


Figure 7 - SEA and current ecosystem extent in strucutre plan area

[1] Depending on site specific vegetation composition, MF4 has been found to be interchangeable with Kahikatea Pukatea forest (WF8), in the Auckland region.

5.1.3 Native flora

Although little native vegetation remains, there are records of nationally or regionally threatened plant species occurring in close proximity, within 1km, to the structure plan area (these records are summarised in table 1 below).

Table 1 Threatened Plan Species

Species	National threat status (2012)	Regional threat status (2005)
Phylloglossum drummondii	Nationally Critical	Serious decline
Plumed Greenhood (Pterostylis tasmanica)	Nationally Vulnerable	Sparse
Korokio (*Corokia cotoneaster*)	Not threatened	Sparse
Mingimingi (*Coprosma propinqua var. propinqua*)	Not threatened	Regionally vulnerable
Small-leaved kowhai (*Sophora microphylla*)	Not threatened	Sparse
Pomaderris phylicifolia	Nationally Endangered	Unknown (old records)

5.1.4 Native birds

Similar to the native flora records above, the only records of nationally or regionally threatened bird species occurring in the structure plan area are associated with the SEA to the north of the structure plan area (SEA_T_2192 and SEA_T_2192a)

Species	National threat status (2012)	Regional threat status (2005)
Kaka *(Nestor meridionalis)*	Recovering	Regionally Vulnerable

Given the small amount of native vegetation remaining and the highly modified nature of the structure plan area, the landscape provides little in the way of habitat or connective corridors for forest birds.

Common bird species found across the structure plan area, especially forest-dwelling species are low, however across the wider landscape 50+ species, both native and introduced have been recorded.

Whilst not specifically recorded in the structure plan area important bird species have been sighted in the vicinity, within 6km, including grey duck (*Anas superciliosa*), Northern New Zealand (NZ) dotterel (*Charadrius obscurus aquilonius*), Caspian tern (*Hydroprogne caspia),* Red-billed gull *(Larus novaehollandiae)*

Native birds which are common in modified rural landscapes in Auckland, and therefore likely to be common across the Silverdale West Dairy Flat Business Area, include pukeko, Australasian harrier, silvereye, kingfisher, white-faced heron and spur-winged plover. Common native forest birds such as tui, fantail, silvereye grey warbler and kereru are likely to be present in those few areas with remnant native vegetation, although the small and isolated nature of these remnant fragments means numbers are likely to be low. None of these species are classified as nationally or regionally rare or threatened.

5.1.5 Native Lizards

Lizard habitat within the Silverdale West Dairy Flat Business Area is limited due to the lack of potential habitat provided by forest, scrub, and rank grass. The area of SEA, small stands of exotic treeland and scrub in the northern extent of the site provide some potential lizard habitat.

There are at least six native species of lizard that are known to inhabit forest and scrub areas in the vicinity of Silverdale (ARC and NSCC 2005), which include:

- Copper skink (Cylodina aenea).
- Ornate skink (C. ornata).
- Forest gecko (Hoplodactylus granulatus).
- Pacific gecko (Hoplodactylus pacificus).
- Auckland green gecko (Naultinus elegans elegans).
- Common gecko (Hoplodactylus maculatus)

The introduced Plague skink (*Lampropholis delicate*) and the threatened ornate skink have both been recorded in a forested section of Weiti Stream, and copper skinks have been recorded just outside the structure plan area to the north.

5.1.6 Native bats

Despite the absence of large tracts of mature bush in the structure plan area, it is possible that native long-tailed bats could be present.

Bats roost in cavities in mature trees and in the absence of suitable native trees, do use exotic tree species. Bats feed on the wing for flying invertebrates and often forage near streams where invertebrate life is more abundant.

Long-tailed bat surveys undertaken by council and consultancies at nearby locations have all detected small numbers of bats, the closest to the structure plan area being only 5kms away.

No surveys have been carried out specifically within the structure plan area, it is possible that bats are present in low numbers, traversing the landscape between roost and foraging sites.

Long-tailed bats are listed as a 'nationally vulnerable' threatened species by the Department of Conservation and so have a high ecological value.

