

Urban Design and Landscape Management Plan

Brookside

NZ01105065

Prepared for
Jagger NZ Limited

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1 Introduction

Jagger NZ Limited is proposing to develop Duck Creek North within the Suburb of Whitby, Porirua into a residential subdivision to be known as “Brookside”. Cardno has been contracted by Jagger NZ Limited to develop a Landscape Masterplan and Landscape Management plan for this development. The design for this subdivision has been developed by Land Matters Ltd in consultation with the Porirua City Council, Greater Wellington Regional Council, The Department of Conservation, and various other bodies and consultants and aims to build upon the Comprehensive Development Plan (CDP) that was formerly developed by Whitby Coastal Estates Limited.

The Duck Creek land is divided into two main areas, Duck Creek South and Duck Creek North. Duck Creek South relates to the upstream portion of the development from Discovery Drive to Silverwood Forest. Duck Creek North relates to the downstream portion of the development from Discovery Drive to an unformed legal road before the Scenic Reserve beside the Pauatahanui inlet which is an arm of Porirua Harbour.

This Landscape Management Plan is for the Duck Creek North lands and the new subdivision which is to be called Brookside. This plan describes all of the on-site landscaping concepts proposed for this development, namely the management objectives and policies; design and construction principals; staging and implementation strategies; and a maintenance regime for the works.

In order to gain a better overall understanding of the many goals of the landscape design it is suggested that the following other documents also be reviewed;

- Tonkin and Taylors Stream Ecological Valuation and Ecological Assessment. Report prepared for Jagger NZ Limited;
- Boffa Miskell Limited 2010. Ecological Impact Assessment: Duck Creek Comprehensive Development Plan – Stream side sections in Whitby, Porirua, Wellington. Report prepared for Whitby Coastal Estates Limited; and
- Comprehensive Development Proposal, The Duck Creek Land, Whitby, Porirua City, Cardno.

Please note that this plan has been created in accordance with

- Restoration planting A guide to planning restoration planting projects in the Wellington region

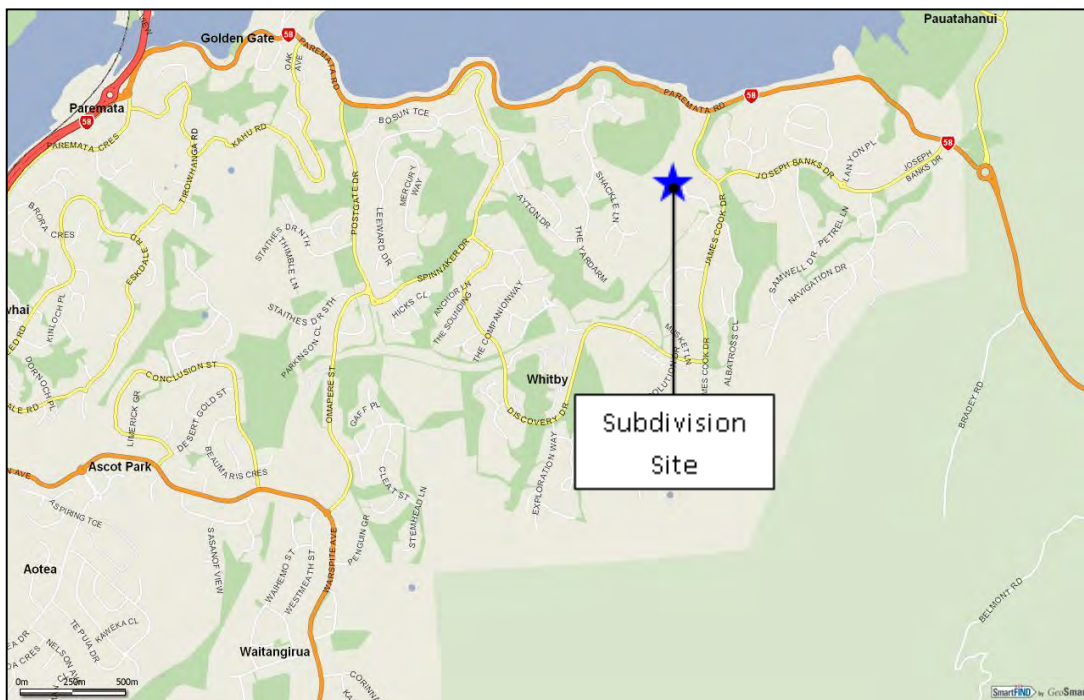


Figure 1 Location Map [Extract from Wisers Maps]



