report

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Park Estate SHA
Ecological Assessment

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1.0 Introduction

Hugh Green Ltd is undertaking a structure plan and plan change process for the Park Estate Road development (the site) on the Hingaia Peninsula to allow the current agricultural land use to be changed to residential. The aquatic, coastal and marine ecological values of the Hingaia Peninsula have been thoroughly studied as part of various previous catchment and planning processes (e.g., Golder 2009).

A site walkover was carried out on 3 October 2014 to collect additional terrestrial and aquatic ecological data to supplement existing information and further assessments of the wetland habitat were made in early 2015 to inform the structure plan change process. In addition, a site walk over was undertaken with Auckland Council Housing Project Office (HPO) and project staff and discussions were held over watercourse classifications, wetland habitat values, potential stormwater management at the site and the draft preliminary assessment of values, ecological constraints and opportunities that was prepared in October 2014.

This report reviews relevant literature including Proposed Auckland Unitary Plan (PAUP) provisions and supporting documents relating to the ecological values present, describes and evaluates the ecological values of the property, outlines potential ecological constraints and opportunities provided by the change in plan status and also discusses potential mitigation or restoration options that are likely to enhance existing ecological values.

2.0 Site Description

The site is roughly triangular in shape with the northern boundary formed by Park Estate Road and eastern boundary comprising the Southern Motorway. Drury Creek forms the south western boundary. The Hingaia Peninsula is located within the Manukau Ecological District which forms the southernmost portion of the Auckland Ecological Region (McEwen 1987). The Manukau Ecological District was characterised on the basis of geology and topography and encompasses low altitude flat to rolling land between the southern shores of the Manukau Harbour and the north bank of the Waikato River (McEwen 1987). Existing land use within the site is dominated by high producing exotic grassland (Figure 1). Eight watercourses and six artificial ponds were identified within the site.

3.0 Study Methods

The assessment approach involved the following components:

- A review of existing information.
- Site walkover and assessment of aquatic and terrestrial ecological values.
- Classification of streams using the PAUP definitions.
- Detailed assessment of the history, extent and values of the wetland.
- Site walk over and discussions with Auckland Council Special Housing Office staff.

Figure 1: Land cover within the Park Estate site.

Desktop Review

Existing sources of information included:

- Golder (2009) – Hingaia South Catchment: Ecological and environmental assessment.
- Julian (2000) – Hingaia ecology report concepts and guidelines.
- Larcombe (2000) – Effects of proposed urban development of the Hingaia Structure Plan Area on the coastal marine environment.
- Kessels and Associates (2000) – Hingaia Development Project ecological review.
- Proposed Auckland Unitary Plan.
- New Zealand Freshwater Fish Database (NZFFD) records.
- Aerial photos obtained from OPUS (previously held by NZ Aerial Mapping) dating from 1942, 1960, 1969, 1981 and 2014 provided by Auckland Council.

Site Walkover and Watercourse Classification

The site walkover which informed our description of the existing terrestrial, freshwater and coastal margins was made in October 2014 with follow up site visits in January and March 2015. Freshwater Solutions Limited carried out the freshwater component whilst Mitchell Partnerships Limited (Dr Gary Bramley) carried out the terrestrial component.

Terrestrial plant, bird and mammal species encountered were recorded and communities described. Appendix A and B lists plant and bird species recorded respectively. There are no Significant Ecological Areas (SEAs) listed in the PAUP within the site but the adjacent estuary (part of Manukau Harbour) is regarded as an SEA and significant for wading birds.

Watercourses were classified in accordance with PAUP criteria (refer Appendix C for criteria) following a review of existing information (i.e., Golder 2009) and during the site visits carried out in October 2014, January 2015 and March 2015. Aquatic habitats, wetlands and aquatic flora were described. Fish observed and any areas of potential īnanga spawning habitat were noted.

Follow up Wetland Assessments

A follow up assessment of the wetland within the property was undertaken during summer conditions in January 2015. The extent of the wetland was assessed by reference to the presence or absence of hydrophytic (water adapted) plants, in particular *Carex* and *Ranunculus*, which were assumed to reflect the annual or long-standing extent of water at the site. Where these plants were detected the area was included within the wetland, and where they appeared to be absent, the area was excluded. This is not absolutely definitive, because palatable species (such as *Ranunculus*) could have been absent due to grazing pressure, however given the assessment was undertaken when the whole area was dry, it was considered to be reliable for the purposes of defining the boundary of the wetland.

An assessment of the history of the wetland and wider site conditions was made by reviewing high resolution aerial photographs dating back to 1942 obtained from Auckland Council. A series of aerial photographs of the site taken in 1942, 1960, 1969, 1981 and 2015 were reviewed (Appendix D). The approximate location of historical wetland boundaries on each of the historical aerials were mapped based on changes in the vegetation appearance and the location and nature of drainage channels visible in each

photos. Historical wetland boundaries are indicative only as there were difficulties associated with georeferencing the historical aerials due to the significant changes in features within the site over time (since 1942) and also due to the complicating presence of shadows on the black and white photos.

Site Walk over and Discussions with Auckland Council

A site walk over was held with SHO staff, other Auckland Council staff, and the project team in January 2015. During this site walkover discussions were held with Mr Rue Statham and Mr Mark Iszard over Freshwater Solutions' preliminary stream classifications, the extent and values of the wetland and the ecological constraints and opportunities relevant to the site.

Following the site walk over the SHO provided advice on a range of issues including stormwater management, wetland and stream classifications, catchment management, existing piped inflows to the site. A workshop was held in March 2015 at the Manukau City Auckland Council office between HPO staff, iwi and the project team. This workshop provided further opportunity to discuss and agree on the ecological values, constraints and opportunities. The outcomes from the workshop have been incorporated into this report.

4.0 Terrestrial Environment

4.1 Vegetation

The vegetation comprises mostly exotic pasture used for cattle farming but sheep and horses are also grazed. There is also an area of messmate (*Eucalyptus obliqua*) plantation. Very little native vegetation or habitat for native fauna remains since the majority of the land has been subject to grazing as shown in Figure 2. A list of plant species recorded at the site is provided in Appendix A.

Figure 2: Pasture at the Park Estate Road site.

The coastal fringe is fenced to exclude livestock in the northern part of the site. This coastal buffer varies in width, but is generally narrow and the vegetation comprises mostly exotic weeds including maritime pine (*Pinus pinaster*), tree privet (*Ligustrum lucidum*), gorse (*Ulex europaeus*), pampas (*Cortaderia selloana*), Japanese honeysuckle (*Lonicera japonica*) and black wattle (*Acacia mearnsii*) with common exotic grasses. Native species within this

coastal fringe are sparse, but include tī kōuka (*Cordyline australis*), māpou (*Myrsine australis*), whekī (*Dicksonia squarrosa*) and bracken (*Pteridium esculentum*). An example of this coastal fringe vegetation is shown in Figure 3. Watercourses crossing the site drain directly to the sea, but these are not fenced to exclude livestock and include no native riparian vegetation. A representative example is shown in Figure 4. Remnant or modified vegetation persists at some locations including oioi (*Apodasmia similis*), bachelor's button (*Cotula coronopifolia*) and flax (*Phormium tenax*) (Figure 5).

Figure 3: Coastal fringe vegetation at the Park Estate Road site.

Figure 4: Riparian vegetation within the site has mostly been removed.

Figure 5: Remnant flax *(Phormium tenax)* affected by grazing livestock.