5.2 Freshwater catchments

This section describes the aquatic habitat and biological characteristics of streams and ponds draining the Silverdale West Dairy Flat Business Area.

The freshwater systems within the structure plan area, including John Creek and wetlands, are highly modified from their original condition and freshwater ecosystem, habitat and fauna values have all been severely compromised.

Silverdale West is located within the upper reaches of John Creek which is a tributary of the Weiti Stream. The main stem of John Creek is a permanent stream and its tributaries are a mixture of permanent and intermittent streams. John Creek flows south to north through the site, then passes through a culvert under the SH1 before connecting to the Weiti Stream (some 600m downstream of the site) and ultimately into the Weiti River estuary. The downstream estuarine environs of the Weiti River and Karepiro Bay are identified in the AUPOP as significant ecological areas (both terrestrial and aquatic). These are:

- SEA M2 65a Weiti Estuary Intertidal
- SEA M2 65b Weiti Estuary Shell spits
- SEA M2 65c Weiti Estuary.

These SEA's provide significant habitat for coastal birds. The shell spits are key breeding grounds for the threatened NZ dotterel.

Stream modifications include channelization and straightening, removal of riparian vegetation, installation of structures such as culverts and dams, and agricultural

run-off pollution. These changes have resulted in low habitat diversity, decreased biodiversity and degraded water quality.

Virtually all freshwater wetlands have been partially drained, filled or otherwise reclaimed, largely for agricultural purposes; although some areas of degraded wetland do remain, or are recovering due to low livestock numbers. These modifications have resulted in a near complete loss of wetland ecosystem types from the area along with the biota dependent on them. Valuable ecosystem services provided by wetland systems have been lost.

5.2.1 Streams

Streams north of Wilks Road (John Creek and tributaries), feed to the Weiti Steam, and on through the Weiti River estuary to Karepiro Bay on the East Coast, the whole northern system being part of the Weiti Catchment.

South of Wilks Road contains upper catchment tributaries of the Rangitopuni Stream and Dairy Stream, which are in the Upper Waitemata Catchment and feed into the Upper Waitemata Harbour.

The riparian vegetation along the line of John Creek and its tributaries appears to consist almost exclusively of exotic vegetation; although noted, one short stream reach is covenanted; a stream reach which has undergone restoration efforts though consent conditions.

Pasture grasses and occasional scattered trees including, willow, poplar and hawthorn appear to make up the dominant riparian vegetation in the upper catchment, where the main stem and its tributaries are small and mostly confined to modified natural channels (straightened) or seepages.

Willows are more common towards the northern end of the site; in places where stock access has been restricted, scrubby sub-canopy and understorey tiers are present. The large sprawling willows throughout the middle and northern sections of John Creek are described as growing within the stream channel, and are contributing to the creation of large pools and debris dams.

The John Creek channel is described as U-shaped throughout and both the main stem and tributaries are modified through the middle and upper sections of the Creek; with a number of straightened reaches present. The channel is termed as more natural in the northern corner of the site, with a greater diversity of hydrological conditions.

The riparian vegetation appears to be more diverse in the northern corner of the site and includes a small section of native forest, over hung grassy banks, scattered exotic trees with occasional totara, and a small section of dense willow canopy.

Figure 8 shows current flood hazard information held on the council's GIS system. This is currently being reviewed by the Healthy Waters Team as part of the investigations for the catchment management plan.

Historical surveys suggest the highest stream values are found in the northern part of John Creek, and its tributaries in the north and west of the catchment. The majority of John Creek was found to have moderate instream values, with the lowest, most degraded areas in the southern and eastern tributary sections.