Figure 2 Aerial Location Map of Duck Creek North [Extract from PCC GIS]

2 EXISTING DUCK CREEK NORTH SITE

Jagger NZ Ltd have purchased the lower nine of Whitby Golf Course and some of the surrounding land holdings from the previous owner Whitby Coastal Estate Ltd. This area, which is approximately 13 ha, is located on part of the flood plain for the lower sections of Duck Creek. The area to be developed by this Landscape Management plan is Duck Creek North Land Holdings which is to be called Brookside (“the site”). The site has been unmaintained for some time now and is now mainly covered in long rank grass along with a small number of exotic trees such as willows and pines and the occasional native trees and shrubs such as kanuka, toe toe, tree ferns, cabbage trees and pittosporums also exist.

The site lies from 1-20 meters above sea level, sits on a base landform of Sandstone Rock and is made up of rolling hills draining to a stream floodplain. The site has a long narrow dimension and is oriented generally north / south. From the Wellington Regional Council’s Regional Landscape Atlas, which identifies “outstanding natural features and landscapes” and “significant amenity landscape values” the site does not sit within an area classified by the Regional Council as a significant local landscape and is not within a landscape protection area. Porirua City Council (PCC) does not classify this area as having significant landscape character. Though, some of the surrounding hills within the Silverwood Forest holdings are classified as a landscape protection area in the District Plan. Within PCC’s District Plan under section C9 Landscape and Ecology, under policy C9.1.15 the following paragraph has special note to the project

¹Duck Creek and the surrounding catchment within the Whitby Landscape Protection Area is considered to have high landscape and ecological values, and plays an important role in the overall landscape character and open space network of Whitby and Porirua City.

It is of note that Duck Creek itself is considered to be a regionally significant stream due to the presence of several threatened native fish. Also Duck Creek is a tributary of the Pauatahanui inlet, a nationally recognised conservation site. The Department of Conservation also owns a scenic reserve, “Duck Creek Scenic Reserve” which is beyond the development and the Pauatahanui inlet, because it is separated by an unformed legal road.

Originally the past landscape was rich podocarp/broadleaf forest but with a coastal influence evident, kowhai and ngaio fringing the dry harbour banks.

Two forest blocks border the site and are considered “Ecosites” under the PCC District Plan. Yardarm Bush (Ecosite# 151) is located to the south west of the site while Duck Creek Bush (Ecosite# 16) is located to the north-west of the site. The Ecosites are described in Tonkin and Taylors Stream Ecological Valuation and Ecological Assessment in section 3.1.2.

¹ PCC District Plan – Section c9 Landscape and Ecology, Policy C9.1.15 page C9-13

3 Urban Design Vision

Brookside will be a unique high quality residential subdivision that incorporates attractive openspace reserves and will provide a fantastic place for residents to live work and play.

This new suburban community will consist of single family dwellings that will be of a similar scale and density to existing neighbouring communities and so will fit well within the Greater Whitby Community. The minimal scale of the earthworks are sensitive to the surrounding landscape and so existing views from adjoining properties will for the most part be unimpeded. The subdivisions earthworks design will also enable the new residential properties to be built above the valley floor flood plain.

The entrance to Brookside subdivision will be defined by an attractive entry monument located to east of the first bridge which will include theme lighting and will help define Brookside's unique identity.

Depending on the use of available reserve contributions, there will be an attractive park and a series of passive recreation facilities for the community located on the creek banks.

Brookside Park is proposed to feature a large grass openspace that will accommodate a variety of different uses, attractive planting, seating and on-street parking areas. Other passive recreation opportunities which include seating areas will be provided enabling the community to enjoy the creek at close quarters at key locations.

Brookside will provide great connectivity from Discovery Drive to the Pauatahanui Inlet via a 2.6m wide pedestrian and cycleway access to the riparian reserve the length of Duck Creek. This linkage will complete the greater Duck Creek riparian reserve walkway system which originates in the southern upper end of valley in The Banks subdivision. This linkage of the upper reaches of Duck Creek to the Pauatahanui Inlet will be a valuable asset for the community. Linkages to the greater Whitby pedestrian walkway systems and reserves have also been included within the design. The linkages will connect to Shackle Lane to the west and to Observatory Close, Sailmaker Close and Picketboat Lane to the east. The north-south 2.6m wide shared pedestrian pathway and cycleway linkage will connect the community to the Whitby Village shopping centre, local schools and the greater transportation network.