4.2 Birds

Birds were commonly encountered at the site and bird song was nearly continuous. Most birds recorded were exotic or common native species (see Appendix B), but three species of conservation note were detected including New Zealand pipit (*Anthus novaeseelandiae*) in open pasture and black shag (*Phalacrocorax carbo*) and little black shag (*Phalacrocorax sulcirostris*) flying or roosting near the adjacent estuary. New Zealand pipits have a conservation ranking of 'At risk' (Declining), whilst both shag species are regarded as 'At risk' (naturally uncommon) (Robertson et al. 2012).

Pipits are commonly found in farmland, coastal, wetland and forested habitats, but are absent from much of the Auckland Region and Waikato Region and are only sparsely present where they do occur (Robertson et al. 2007). Pipits are considerably more common along the west coast of those regions, and are known from the areas immediately north of Auckland in reasonable numbers (Robertson et al. 2007). They are absent from the more intensively farmed or inhabited areas, including the Hamilton Basin and Auckland city (Robertson et al. 2007), because of a lack of suitable habitat. The greater Auckland area is not regarded as a stronghold area for pipit populations. Nationally New Zealand pipits are more common through the central North Island (south of Taupo), Northland, East Cape and throughout the South Island (Robertson et al. 2007).

As well as shags and other coastal birds the estuary area is likely to provide habitat for banded rail (*Rallus phillipensis*) and other birds of conservation concern. Banded rail have a conservation ranking of 'At risk' (Declining) Banded rails are known to inhabit the wider Manukau Harbour (Robertson et al. 2007) and are very likely to be resident in the mangrove forest and saltmarsh areas near the site. Banded rails would not occupy the more terrestrial habitats within the site itself.

4.3 Other Fauna

There is only very limited habitat which is suitable for native bats (*Chalinolobus tuberculata*), although the tall pine trees on the estuary edge may be suitable as potential roosts. The nearest long-tailed bat records[1] are from Redoubt Road (Manukau) and Clevedon Scenic Reserve. Both locations are within flying distance for bats but the lack of suitable habitat within the site means that a resident bat population is unlikely.

Lizards that may occur on the Park Estate SHA include copper skink (*Oligosoma aeneum*), Pacific gecko (*Dactylocnemis pacificus*) and the introduced species rainbow skink (*Lampropholis delicata*). Copper skink are regarded as 'not threatened' (Hitchmough et al. 2013), whilst Pacific gecko are regarded as 'At risk' (Relict). Forest gecko (*Mokopirirakau granulatus*), Auckland green gecko (*Naultinus elegans*), ornate skink (*Oligosoma ornatum*), shore skink (*O. smithi*) and moko skink (O. *moco*) are also known from the Auckland Region but are less likely to occur within the site because of the lack of suitable habitat and the presence of introduced predators.

5.0 Freshwater Environment

5.1 Overview

Golder (2009) assessed the ecological characteristics and values of watercourses within the site for the Hingaia South catchment Integrated Catchment Management Plan (ICMP) during low summer baseflow conditions. Golder (2009) classified watercourses at the site as either permanent or intermittent in accordance with the Proposed Auckland Regional Plan: Air, Land and Water (PARP:ALW). Stream definitions and criteria used in the PARP:ALW have since been updated in the PAUP. Golder (2009) classified more length of stream at the site as ephemeral and less length of intermittent and permanent stream when compared with the present study. Differences between the two studies most likely reflect updates to the stream definitions and criteria.

Eight watercourses (W1–W8) were identified within the site (Figure 6). The PAUP stream status of the watercourses using the current land use and drainage pattern as the baseline is shown in Figure 6. Analysis of historical aerial photographs taken in 1942, 1960, 1981 and 1990 provide a good indication of the changes to the drainage patterns that have occurred within the site over the past 75 years. All watercourses except Watercourses W1 and W2 appear to have been fully or partially formed during extensive drainage works prior to 1942 and up to the 1980s (Figure 7 and Figure 8).

It is unknown what, if any, natural stream channels occurred within the site prior to the drainage works (pre-1942). The 1942 aerial photograph indicates there were no 'natural' stream channels entering the site from the north or east beneath what is now the Southern Motorway. There was a drain associated with Watercourse W7 entering the site from the east in 1942 and 1960 and a drain associated with Watercourse W6 in 1942 (Figure 8). This suggests that if there were any natural streams within the site prior to the drainage works then they were probably small spring-fed streams that flowed into what was a more extensive wetland prior to the drainage works a century ago. Based on current knowledge, it appears highly likely that some or even the majority of what is referred to in this report as Watercourses W3 to W8 can be considered artificial channels.