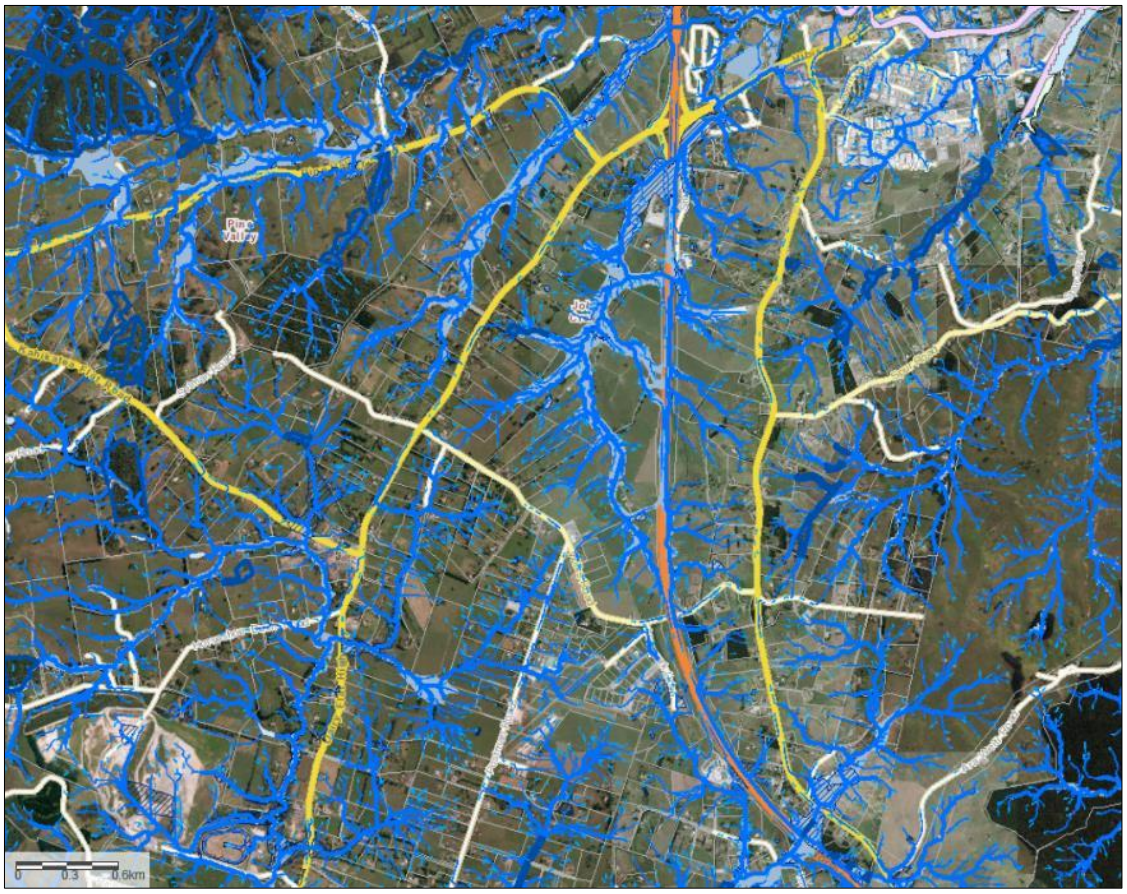


Figure 8 – GIS flood hazard identification

4.2.1 Instream fauna

Historical data of recorded Invertebrate taxa from the pasture stream sections of the structure plan area reflected the highly modified nature of the catchment and habitat (i.e. channelization, riparian buffer clearance). Invertebrate communities recorded from the catchment contained a high proportion of pollution tolerant taxa including Potamopyrgus snails (Mollusca), chironomids and Austrosimulium (Diptera), and ostracods and amphipods (Crustacea). The pasture stream sections of John Creek were dominated by Mollusca and Diptera.

The MCI-sb scores ranged between 42 and 57 and are typical of degraded and modified rural habitat, with moderate to low water quality.

The fish community are generally restricted to Shortfin Eels and Banded Kokupu, which are tolerant of a wide range of habitat and water quality conditions, and are known to inhabit highly degraded environments. However Common Bully (*Gobiomorphus cotidianus*) and Inanga (*Galaxias maculatus*) have been found just outside the John creek catchment.

5.2.2 Fish barriers

Several culverts have been observed within the pasture stream reaches, with many of the culverts broken or overgrown with grass, and likely to represent barriers to most fish species.

It should be noted that only shortfin eels have been recorded in the middle sections of John Creek reach. Shortfin eels are excellent climbers, capable of climbing over substantial obstacles and even over wet land or wetted stream margins.