A large portion of the creek will have generous amounts of native plantings that will develop sound environmentally responsible ecological habitats for local wildlife. The majority of Duck Creek within this block will remain in its current natural form with the new realigned section of creek to provide fish passage and a series of diverse habitats along with an attractive riparian canopy of native trees which will provide shade and shelter along Duck Creek. This planting and other planting along the creeks length will help to create a habitat that is more conducive for aquatic and bird species to inhabit this area. Low maintenance plant species which have fast growth rates that will aid in reducing soil erosion along the creek corridor will be chosen. A successional planting regime is to be undertaken over an approximately three (3) year period to establish the beginnings of a native forest canopy environment within the riparian reserve.

A vegetative treatment corridor area is proposed adjacent to the creek that will treat stormwater and reduce sediment and other elements from entering the creek system and the nationally significant and environmentally sensitive Pauatahanui Inlet. An informal walkway will be located in this area to provide access to the creek and increased amenity for the public.

Overall it is expected that the design of the subdivision will have a positive impact on the surrounding community by increasing connectivity, adding new amenities with a diverse range of spaces and places that give people variety and choice with respect to passive recreational activities. The subdivision allows for ease of movement, will be easy to navigate with wide open spaces and walkways enabling people to get move around safely. The subdivision is also highly legible due to its well thought out design and layout.

Upon completion, Brookside will become a well-groomed park like subdivision that provides an attractive place to live along with great community openspace reserves that will be an asset for the community of Whitby.

4 Objectives and Policies

4.1 Landscape and Views:

Objective:

- Access and views to Duck Creek are to be enabled and enhanced where possible to provide the best use of this significant amenity for the community. Any access and views to Duck Creek will be created and maintained in ways that will not compromise the ecological wellbeing of the stream.

Policies:

- The ecological wellbeing of the stream and its fauna will be enhanced by planting and secured by way of long term tenure (vesting).
- Where practicable views of the creek are to be developed and are to be framed by planting in selected locations along the walkways/cycleways.
- Access and views to the creek from residential properties that are adjacent to the creek are to be developed where possible.
- Selective thinning of vegetation to retain these views and access may be deemed necessary in the future once the tree species have become mature and should be carried out by an Arborist.
- Use of locally appropriate building/construction materials should be taken into account when constructing this development.

4.2 Recreation and Access:

Objective:

- The use of Duck Creek North for passive recreation is to be encouraged by the local community and by visitors.
- To provide an adequately sized openspace park area that enables community access to the creek that is purely for passive recreation purposes

Policies:

- A 2.6m wide pedestrian walkway/cycleway is to be created to provide access along the majority of the creek and to link into the greater walkway system of Whitby and to connect the creek and community to the Pauatahanui Inlet surrounds.
- Pedestrian walkways adjacent to the Creek are to be at a grade of no greater than 1 in 12 to facilitate the access of disabled persons to the site. These would include wheelchairs, prams and disabled walkers, people of low fitness and most ages.
- Access to the greater Whitby region via pedestrian walkways to Discover Drive, Shackleton Lane, Sailmaker Close, Picketboat Lane and Observatory Close are all incorporated into the design.
- Maintenance works are to be undertaken to ensure that the concrete path network is safe to walk on and physically unobstructed by vegetation or damage.
- Dogs are permitted within the reserve areas in accordance with the Dog Control Bylaw 2008.
- Duck Creek North reserve areas are to be considered litter free areas and as such it is not suggested to provide litter bins.
- No camping is to be permitted within any of the reserve areas.

4.3 Land Management and Maintenance:

Objective:

- Duck Creek is to be kept as a safe usable space for the enjoyment of the local community.

Policies:

- All surfaces that have a possible risk of erosion will be managed and controlled in an appropriate manner.
- On-going maintenance will be provided to ensure that the Duck Creek walkway/cycleway system is safe and useable for the public, including control of weeds, paths, managing surface run-off and removal of excessive debris.
- All rubbish and other debris shall also be removed on a regular basis through regular inspection by maintenance staff.
- Access for maintenance vehicles will be provided.

4.4 Flora

Objectives:

- Install, enhance and maintain native tree and shrub species within the 20m riparian area of Duck Creek and associated vegetative treatment corridor, creating self-sustaining native vegetation that requires minimal maintenance.
- Install, enhance and maintain reserve areas of the Duck Creek North development to provide an attractive place for the community to live.