[1] http://naturewatch.org.nz/projects/auckland-bats

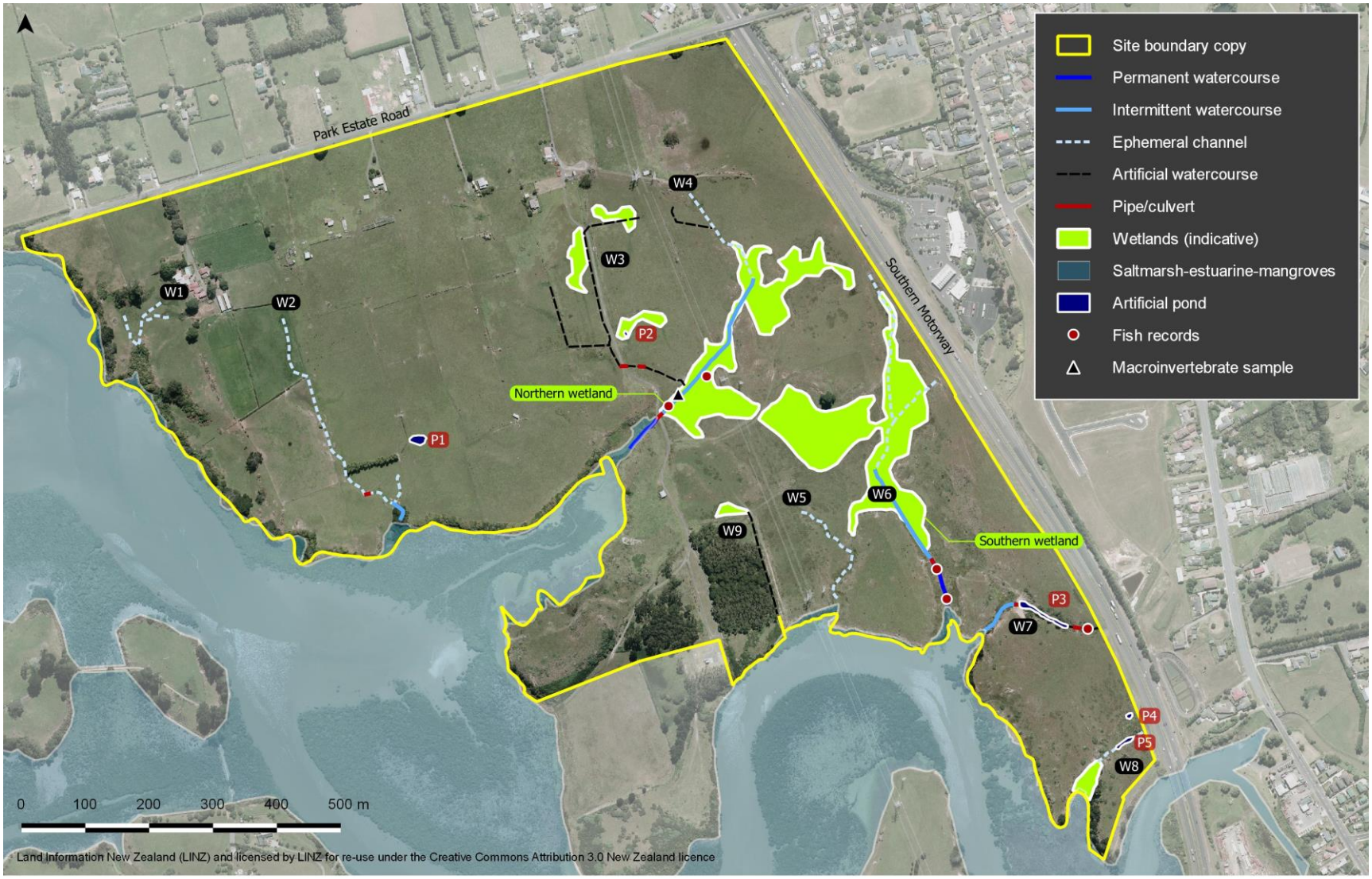

Figure 6: Current watercourses, ponds and indicative wetland areas within the site.

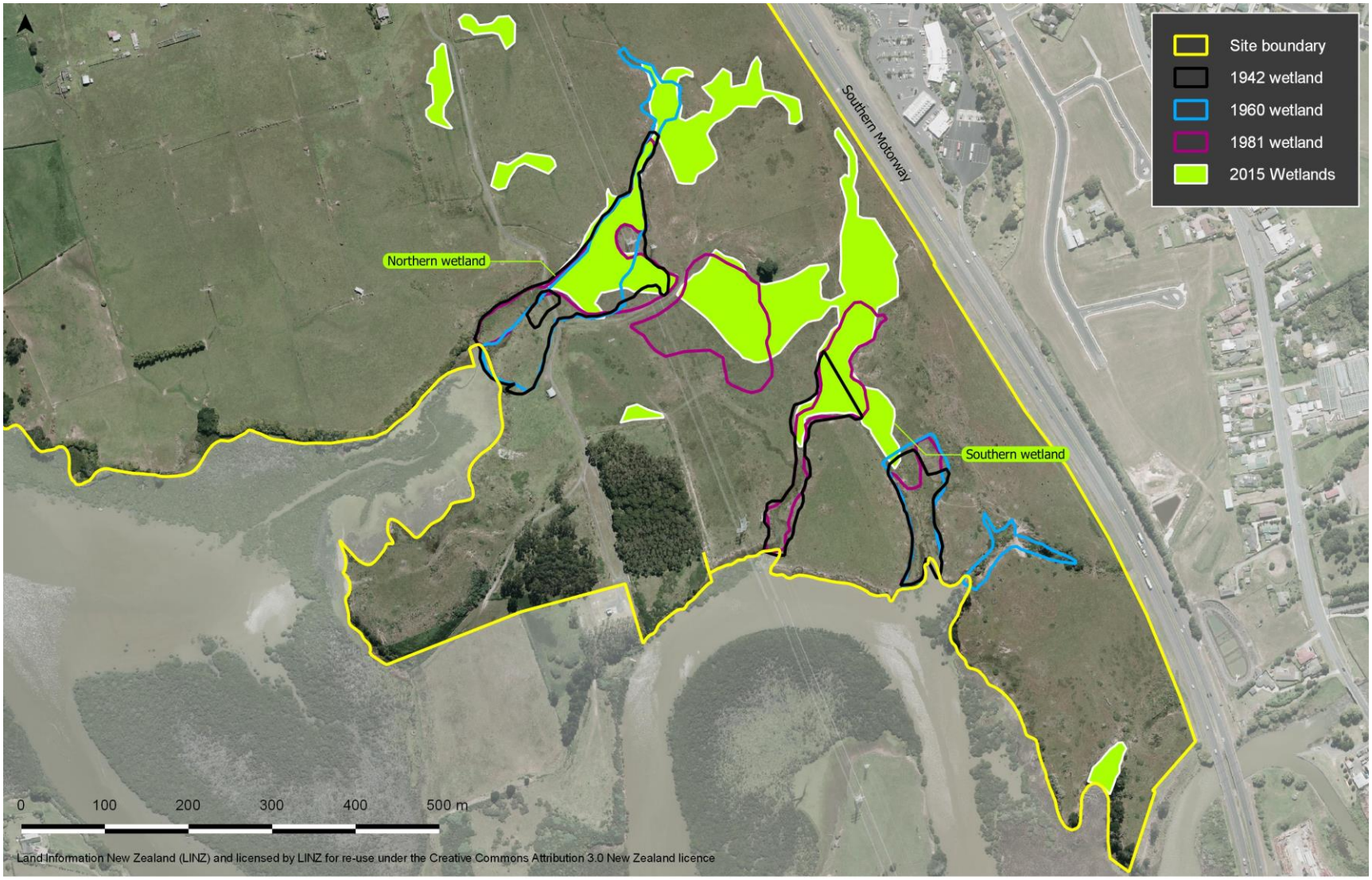

Figure 7: Indicative wetland areas within the site in 1942, 1960, 1981 and 2015.