Banded Kokopu were previously noted in the most northern section of the site indicating potentially impassable barrier(s).

5.2.3 Wetlands

It appears that virtually all original wetlands within the structure plan area have been drained or infilled for other uses. There are some extensive floodplains across the base of the structure plan area. The John Creek floodplain provides an indication of probable location and a sense of these historical.

The locations, extent and condition of remaining wetlands in the structure plan area is not well known and/or undocumented, and these habitats need to be surveyed and mapped as part of the stream survey work before the development of detailed development plans for the area.

Any remaining small areas of freshwater wetland are likely to be highly modified by stock access (grazing and pugging), drainage or the creation of stock ponds. Consequently, freshwater fauna and terrestrial flora and fauna associated with wetlands is also likely to be all but absent from the structure plan area.

Freshwater wetlands perform a varied and valuable set of ecosystem service functions, including flood water attenuation, sustaining and balancing base flow rates, and filtration and removal of sediment, nutrients and other pollutants reaching watercourses through overland flow. These ecosystem service values are lacking in the structure plan area.

6 Outcomes sought

An increase in the area of native vegetation in the structure plan area is important, as the current state is notably sparse, providing a major barrier at the landscape scale for flora, fauna and ecological function. This will be an important factor in contributing to the North West Wildlink.

Buffering existing forest fragments and establishing additional areas to provide habitat for native species, is a critical initiative in the structure plan area. Protection and enhancement of watercourses is needed to improve water quality, habitat, and function. Comprehensive invasive weed and pest animal control throughout, helping to achieve Pest Free Auckland by 2050.

Opportunities exist to increase wetland areas and use riparian and wetland margins for green ecological, recreational and active transport corridors. They may also serve to help alleviate downstream flooding and provide attenuation in extreme weather events.

Riparian areas provide a key opportunity to increase vegetation cover, connect and buffer existing ecological areas, provide landscape level corridors for the movement of native flora and fauna, e.g. northwest wildlink, and to restore ecological connectivity and function.

All areas of open space, streams, forest, street trees, residential gardens, storm water devices and any other area that could potentially support plants and animals in this geography would combine and contribute to what is commonly referred to as a Green Network.

6.1 Terrestrial

As seen from figures 1, 3, 6 and 7, the terrestrial structure plan area is lacking in variety in terms of mature native vegetation and areas of significant ecological value. As such, it is critical that pressures of development are managed to maintain the values of all remaining areas of native vegetation and ecological value as an absolute baseline and also enable the enhancement and buffering of these areas as much as possible.

The current lack of native vegetation across the structure plan area means there is a lack of habitat value for most native flora and fauna. Increasing vegetation cover In order to increase the abundance of native birds, lizards and other fauna, and by association available habitat and food resources, should be the key requirement of development.

The current lack of native vegetation also means that the structure plan area constitutes a ‘gap’ in ecological connectivity and a barrier to the movement of flora and fauna at the broader landscape scale. The creation of the structure plan and subsequent development across the structure plan area provides an invaluable ‘one-off’ opportunity for this gap to be bridged with new areas of vegetation. This would

help re-establish connectivity of ecological function and the movement of flora and fauna between the Hibiscus Coast and the West.

Given the likely development outcomes of business focused development, the most significant opportunity to achieve all of these outcomes is the restoration and planting of riparian corridors. Riparian margins constitute an existing (albeit severely degraded) corridor across the landscape and thus can act as spines around which to focus revegetation activity. Riparian corridors are able to be readily utilised as a basis for revegetation and restoration.

Esplanade reserves, where required will be vestments to council, and provides an excellent starting point for these purposes. To maximise increases in both vegetation cover and landscape level ecological connectivity requirements for planting and restoration of as many riparian corridors as possible. The major stream within the structure plan area, John Creek, flows in a roughly south/north direction. As such, additional permanent and intermittent stream riparian margins provide an ideal opportunity to reconnect these areas either side of the structure plan area in a westerly direction, with restored lowland wetland areas acting as small biodiversity hubs, where possible.