Policies:

- The initial planting of the creek riparian zone shall be carried out utilising low maintenance fast growing native plant species to create a forest canopy over the creek that will minimize soil erosion and invasion of weed species.
- A staged approach to planting will be utilised with frost sensitive species and slow growing enrichment species such Kahikatea, and Titoki being planted in approximately year three when some initial cover has become established.
- To construct a suitable environment for aquatic life and the development of a pre-human native riparian habitat there needs to be on-going consultation with an ecologist with respect to design and development of Duck Creek and its margin along with the development of the vegetative treatment corridor.
- All species declared as pests under the Greater Wellington Regional Council's Regional Pest Management Strategy 2002-2022 will be controlled and removed by the owner's representatives.
- Animal pest control is to be initiated to ensure the development of plant material.
- All plant species should be eco sourced from within this ecological district.
- The guidelines as set out in this document with respect to long term maintenance shall be followed where practicable.
- A maintenance plan will be developed that includes regular inspections and identifies required on-going maintenance, releasing of weeds and replanting of diseased, deceased specimens.
- All tree maintenance is to be in accordance with accepted arboriculture standards, practices and procedures and approved by an Arbourist.

4.5 Birds and Aquatic Species

Objective:

- Enhance the environment for local bird and aquatic life.

Policies:

- A variety of environments are to be created within the creek channel for aquatic species by the use of varying widths of the creek and its substrates, boulders, partially buried logs, variation of creek bank type and aquatic vegetation. The proposed vegetative treatment corridor is also to provide a significant habitat for local wildlife.
- Planting of native species that provide food sources and habitats for birds should be included.
- The creek planting is to be located to enhance the Inanga spawning area which lies from the northern most tip of the site to an approximate location
- Incised creek banks are to be regraded to provide better access to the creek and a variety of habitat types including shoal areas for native fish spawning.
- The creation of a planted corridor to link the Yardarm Ecosite to the remnant bush area adjacent to Sailmaker Close, Picketboat Lane and Elipsce Lane is to be established.

4.6 Stormwater System

Objectives:

- Incorporate stormwater design into the subdivision that provides a high level of treatment of stormwater to so that there are little to no significant cumulative effects from the development on Duck Creek or Pauatahanui Inlet.
- To educate future land owners in the use of stormwater systems to help reduce pollutant loading such as by incorporating “Drains to Streams” signage at roadside sumps and other stormwater system inlets.

Policies:

- Implement low impact stormwater design features to reduce the levels of contaminants (including suspended solids and heavy metals) reaching the natural waterways to which stormwater discharges (Duck Creek and the downstream receiving environment).
- Incorporate a range of measures that will reduce pollutant runoff at source.
- Incorporate a vegetative treatment corridor that will aid in reducing contaminants from stormwater before it enters Duck Creek.
- Incorporate enviro-pods or similar into the new stormwater network.

4.7 Management Plan Review

Objective:

- To ensure that this management plan remains a useful tool for the managers of this amenity it should be under continuous review until hand over to Porirua City Council.

Policies:

- The management plan as described should be updated and kept under continuous review to ensure that it best serves all of the objectives as outlined here.
- Additional other objectives and policies may also be introduced to this plan as it is intended to be a living document which best serves the interests of the greater community of Whitby and the residents who live within this development.
- Any amendment proposed to the authorised Landscape Management Plan shall be submitted in writing to the Manager, Environmental Regulation, Wellington Regional Council.
- Implementation of any amendment shall only occur once the amendment has been authorised in writing by the Manager, Environmental Regulation, Wellington Regional Council.

4.8 Development Plans

In order to gain a better overall understanding of how the Duck Creek land is to be developed please refer to the following documents;

- Proposed Duck Creek North Subdivision, Whitby, Stream Ecological Valuation and Ecological Assessment
- Duck Creek Land, Whitby: Proposed Roding Standards, Tim Kelly Transportation Planning Ltd
- Comprehensive Development Proposal, The Duck Creek Land, Whitby, Porirua City, Cardno

5 DESIGN PRINCIPALS & CONCEPTS OF LANDSCAPE WORKS

5.1 Brookside Community Theme

Brookside will be a medium-density residential community, displaying high-quality architecturally designed three to four bedroom stand-alone homes designed and built by Jagger NZ Limited and Classic Builders. Classic Builders are involved in numerous residential high quality developments throughout NZ where design outcomes are integral to the success of the development. Classic Developments is the property development arm of Classic Builders and has over 600 sections under construction in the Northland, Auckland, Bay of Plenty, Waikato and Otago regions. Classic Builder were winners of BRANZ New house owner satisfaction survey in 2013 and 2104.