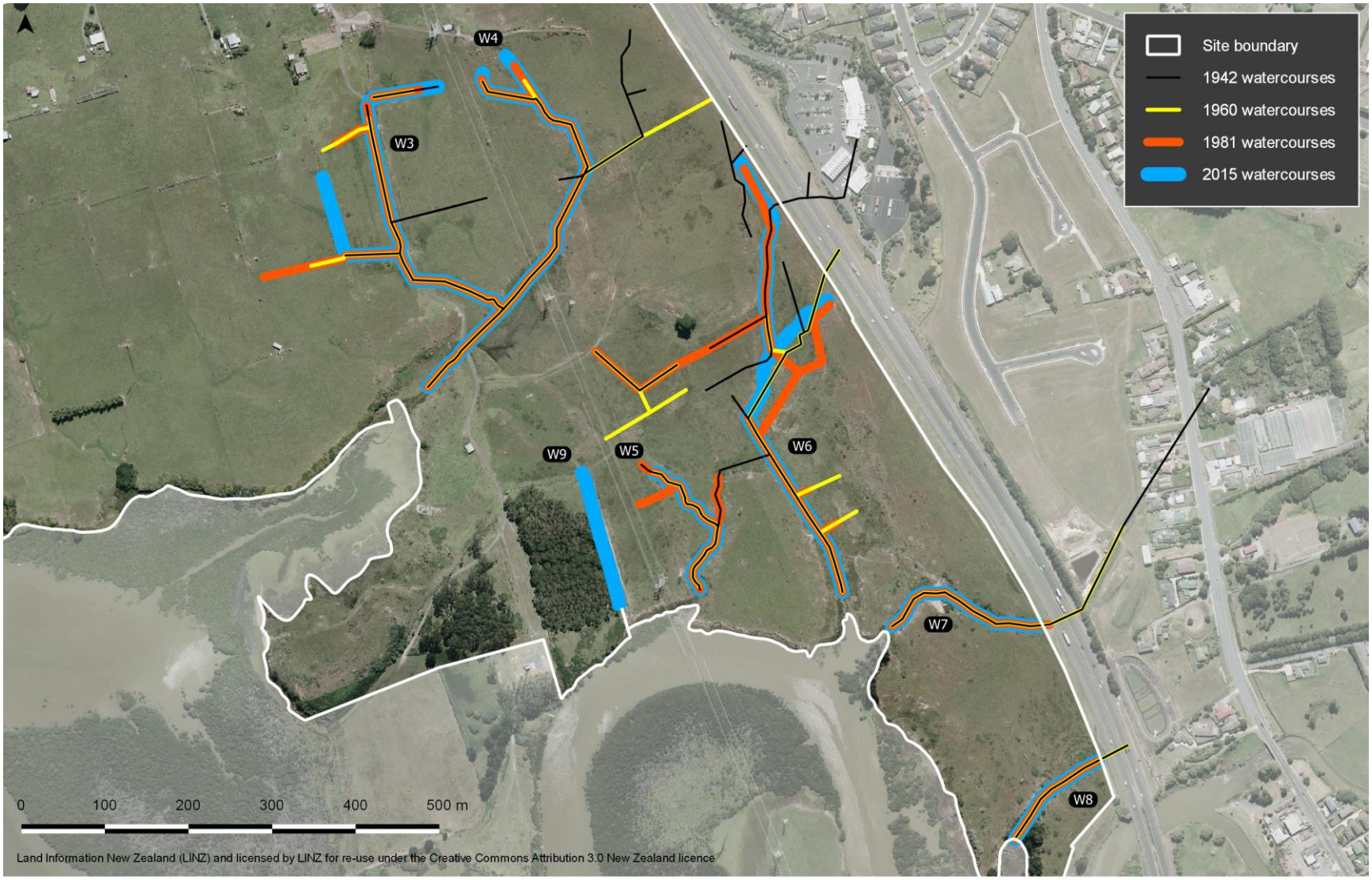

Figure 8: Indicative watercourses/drains within the site in 1942, 1960, 1981 and 2015.

Watercourses W3–W8 appear to have flowed in actively maintained artificial drains between at least the early 1940s through to the 1980s when it appears that the property was more intensively farmed and the drains more regularly maintained than what has occurred over the past 25 years. The drains have not been maintained in recent times and the drainage patterns appear to be slowly reverting back to what may have existed 100 years ago.

5.2 PAUP Stream Classification

The PAUP stream classification status of the watercourses within the site was based on the current land use and drainage patterns and was the same approach applied by Golder (2009). All watercourses within the site are currently in a highly modified and degraded condition due to unrestricted grazing damage, historical channelisation and channel clearance/excavation. Ephemeral reaches were the most common stream class within the site (total length = 1,438 m), followed by artificial channels (total length = 856 m), intermittent reaches (total length = 526 m), permanent reaches (total length = 133 m) and piped/culvert sections (total length = 41 m) (Table 1).

Table 1: Summary of stream types and lengths within each watercourse.

Watercourse	Pipe	Artificial (m)	Ephemeral (m)	Intermittent (m)	Permanent (m)	Number of branches
W1	-	-	172	-	-	3
W2	5	-	375	31	-	2
W3	13	568	-	-	-	2
W4	7	83	175	262	63	2
W5	-	-	199	-	-	1
W6	3	-	467	166	70	2
W7	13	41	-	67	-	1
W8	-	-	50	-	-	1
W9	-	164	-	-	-	1
Total (m)	**41**	**856**	**1,438**	**526**	**133**	-

5.3 Description of Watercourses

The following presents a brief description of each of the eight watercourses and artificial channels identified within the site.

Watercourse W1

Watercourse W1 comprises three ephemeral branches totalling 172 m in length (Table 1) and located in the north-western corner of the site (refer Figure 6 for location). All three branches lacked defined channels and exotic pasture grasses grew within the overland flow paths. The channels held no surface water except during or immediately after heavy rainfall events. Three branches associated with Watercourse W1 provided no intermittent or permanent aquatic habitat capable of supporting aquatic life and had no aquatic ecological values (Figure 9 and Figure 10).

Figure 9: View of lower Watercourse W1 in October 2014.

Figure 10: View of mid-upper Watercourse W1 in October 2014.

Watercourse W2

Watercourse W2 is a 372 m long predominantly ephemeral watercourse located in the north western portion of the site (Table 1 and Figure 6). The ephemeral section of Watercourse W2 extending from the lower reaches upstream holds no water except during or immediately following heavy rainfall events and were dry in January 2015. The ephemeral reach lacked a well-defined channel and had exotic pasture grass growing throughout (Figure 11). The lowermost intermittent reach extends for 31 m upstream from an area of mangroves provided some aquatic habitat of low quality and has low ecological value (Figure 12). There are two culverts along Watercourse W2 totalling 5 m in length.

Figure 11: View of ephemeral habitat along Watercourse W2 in October 2014.

Figure 12: View of intermittent habitat in lower Watercourse W2 in October 2014.

Watercourse W3

Watercourse W3 is a 568 m long artificial watercourse aligned with the access road running through the centre of the site (Table 1 and Figure 6). Watercourse W3 has ephemeral characteristics in its mid-upper section and intermittent characteristics in its lowermost reaches and is grazed throughout (Figure 13). The mid-upper section is poorly defined and has pasture grasses growing throughout. There is a small area of grazed wetland at the head of Watercourse W3 and may represent a potential spring area. There are two culverts totalling 13 m in length along Watercourse W3. There was very little or no surface water within Watercourse W3 during the October 2014 survey and was dry in January 2015 so aquatic habitat was limited and ecological values are very poor within Watercourse W3.

Figure 13: View of ephemeral artificial channel in Watercourse W3 in October 2014.

Watercourse W4

Watercourse W4 is one of two main watercourses draining the site (Table 1 and Figure 6). The watercourse comprises two branches totalling 590 m in length. Watercourse W4 originates in area of the site that a century ago is likely to have been wetland but is now grazed pasture. It is unclear from historical aerial photographs if the ephemeral, intermittent and permanent habitat within Watercourse W4 is artificial or rather highly modified watercourses that have replaced natural flow paths (see Figure 7).

The majority of Watercourse W4 was classified as intermittent (262 m) and ephemeral (175 m). The lowermost 63 m reach extending downstream from the access road culvert (~7 m long) was classed as a permanent stream section.

Ephemeral habitat within Watercourse W4 was heavily pugged, had pasture grass/weeds growing in channels, held very small amounts of surface water and lacked defined channels. As a result, ephemeral reaches provide very limited habitat (if any) for invertebrates and no habitat for fish due to a lack of connected surface water of sufficient depth. Intermittent reaches held surface water in shallow (<0.1 m deep) non-flowing pools in October 2014 after heavy rainfall (Figure 14) but were dry in January 2015 (Figure 15).

The intermittent and permanent sections in Watercourse W4 provide poor quality aquatic habitat that are likely to support water and habitat tolerant species. This lowermost permanent section is likely to be influenced by the tidal movement of saltwater up the channel as it flows through coastal saltmarsh (e.g., bachelor's button meadow) (Figure 16).

Figure 14: View of intermittent habitat on Watercourse W4 in October 2014.

Figure 15: View of intermittent habitat on Watercourse W4 in January 2015.

Figure 16: View of permanent habitat on Watercourse W4 in October 2015.

Watercourse W5

Watercourse W5 is a 199 m long ephemeral watercourse located near the centre of the site and lies within a shallow grazed pasture depression (Table 1 and Figure 6). Watercourse W5 was dry in January 2015 and held little to no surface water in October 2014 after heavy rainfall. Watercourse W5 originates in area of the site that a century ago is likely to have been wetland but is now rough grazed pasture. As with many watercourses within the site, Watercourse W5 lacks a defined channel, lacks evidence of stable surface water during the year, provides no aquatic habitat and has poor aquatic ecological value.