Another key opportunity is promoting the use of road corridors and urban gardens for the planting of additional native vegetation. This would provide further habitat value and green connectivity across the intervening urban matrix which sits between the key corridors of connectivity constituted by the restored riparian areas.

A summary of desired outcomes and possible mechanisms to achieve these outcomes includes:

- retention of all remnant native forest patches, those specifically identified as an SEA and/or preferably those that are not, including wetlands.
- enhancement of remnant forest patches through buffer planting, creation of green corridors to restore connectivity and pest plant and animal control.
- planting of wetland and watercourse margins to create a natural green corridor and allow for colonisation and/or movement of flora and fauna across the landscape. Vegetated watercourse margins will also function to filter runoff from surrounding land.
- retaining and encouraging native bird species is very important for continued ecological function and to enable pollination and seed dispersal in existing and future native ecosystems. New vegetated areas will provide suitable habitat for a range of bird species.
- new native vegetation areas should be protected in perpetuity either through covenants or vestment with council.
- all new native plantings should be aligned with the original vegetation types of the relevant locations as these are most suited for local conditions such as soil type and hydrology. All native plants should be eco-sourced from south Rodney or northern Tamaki Ecological District(s).
- retention or creation of areas of suitable habitat for native skinks, perhaps in alignment with areas to be vested or acquired as open space, e.g. riparian corridors and the coastal edge.

- mature tree species should be retained wherever possible, whether native or exotic, to provide bat roosting habitat.
- encourage street trees, public amenity plantings and private garden plantings to be made up of a diverse range of native species.
- weed and animal pest management throughout all existing SEA and planting.

6.2 Freshwater

Freshwater systems within the structure plan area have been heavily modified and degraded as a result of the surrounding land use. It is critical that no further loss of streams or wetlands occurs in the structure plan area, as far as practicable, and that the pressures of development do not result in further degradation of these freshwater systems. Furthermore, the opportunity provided by the creation of the structure plan and subsequent development across the structure plan area should be utilised to enable the restoration of freshwater ecosystems and habitat wherever possible, thus increasing both biodiversity values and valuable ecosystem service values.

The revegetation of stream riparian corridors outlined above will not only increase terrestrial ecosystem values but also freshwater ecosystem values. Riparian vegetation acts to filter and reduce the input of sediment, nutrients and contaminants such as heavy metals. It also shades the stream and thereby reduces water temperatures – raised water temperature is perhaps the most significant limiting factor for many native fish and other in-stream fauna. Riparian vegetation also contributes detritus input into the stream, which increases food availability and habitat heterogeneity for in-stream fauna.

Other specific opportunities to increase in-stream values include the removal of structures which act as barriers to fish passage such as inappropriate culverts and online dams and ponds. As well as blocking fish passage, online dams and ponds also contribute to raising water temperatures and the associated negative effects on in-stream fauna.

As important as the removal of existing in-stream structures is the prevention of adding new ones. With the large amount of construction and road building expected to occur across the structure plan area it is important that considerations are made to limit the effects of these activities on in-stream values. In particular, adding further structural barriers to streams should be avoided. This includes minimising the number of new stream crossings, and where new stream crossings are necessary ensuring they appropriately allow fish passage, as well as ensuring they are as perpendicular as possible to the direction of the stream to minimise their impact.

Where possible, restoring more natural sinuosity to previously straightened or channelized streams will also slow stream flow rates, decrease stream depths, and contribute to habitat heterogeneity for in-stream fauna, especially smaller species or juveniles disproportionately affected by high depths and flow rates. However, these factors may conflict with utilisation of streams for stormwater management purposes.

Modified watercourses, especially in urbanised locations with large impervious surface areas, can suffer from lack of ground water recharge. Maintaining continuity

of flow throughout the year is vital to watercourse health and function and the smaller low order streams of the Auckland region rely on groundwater recharge to achieve this. Retaining natural landform and avoiding development within the floodplain in the future will protect remaining watercourses and groundwater levels.