Brookside's built environment will also be to a very high standard with the use a pallet of modern building materials that reflect Whitby's local character. With respect to Landscape materiality and where practicable building materials will be locally sourced. i.e. stone from local quarries, site furniture form local sources and ecosourced plant material from the Wellington ecological district.

A high emphasis will be place upon respecting the local environment and protecting the existing native bush with specific reference to the Doc scenic reserve, and the two forest blocks which boarder the site (Yardarm Bush (Ecosite# 151) and Duck Creek Bush (Ecosite# 16)).

The intent of the landscape concept for "Brookside" is to develop a high quality residential subdivision that incorporates attractive tree lined streetscapes and a community walkway system that enables access to the majority of Duck Creek North.

The majority of Duck Creek North will remain in its current natural form with the new realigned section of creek to provide fish passage and a series of diverse habitats along with an attractive riparian canopy of native trees which will provide shade and shelter along Duck Creek. This planting and other planting along the creeks length will help to create a habitat that is more conducive for aquatic and bird species to inhabit this area.

5.2 Brookside Entry Monument

The entrance to Brookside subdivision will be defined by an attractive entry monument located to east of the first bridge which will include theme lighting. Brookside has one vehicular ingress which is located at the first of the projects three bridges and connects to James Cook drive close to the Doc Scenic Reserve and the Pahautanui Inlet. This ingress point is also the developments face to the world and will have an appropriately themed entry monument that is representative of the style and character of the proposed residential development. Working in collaboration with Brookside's Building partner Classic Homes a themed entry monument has been created to provide an attractive entry monument for this community. An artists impression of the proposed entry monument is as per the graphic below.



Figure 3 Brookside Entry Monument

A larger A3 render of the Monument Structure is located in Appendix A with the Landscape Concept for the subdivision and section elevations of representative areas of the project. The entry monument is to

be visually tied to the new bridge that via themed lighting design. Concepts for the lighting will be developed in consultation with Porirua City Council at the detailed design phase of the project.

5.3 **Brookside Park and Public Openspaces**

Through the development of the Comprehensive Design Plan for Duck creek one major theme was reiterate and that was the communities desire to have access to Duck Creek. Brookside's subdivision design achieves this goal and there will be a 2.6m wide shared pedestrian/cycleway that will run from the southern end of the project at Discovery Drive to the Northern end of the project at James Cook Drive and the Doc Scenic reserve. This pathway will connect the public to the creek and also will connect the public to the sites series of reserves that are listed below. The reserve areas have been strategically located adjacent to Duck creek to take advantage of this public amenity. Along with providing an even better amenity for the public these reserve areas will also provide habitat for native flora and fauna within the riparian reserve.

5.3.1 **Brookside Park**

Brookside Park is to be centrally located within the subdivision and located adjacent to Duck Creek. The park will feature a large grass openspace that slopes towards the creek, attractive planting, seating and an on-street parking area. The park will provide a large passive openspace that allows a chance to enjoy a 30 metre length of Duck Creek and will include pathways down to the water's edge and unobstructed views to the stream itself. The park will be accessible to all members of the public.

5.3.2 **Openspace Seating Areas**

Two other openspace areas have been identified (shown on the Landscape Concept as Zone "D") will include seating areas and the ability for the public to get up close to the water's edge.

The most southerly seating area is surrounded by existing regenerating native bush to the south and east. New plantings will be provided that enclose, reduce the views of the neighbouring homes and provide a sheltered environment which will look across a grass openspace on a south east aspect towards the creek.

The second seating area is to be located within the newly constructed stream diversion on the southern side of the developments third bridge. Views to the creek will be facing a north-westerly aspect and afternoon sun will be able to be enjoyed in this location. A boulder cascade area is to be located within the creek at this point and will provide gentle water trickling noises and be visually pleasing to the eye as there will be movement and action as the water rolls over the rocks. The boulder cascade will be also specially designed and constructed to enable an informal secret crossing point over Duck Creek which will add a sense of play and another dimension to the seating area. On the other side of the creek the 2.6m wide shared pathway comes very close to the creek before it heads under the bridge towards the Pahautanui inlet. A small informal pathway will connect the seating area via the boulder cascade pathway to the 2.6 shared pathway.