Watercourse W6

Watercourse W6 originates near the Southern Motorway and appears to receive stormwater from the motorway and nearby service station. It is unclear from historical aerial images (dating back to 1942) whether Watercourse W6 is an artificial channel or a highly modified natural watercourse. Irrespective of the uncertainty, and to be consistent with Golder (2009), Watercourse W6 was classified as if it was historically a natural flow path.

Watercourse W6 has the longest total length of stream channel within the site (705 m) and dominated by ephemeral (467 m) and intermittent (166 m) reaches (Table 1 and Figure 6). The lowermost channelised section of Watercourse W6 is permanent (70 m) (Figure 17). The transition between permanent and intermittent sections was demarcated by a perched ~3 m long culvert. Golder (2009) identified the lower reaches of Watercourse W6 as intermittent as opposed to permanent.

Ephemeral habitat in the mid-upper reaches of Watercourse W6 lacked defined channels, was heavily pugged, had pasture grass/weeds growing in channels, held very small amounts of surface water in pugs after heavy rainfall in October 2014 but were dry in January 2015 (Figure 18). As a result, ephemeral habitat in Watercourse W6 provides very limited (if any) aquatic habitat for invertebrates and no habitat for fish due to a lack of connected surface water of sufficient depth and no surface water in dry periods. The

intermittent section may provide temporary aquatic habitat during wet periods of the year but not in summer as these sections dry up (e.g., in January 2015). The permanent habitat downstream from the culvert held surface water in October 2014 and January 2015 and is influenced by tidal movements of water up the channel and is more likely to support fish. All aquatic habitats within Watercourse W6 were poorly shaded, damaged by stock grazing, provide poor overall quality aquatic habitat.

Figure 17: View of permanent habitat on Watercourse W6 in October 2014.

Figure 18: View of ephemeral habitat on Watercourse W6 in January 2015.

Watercourse W7

Watercourse W7 is located in the southern portion of the site and comprises 168 m of highly modified intermittent stream habitat (Table 1 and Figure 6). The stream appears to receive runoff from the Southern Motorway but there is no catchment east of the motorway. It appears from historical aerial photographs (e.g., 1942) that drains dug upstream from the site boundary are artificial. The shallow gully depression that the lower reaches of Watercourse W7 flows in (within the site) suggests this section is at least a probable natural flow path. Watercourse W7 has been highly modified and displays evidence of channelisation as it is deeply incised in the lower reaches just before it discharges to the coastal margin (Figure 19). Watercourse W7 has been dammed in its mid-reaches and an online pond has formed. This pond and the small length of channel upstream have been classified as artificial.

Figure 19: View of intermittent habitat on Watercourse W7 in October 2014.

Watercourse W8

Watercourse W8 is located in the southern corner of the site and comprises 50 m of highly modified ephemeral stream habitat (Table 1 and Figure 6). It is unclear from historical aerial photographs if Watercourse W8 is an artificial channel or a highly modified watercourse. The stream has been channelised since at least 1942 and drains to the estuary via a small wetland (Figure 20). Watercourse W8 lacks a defined channel and the follow path is lined with pasture grass. The stream appears to receive runoff from the Southern Motorway into two ponds (P4 and P5) but there is no catchment east of the motorway feeding into Watercourse W8. There does not appear to be obvious outlets from

the ponds into Watercourse W8.

Figure 20: View of ephemeral habitat on Watercourse W8 in October 2014.

5.4 Wetlands

The PAUP does not identify any wetlands within the site. The low lying areas within the site are classified as 'Natural Hazard – Coastal Inundation' and the entire site is classified as Stormwater Management Area.

Wetlands are defined as 'permanently or intermittently wet areas, shallow water or land/water margins that support a natural ecosystem of plants and animals that are adapted to living in wet conditions' (RMA 1991). Recognising wetlands and delimiting their boundaries on the ground is difficult for a variety of reasons, including that features visible on the land surface are functionally connected to the wider catchment and invisible groundwater supplies (Johnson and Gerbeaux 2004). In the case of the site under discussion here, the catchment is very limited in extent, which limits the natural surface water inputs, but the wetland is also influenced by stormwater flows which appear to originate from across the Southern Motorway. Without input from stormwater the catchment would otherwise be water limited, at least in dry periods, despite the limited groundwater input which supplies the wetland during those times. Vegetation and plants typical of wetlands may extend onto relatively dry lands that have infertile soils. Generally speaking the vegetation type and structure, topography, substrate, water regime and nutrient status are helpful in classifying wetland types. By surveying the site during both wetter and drier seasons and considering the vegetation types present we were able to assign the parts of

the wetland which were more permanently wet and able to support plant species indicative of wetlands, from those which were seasonally or temporarily wet and did not support typical wetland species.

From analysis of the aerial photographs the overall extent of wetland reduced between 1942 and 1960 and has increased substantially since then. Based on our estimates it appears the wetland area in 2015 was nearly twice as large as it was in 1960. This increase in wetland area has at least two possible causes; firstly changes in the frequency and extent of artificial drain maintenance as part of farming operations and secondly either an increase in runoff or a change in hydrology between 1969 and 1981 associated with the construction of the Southern Motorway. Evidence for this conclusion includes the disappearance of obvious linear drains between 1969 and 1981 and the expansion of the wetland towards the Southern Motorway between 1981 and 2015. Two wetland areas near the southern margins of the site have persisted throughout.

Figure 6, Figure 7 and Figure 8 show the extent of the wetland and drainage channels present within the site in 1942, 1960, 1981 and 2015 (refer Appendix D for aerial photographs). Analysis of historical aerial photographs taken in 1942, 1960 and 1981 and comparing them with the present provide a good indication of changes that have occurred to the sites drainage patterns and the extent of the wetland over the past 75 years and that historical modifications within the site pre-date 1942.

Review of historical aerial photographs in combination with information presented in Figure 6, Figure 7 and Figure 8 indicate that before 1942 the likely situation was three disconnected and moderate sized wetlands located around the poorly drained outlets of the watercourses referred to in this report as W4, W5 and W6. Farming activity prior to 1942 and through to at least the 1960s substantially modified those wetlands and reduced their extent through the construction of linear drains that were actively maintained and diverted water away from grazed land during times of high rainfall or a high water table. The result of historical drainage works commencing pre-1942 was to effectively reduce the wetlands.

More recently the drains have not been so rigorously maintained, to the point where they are not as distinctly obvious in the most recent aerial photographs, and drainage has been substantially impeded allowing water to pond and wetlands to slowly re-develop. The extent of the wetlands has expanded accordingly to accommodate the low lying poorly drained nature of the land, and the changes in hydrology and runoff caused by the presence of the Southern Motorway, resulting in the larger area of connected wetland which was mapped in 2015 extending from Watercourse W4 to W6 (but excluding W5). At the time of the October 2014 and January 2015 site visits, Watercourse W5 was present as a dry channel within a shallow depression that had been disconnected from its water source by earthworks and as such was not considered to be part of the wetland complex.

The wetlands within the site have been highly modified by a century of grazing and drainage works but still serve to buffer the adjacent estuarine habitats that are more intact. The upper area of the northern wetland held no surface water during the October 2014 or January 2015 site visits (Figure 21). The lower area of the northern wetland held shallow surface water with boggy outer margins during the October 2014 site visit (Figure 22) but was dry in January 2015 (Figure 23). Watercourse W4 flows along the northern boundary of this wetland. The northern wetland and Watercourse W4 drains into a large bachelor's button meadow near the coastal margin (Figure 6).