Virtually all natural wetlands in the structure plan area are likely to have been removed. As such, the high value of these areas for both biodiversity and ecosystem service provision is missing from the area. Where possible, re-establishment of wetland ecosystems should be undertaken. The most suitable locations for wetland re-establishment and restoration to occur are the confluence of streams, and floodplain areas of the structure plan area where wetlands would historically have occurred; present topography and hydrology lend themselves to restoration of this ecosystem type. Contours in these areas appear to be relatively unmodified so repatriation is likely possible. Importantly, wetland re-establishment and restoration can be aligned with floodplain locations required to be kept free from development for stormwater management purposes to also achieve ecological outcomes in these areas.

Protection and retention of natural flood plains outside of the 1% annual exceedance probability (AEP) of flooding will also contribute to maintaining and improving watercourse form and function, and prevent scouring or erosion of downstream channels. Protection of floodplains is also likely to have cost benefits for adjacent infrastructure. Note that while ensuring development occurs outside the 1% AEP is likely to protect infrastructure in general, this does not allow for natural watercourse and floodplain function and encroachment on floodplains is likely to result in further watercourse degradation.

It is acknowledged that stream retention may not be possible for all reaches, due to the large floor-space / footprints required by development of business land, and in such cases where reclamation is justified, and has been demonstrated to be unavoidable, mitigation through offsetting principles should be applied.

A summary of desired outcomes and possible mechanisms to achieve these outcomes includes:

- avoid any loss of wetted habitat, enhance and increase wetted habitat as a primary principle.
- retain all orders of watercourses i.e. including tributaries whether permanent or intermittent. Protect overland flow paths so that intermittent watercourses remain.
- retain natural topography to promote ground water recharge and natural watercourse form.
- introduce and integrate wetland and riverine elements into developments and use these spaces as opportunities for providing green corridors and recreational walkways and linkages.
- require planting of riparian margins to a minimum width of 10m on both sides of watercourses and wetlands.
- Any recreational or transport areas associated with riparian corridors should occur outside the 10m planted area.
- Removal of exotic riparian species, and replace with native species; noteworthy exotic trees could be retained in incorporated.

- keep development footprints outside of the natural flood plain to avoid effects on hydrology.
- remove online ponds when subdivision provides opportunity.
- seek repatriation of wetlands and modified watercourse channels to their natural state during development.
- protect fish spawning areas from modification, provide for suitable enhancement plantings and implement long term pest animal control.
- remove barriers to fish passage and ensure infrastructure design allows for long term fish passage, including bridging in preference to culverts wherever feasible.
- ensure any watercourses that form part of the structure plan area boundary are protected as per recommendations above.
- any works in watercourses to adhere to hygiene protocols to avoid spreading aquatic weed species.
- map and delineate watercourses prior to developing any scheme plans or yield calculations to identify constraints and achieve maximum watercourse protection.
- restoration of lost wetland areas will increase ecosystem diversity.
- stormwater outflows from roads are likely to be contributing to pollutant load so opportunities to improve these during any transport corridor improvements should be taken. New roading infrastructure should be designed to avoid these inputs as much as possible.
- encourage roads and/or active transport routes bordering on stream esplanade areas and other planted riparian areas to effectively widen these corridors and provide connection to the public realm.
- stream and wetland crossings seek to avoid freshwater habitat loss, whilst ensuring that crossings are, as far as practicably possible, perpendicular to the stream and/or wetland where required.

7 Gap Analysis

7.1 Terrestrial

The terrestrial biodiversity information, currently available for the area, is reasonably detailed enough to understand how development can be integrated into the area, and where enhancement and restoration initiatives should focus.

Further refinement can proceed once further detailed analysis has been made with regards to main arterial / collector roads, infrastructure and when development zones are understood.

7.2 Freshwater

Further freshwater habitat information should be sought. There is a need to focus on understanding the full extent of permanent and intermittent streams, and wetland communities.

Current reports are either outdated and have used former ARC Regional Plan stream classifications, or are incomplete. There is a need to update the stream / wetland extent classifications, to be consistent with the Auckland Unitary Plan.

However, this work cannot proceed until such time that there is adequate hydrological conditions within groundwater; this work will need to wait until late spring 2018 to fully understand the intermittent stream reaches.

Attachment 1 Ecological Constraints Analysis - Silverdale West Structure Plan, 2009.

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