5.3.3 **The Vegetative Treatment Corridor**

The vegetative treatment corridor area is located between Brookside Park to the south, The Yardarm Ecosite and the projects entry road to the west, existing residential properties which are 20m higher in elevation and screened by planting to the east and four new residential homes to the north. This area will be designed to treat stormwater runoff from the project and to provide a natural getaway area with that includes an informal walkway provided within it in order for the public to be able to enjoy this area. As the residential properties are located in the distance and this area will be lower in elevation than the adjacent road it will have a secluded feel as it is somewhat separated from the subdivision. The walk will meander through a series of spaces which will include feature plantings of food sources for birds, plantings that provide annual colour and other sensory experiences. The pathway will also provide a more informal and natural point of access to the creek in a few key locations.

5.4 Duck Creek Realignment Design Concepts

The design of the realigned section of creek bed will be undertaken to create the most natural environment as possible. Instead of a centralised stormwater drain with symmetrical batter slopes on either side that forms a floodable channel, a meandering creek bed with variable side slopes is to be created. The new alignment will create a creek bed with a series of run/riffle/pool and boulder cascade environments along with a variable channel floor area. The side batter slopes are to be of varying grades with the intention of creating an irregular natural effect.

Natural looking rock weirs will be installed at some locations across the creek instead of concrete weirs, these weirs will guarantee fish passage by having a grade of no greater than 1/15 as outlined by the Greater Wellington Regional Council. The overall longitudinal creek grade has also been designed to guarantee fish passage.

All of these features provide a greater range of habitat for local aquatic life. As per "NIWA" the width of a protected riparian area most likely to support self-sustaining native vegetation with minimal maintenance, is 15-20 m (NIWA 2000). This 20m width will be the targeted design width for the stream. The stream planting as ecological mitigation should aim to achieve a 10m width on each bank where this is available for the best design of the riparian corridor of Duck Creek North.

There are no culverts and all three crossings over Duck Creek North are to be in the form of bridges.

5.5 Planting Design Concepts

Ecologists from Boffa Miskell have identified a range of plant species that are well suited and tolerant of the local environmental conditions as well as being in keeping with the species already in use in the local area for Duck Creek South. All plant species that are to be used are to be eco-sourced native specimens. The choice of low maintenance, hardy species has also been considered as one of the design parameters. It is also intended the plant species selected will provide food sources and habitat for local wildlife.

As with the development of the Riparian corridor for Duck Creek South the main goal for this site development is to produce a riparian native forest canopy over Duck Creek North that match's pre-human habitation and modification of this area along with creating an attractive addition to Whitby's walkway system for passive recreation opportunities for local residents and visitors. A secondary goal is to enable the linkage of the green network of existing plantings within this area. Linking vegetation is especially important, as many native birds need continuous cover and access to sizeable tracts of bush as they will not fly over open or built-up areas. All native birds rely on the food that comes from native plants, including insects that live amongst these plants and so connecting up the local "Yardarm" and "Duck Creek Ecosites" along with other small remnant regenerating bush areas will greatly aid all of the local native birds and other wildlife.

The planting concept/strategy for the site identifies seven (7) specific planting areas as follows. The species within these areas are often similar but the application with respect to design varies depending on the location.

1. Planting Zone A - Streetscape Areas
2. Planting Zone B - Planting of native riparian species in riparian reserve to create a forest canopy over the creek in its original location.
3. Planting Zone C - Planting of native riparian species in riparian reserve to create a forest canopy over the creek in its new location.
4. Planting Zone D – Brookside Park and Openspace planting
5. Planting Zone E – Feature planting of Brookside Entry Monument
6. Planting Zone F – Native planting of the vegetative treatment
7. Planting Zone G – Native Screen planting of the PCC Pump station

5.5.1 Planting Zone A - Streetscape Areas

The streetscape areas will feature native street trees with grassed berms and strategically located shrub planting to highlight significant features within the subdivision.

The selection of species has taken into account safety and visibility factors since they are to be located in the road reserve, i.e. sight lines through a range of 1.2 to 2 metres from adjacent surfaces are to be left open. This planting will also benefit the development in that it will provide a more varied streetscape, a more intimate experience for the local residents and hopefully lower traffic speeds of vehicles because of the increased visual mass and feel of the reduced road width (ie. A traffic calming measure).