Figure 21: Upper area of northern wetland with no surface water.

Figure 22: Surface water in the lower northern wetland in October 2014.

Figure 23: Absence of water in the northern wetland in January 2015.

The southern wetland is shown in Figure 24 and Figure 25. Vegetation within this wetland is predominantly soft rush *(Juncus effusus),* exotic grasses/herbs and *Carex maorica*. The southern wetland held smaller amounts of standing surface water than the northern wetland in October 2014 and was similarly dry in January 2015. The southern wetland drains into a small but diverse salt marsh upstream of the larger salt marsh. Golder (2009) defined wetland areas as being smaller than in the present study and was most likely a reflection of the very dry summer low flow conditions at the time.

Figure 24: Mid-upper area of the southern wetland in October 2014.

Figure 25: Lower area of southern wetland in October 2014.

5.5 Ponds

Five artificial ponds or shallow depressions where surface water accumulated (ponds P1 to P5) were identified within the site during the October 2014 survey (refer Figure 6 for locations; Figure 26 to Figure 30). Ponds P1, P2 and P5 were offline ponds and ponds P3 and P4 were online ponds. Farm ponds were small and held surface water during the October 2014 survey. Some shallow areas of ponded surface water during the October 2014 survey were dry during the January 2015 site visit (e.g., pond P1 and P2; Figure 27) whilst others held significantly less water and reflects the water-short nature of the catchment. All ponds within the site are of low ecological value although ponds P4 and P5 are relatively close the site boundary and may buffer runoff from the Southern Motorway.

Figure 26: Pond P1 in October 2014.

Figure 27: Pond P2 in October 2014 (above) and January 2015 (below).

Figure 28: Pond P3 on Watercourse W7 site in October 2014.

Figure 29: Pond P4 in October 2014.

Figure 30: Pond P5 in October 2014.

5.6 Freshwater Fauna

Watercourses within the site were predominantly artificial and ephemeral or intermittent in character with most surface water and stable habitat occurring in the lower permanent reaches of Watercourses W4 and W6, lower northern wetland and in artificial ponds. Golder (2009) sampled aquatic invertebrates in the lower permanent section of watercourse W4 (refer Figure 6 for location). The invertebrate community was abundant, of low diversity (5 taxa), dominated by *Potamopyrgus* (snail) and had a low MCI-sb score indicative of poor water and habitat quality (MCI-sb = 78). Intermittent and permanent watercourses within the site are likely to share these community characteristics.

Six fish species have been recorded from watercourses within the site (NZFFD and Golder 2009). The locations where fish have been recorded are shown in Figure 6. Species recorded include *Anguilla australis* (shortfin eel), *Galaxias fasciatus* (banded kōkopu), *Galaxias maculatus* (īnanga), *Gobiomorphus cotidianus* (common bully), *Gobiomorphus gobioides* (giant bully) and the pest fish *Gambusia affinis* (gambusia). Īnanga have an 'At Risk' (Declining) conservation status (Goodman et al. 2014). Īnanga were observed in the lower reaches of watercourse W6 during the site visit. The lower reaches of watercourses W4 and W6 that extend into the northern and southern wetlands have tidally influenced lower sections and are potential īnanga spawning habitats (Figure 31).

Figure 31: Potential īnanga spawning habitat in lower reaches of Watercourse W6.

6.0 Estuarine Environment

Estuarine vegetation along the northern part of the site and wider Hingaia Peninsula coastline comprises predominantly mangroves (*Avicennia marina* subsp. *australasica*) (Larcombe 2000). Further south along the site boundary, not all of the coastal margin is fenced, and the natural transitional habitats from mangroves to salt marsh or salt meadows in the estuarine wetlands have been influenced or mostly removed by grazing livestock. Maritime marsh was found to be a common habitat type around the Hingaia Peninsula by Larcombe (2000). Maritime marshes include rush marsh and salt marsh and occur in sheltered, low sloping areas around high tide level. Remnant or modified vegetation persists at some locations including bachelor's button (*Cotula coronopifolia*) meadows as shown in Figure 32 and oioi (*Apodasmia similis*) in Figure 33.

Substrate characteristics of intertidal areas in the reaches that watercourses within the site drain consisted of bands of bedrock along the channel and soft gloopy mud (Golder 2009). The macrofaunal community in this area was dominated by the mud snail *(Amphibola crenata)*, the small snail *(Potamopyrgus)* and the mud crab *(Helice crassa)*; a community which is typical of mangrove mudflats in the Manukau Harbour (Golder 2009).

Figure 32: Bachelor's button meadow downstream of northern wetland.

Figure 33: Oioi *(Apodasmia similis)* at the southern end of the site.

7.0 Ecological Constraints and Opportunities

7.1 Introduction

The site is highly modified and as a consequence the current ecological values of the site are very constrained. The watercourses are either artificial or highly modified and predominately ephemeral (1,438 m) in nature although there is also intermittent (526 m) and permanent (133 m) habitat. The drainage pattern within the site has been very heavily modified over the past century which makes enhancing the existing ecological values within the remaining wetland habitat and in watercourses very challenging. A further compounding factor is that the site is water short (at least seasonally) and this would substantially limit the opportunities for enhancement of either wetlands or stream habitats.

If the site is left undeveloped then the opportunities that exist to enhance the currently degraded ecological values will not be realised. However, the development of the site provides an opportunity for ecological enhancement to occur in a holistic manner that is sympathetic to the various existing habitats within and adjacent to the site (e.g., coastal habitats) so that overall ecological values within the site are enhanced.

7.2 Ecological Constraints

Birds and Avifauna

The Park Estate site was not identified as having high conservation values by Auckland Regional Council (2004). There is only sparse native vegetation within the site with mature individuals generally limited to coastal margins. Most birds recorded were exotic or common native species and a resident bat population is unlikely due to a lack of suitable habitat within the site. Lizards were not surveyed but there is potential for some species to occur (copper skink, Pacific gecko and introduced rainbow skink).

Development of the site will however need to consider potential effects on wading bird ecology. The Manukau Harbour together with the Firth of Thames form the most important wintering grounds for wading birds in the Southwest Pacific (McEwen 1987). The Manukau Harbour is considered to be of international significance and has been identified as a Site of Special Wildlife Interest of 'Outstanding' significance. Parts of the estuary adjacent to the site are mapped as significant areas for wading birds in the Auckland Regional Coastal Plan. An important consideration should be the management of sediment and contaminant runoff from the site to minimise effects on wading bird feeding in the adjacent estuary.

Coastal Margin

The current coastal margin vegetation is narrow and comprises a high proportion of weeds. Improvement of the coastal vegetation will require attention to weed control over many years to improve ecological values.

Wetlands

Restoring the hydrology presents an opportunity to enhance some areas of the existing wetland habitat. The PAUP requires the retention of wetlands and any modifications to the wetland habitat within the site will require resource consent.

Native Fish

Potential īnanga spawning habitat in the lower reaches of watercourses W4 and W6 may

also represent a potential constraint for developing/modifying these sections of stream. Adult īnanga are also likely to migrate into areas of stable surface water in the lower areas of the wetlands. The construction of infrastructure within the lower tidally influenced watercourse sections with the potential to impede fish passage or affect īnanga spawning should be carefully managed and provide for fish passage.

Stream Habitat

The modification, realignment or piping of highly modified ephemeral, or artificial watercourse sections (i.e., W1, W2, W3, W5, W7 and W8) is unlikely to compromise their limited ecological values. The permanent removal of any intermittent or permanent aquatic habitat, which have higher potential ecological values may however be constrained by the availability of suitable restoration areas; within the Park Estate site and offsite mitigation may be required. All ponds within the site are man-made features and are not habitats of ecological value worth retaining.

7.3 Ecological Opportunities

Despite their highly modified state and long history of modification there is potential to enhance the ecological values of the site by enhancing the wetlands and the coastal margins as part of future resource consents. In particular the quality, integrity and connectivity of the wetland and coastal habitats could be improved significantly (Figure 34).

Wetlands

As outlined previously the current and future potential ecological values of the wetlands are compromised due to the drains that intersect the wetlands and the water short nature of the catchment. In their assessment of this catchment, Golder (2009) concluded that restoring the wetlands at this site represented one of the most significant opportunities for enhancing ecological values within the site, but noted that it would require considerable effort and careful management to achieve a good ecological outcome.

Golder (2009) recommended that if the site was to be developed, infiltration of rain water to groundwater should be maximised and that stormwater should be treated and discharged to the wetland as quickly as possible so that the water could be used within the wetland to enhance habitat and ecological values. This approach might require stormwater treatment devices such as rain gardens and at source stormwater treatment devices to be used within the catchment.

The wetland areas within the site, although heavily degraded through grazing and drainage activities, are still potentially valuable habitats. Julian (2000) and Kessels and Associates (2000) identified these wetlands as being modified but providing important wildlife habitat and buffering the more intact adjacent estuarine wetlands. Golder (2009) surveyed the wetlands during summer low flow conditions and considered that the wetland extents were notably smaller than the estimates we have provided here based on winter water levels or the presence of hydrophytic plants during a summer survey. This indicates that the areas are not permanently waterlogged throughout the year. Johnson and Gerbeaux (2004) stated that ‘recognising wetlands and delimiting their boundaries on the ground can be tricky for several reasons’ and go on to say that ‘some wetlands go unrecognised because they dry out in summer’.

Any loss of wetland habitat within the site would likely require the enhancement of remaining wetland habitat on the site or elsewhere as an offset or environmental compensation to ensure ‘no-net-loss’ of overall ecological function.

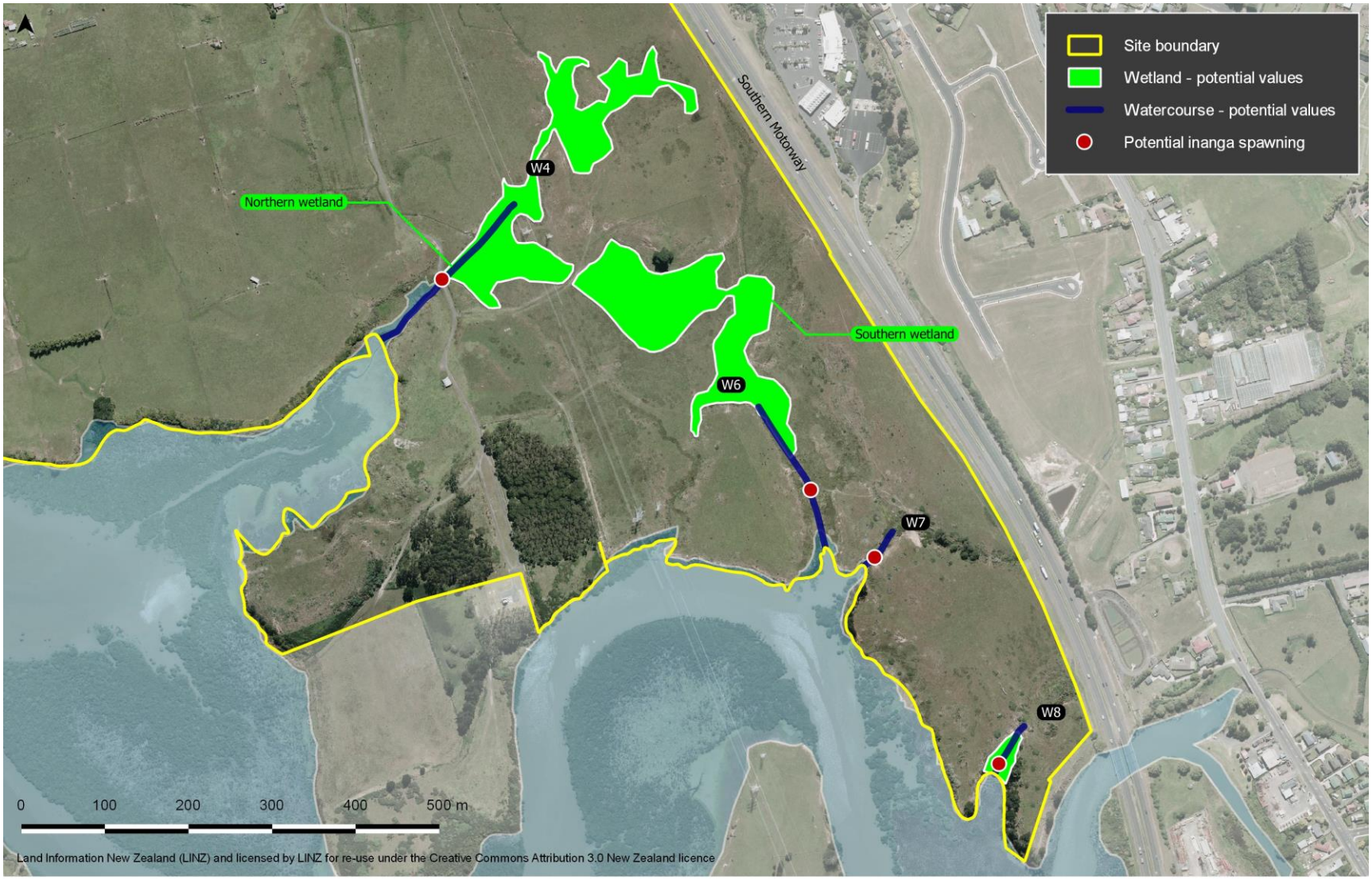

Figure 34: Areas of potential ecological enhancement within the site.

Restoring wetland hydrology is the most important factor in restoring or enhancing wetlands and this is particularly relevant to the wetlands on this site which are water short and result in some permanent and some intermittent wetland areas. If the drainage network is left as it is, the wetlands are very unlikely to recover on their own and support any worthwhile ecological values. By improving the hydrology of areas of the wetlands during the redevelopment of the site there is the potential to enhance the current low ecological values and offset the loss of some of the marginal wetland areas where the hydrology is not adequate for sustaining ecological values. It is recommended that this be achieved by diverting treated stormwater, either via ground soakage or surface discharge to the wetlands where practicable.

Consideration could be given to re-contouring the area around the wetlands and altering the height of the wetland outlets to further enhance their hydrology and to restore and enhance habitat and ecological values. Planting riparian buffer strips around the wetlands would further enhance their values and also buffer them from the catchment development. Connecting the wetland plantings to the coastal margin would also improve habitat connectivity and functioning. Increasing the level and permanence of water in the portions of the wetlands which at present retain the more favorable hydrology will enhance the overall value of the wetlands and offset the 'loss' of more marginal habitat around the edges of the wetlands.

Coastal Margin

Although we could find no published studies which were helpful in determining the width of any coastal buffer required to achieve ecological viability, we note that in general terms the wider the buffer the better for ecological values. The Resource management Act requires a 20 m wide esplanade reserve.

Establishment of a 20 m coastal buffer zone is recommended to provide a buffer between any future development and the sensitive coastal margin and to protect and enhance the important site specific ecological values within the interface between the streams and the land and the coastal margin. Removal of livestock and re-vegetation of such a zone would allow recovery of natural vegetation and ecotones and provide improved habitat for native species. It is recommended that the width of the coastal buffer zone be assessed in more detail once further information about the nature of the development and likely extent and nature of the use of coastal buffer habitat by bird species is known.

Stream Habitat

Golder (2009) did not recommend restoring ephemeral Watercourses W1 and W2 or the artificial Watercourse W3 unless ponds were created in their upper reaches to ensure downstream flows were adequate for creating permanent or intermittent habitat. The majority of freshwater habitat within the site is either artificial or highly modified and ephemeral or intermittent which significantly limits the potential value of any enhancements. Although there are opportunities to enhance ecological values within the site, it may not be of benefit to enhance the artificial or highly modified ephemeral or marginal intermittent reaches, given the water-short nature of the catchment and small ecological improvements that are likely to occur as a result.

There are however opportunities to enhance some intermittent or permanent reaches that are more likely to hold surface water for longer periods and therefore capable of supporting invertebrate and fish communities or provide potential īnanga spawning habitat. These reaches include the lower reaches of Watercourse W4, W6, W7 and W8 (shown on Figure

34). These reaches are heavily modified in their current state so there is an opportunity to increase natural meanders and plant riparian strips if they are retained during development.

Summary

The greatest opportunity relates to the restoration and enhancement of lower wetland habitats (that hold surface water year round) and the lower reaches of certain watercourses provided a reliable water source can be created and is in agreement with Golder (2009). Wetland restoration should be combined with restoration of the lower reaches of the tidally influenced permanent watercourse sections (i.e., W4 and W6) as potential īnanga habitat. Restoring these habitats is likely to provide a greater overall ecological benefit within the site, and in the case of the wetland, also retain habitat for birdlife and adult native fish (eels and īnanga) assuming that the development of the site can improve the hydrology of the wetlands and increase water depths from current levels. Using plantings and weed control to improve the coastal margin vegetation and connecting that vegetation to the wetland and any riparian plantings around the permanent watercourses would serve to link the available natural habitats on the site and would represent a real improvement to the current situation.

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Report Signature Page

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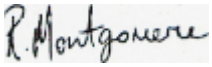

Richard Montgomerie

Director

APPENDIX A

Plant Species

Species (* denotes exotic)	Common name
Dicot herbs	
Bellis perennis	Bellis daisy
Cirsium arvense	Californian thistle
Cirsium vulgare	Scotch thistle
Cotula coronopifolia	Bachelor's button
Jacobaea vulgaris	Ragwort
Lemna disperma	Duckweed
Lotus pedunculatus	Lotus
*Leontodon taraxicoides**	Hawkbit
*Phytolacca octandra**	Inkweed
Plantago lanceolata	Plantain
Ranunculus reflexus	Hairy buttercup
Ranunculus repens	Creeping buttercup
Rumex obtusifolius	Broad-leaved dock
*T. repens**	White clover
*Zantedeschia aethiopica**	Arum lily
Sedges, Rushes and Grasses	
*Agrostis capillaris**	Browntop
Anthoxanthum odoratum	Sweet vernal
Apodasmia similis	Oioi
Carex geminata	
Carex maorica	Maori sedge
*Cortaderia selloana**	Pampas
Holcus lanatus	Yorkshire fog
Isolepis cernua	
Juncus articulatus	Jointed rush
Juncus edgariae	Wiwi
J. effusus	
*Lolium perenne**	Perennial ryegrass
*Paspalum distichum**	Mercer grass
Phormium tenax	Harakeke
Woody Shrubs and Trees	
*Acacia mearnsii**	Black wattle
Avicennia resinifera	Mangrove
*Berberis glaucocarpa**	Barbary
Cordyline australis	Cabbage tree
Coprosma robusta	Karamu
*Cupressus macrocarpa**	Macrocarpa
*Eucalyptus obliqua**	Messmate
*Ligustrum lucidum**	Large-leaved privet
*L. sinense**	Small-leaved privet
Myrsine australis	Mapou
*P. radiata**	Radiata pine
Pinus pinaster	Maritime pine
*Populus alba**	White poplar
*Pseudosasa japonica**	Arrow bamboo
Salix spp.*	Willow
*Solanum mauritianum**	Woolly nightshade
*Ulex europaeus**	Gorse
Climbers and Vines	
*Lonicera japonica**	Japanese honeysuckle
Rubus fruticosis agg.*	Blackberry
Ferns and Tree ferns	
Dicksonia fibrosa	Wheki-ponga
D. squarrosa	wheki
Pteridium esculentum	Bracken

APPENDIX B

Bird Species

Bird Species (* denotes exotic)	**Common name**
*Acridotheres tristis**	Indian myna
*Alauda arvensis**	Skylark
*Anas platyrhynchos**	Mallard
Anthus novaeseelandiae	Pipit
Ardea novaehollandiae	White-faced heron
*Branta canadensis**	Canada goose
Circus approximans	Harrier
Columba livia	Rock pigeon
*Cracticus tibicen**	Australian magpie
Emberiza citrinella	Yellowhammer
Halcyon sancta	Kingfisher
Hirundo neoxena	Welcome swallow
Larus dominicanus	Black-backed gull
*Passer domesticus**	House sparrow
Phalacrocorax carbo	Black shag
Phalacrocorax sulcirostris	Little black shag
*Phasianus colchicus**	Ring-necked pheasant
*Platycercus eximius**	Eastern rosella
Porphyrio porphyrio melanotus	Pukeko
Rhipidura fuliginosa	Fantail
*Sturnus vulgaris**	Starling
Tadorna variegata	Paradise shelduck
*Turdus merula**	Blackbird
*Vanellus miles novaehollandiae**	Spur-winged plover

APPENDIX C

PAUP Stream Status Criteria

River or Stream

A continually or intermittently flowing body of fresh water, excluding ephemeral reaches, and includes a stream or modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal except where it is a modified element of a natural drainage system).

Permanent River or Stream

The continually flowing reaches of any river or stream.

Intermittent Stream

Stream reaches that cease to flow for some periods of the year, and includes.

- Reaches with stable natural pools having a depth at their deepest point of not <150 mm and a total pool surface area that is 10 m^2 or more per 100 m of river or stream bed length.
- Reaches without stable natural pools.

Ephemeral Reaches

Stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. A river reach is ephemeral where it meets at least three of the following:

- Lacks a well-defined channel, so that there is little or no ability to distinguish between the bed and banks.
- Contains no surface water, if no rain has occurred in the previous 48 hours.
- Contains terrestrial vegetation.
- There is no clearly visible organic debris on its floodplain from flood flows.
- There is no evidence of substrate sorting through flow processes.

Artificial watercourse

Man-made watercourses that contain no natural portions from their confluence with a river or stream to their headwaters, and includes:

- Canals that supply water to electricity power generation plants.
- Farm drainage canals
- Irrigation canals
- Water supply races.

Excludes:

- Naturally occurring watercourses.

APPENDIX D

Historical Aerial Photographs

1942 Aerial Photograph

1960 Aerial Photograph

1981 Aerial Photograph