The berm areas within the streetscape are all to be grassed for easy maintenance purposes. Where space permits it is also proposed to install street trees in the berm areas at approximately one tree per every second residential lot in an alternating pattern along each side of the road reserve. This planting of street trees especially in instances where it is adjacent to Duck Creek will provide for a feel of greater connectivity with Duck Creek itself. The street trees located throughout the development will also provide a more pleasant living environment for the residents and visitors to this area. The location of street trees within the road reserve will take in account vehicular sightlines and the recommendations in the traffic report; "Duck Creek Land, Whitby: Proposed Roading Standards, by Tim Kelly Transportation Planning Ltd".

Root barriers will be used when planting street trees within 2m of any hard surface and mulch will be used in the rain garden areas to reduce the need for maintenance. As these areas will ultimately be maintained by PCC all planting areas that interface with grass areas will be bordered by timber edging and will be bark mulched to reduce the need for weeding.

Following is a list of plant species proposed to be used within this zone.

Table 1 – Zone A - Streetscape Plants

Zone A		
Street Trees		
Botanical name	Common name	Mature Height (m)
Alectryon excelsa	Titoki	15
Sophora microphylla	Kowhai	15
Pittosporum eugenioides	Lemonwood	10
Cordyline australis	Cabbage tree	15
Shrubs		
Carex Secta	Purei	1.5
Chinocloa flavicans	Minature toetoe	1.5
Libertia peregrinans	New Zealand iris	0.5
Libertia grandiflora	Iris	1
Phormium green dwarf	Flax	1.2

5.5.2 Planting Zone B - Planting of native riparian species in riparian reserve to create a forest canopy over the creek in its original location.

This planting area essentially traverse the length of Duck Creek North. This area has existing native riparian vegetation (Ngaio, Karamu, Lemonwood, Taupata, Kaeakawa, Amuka, lancewood, carex grasses and Kanuka) which is to be retained along with weed species that are to be removed (Pampus grass, Poplars, Willows, Gorse and Blackberry). The amount of planting to be undertaken for ecological mitigation purpose in this zone is 580 linear metres length. The total length of stream that is subject to restoration in the form of ecological mitigation planting is 749 linear metres which includes the diversion length of the stream.

The overall goal for this enhancement planting is to produce a riparian native forest canopy over the creek that matches pre-human habitation. The tree canopy which will form over the creek will provide valuable shade reducing the water temperature, increasing the oxygen content of the water and reducing the ability of weeds and algae to grow. This native riparian planting will provide a valuable habitat for native birds and other invertebrates. Thus compared to the existing creek environment the overall habitat value, along with scenic and amenity values of this creek are to be greatly enhanced by this enhancement native riparian planting.

The enhancement planting has mainly been located in the lower more northerly reaches of Duck Creek North to provide Inanga spawning habitat. Also planting areas which have an east west orientation are also more desirable to plan given the ability of the planting to provide shade the stream more quickly before full establishment of a riparian canopy.

The enrichment planting has also been strategically place to provide a vegetated corridor for native birds and other wildlife to connect the Porirua City Ecosite #151 "The Yardarm" to the regenerating native bush remnant that is adjacent to the residential properties on the eastern boundary of the site (adjacent to Picketboat Lane, Sailmaker Close and Eclipse Lane).

The establishment of this native riparian forest canopy habitat is to be accomplished in a two staged fashion over a three (3) year period. Within the creek channel itself there are essentially two planting zones as described below, both will initially be planted with a fast growing nursery crop of trees, shrubs and sedges and will then have enrichment plantings of other native successional tree species at the three (3) year period. These enrichment trees unless specifically planted at these times might not naturally return to this environment by themselves. The rationale for this staged planting is to provide a better success rate for plant growth, namely many species react poorly to being planted in bare earth exposed to wind and frost and consequently become stressed, stunted and develop poor habits (abnormal form/shape). Therefore the native planting within the riparian corridor is to be composed of the following groups of species;

- **Pioneer/colonising Species.** The Initial species to be planted are good pioneer/colonising plants which are hardy and can tolerate bare and often less fertile soils. They are also more tolerant of exposure to winds and frost.
- **Successional Species:** The enrichment species that are to be planted at year 3 require better shelter that the initial, now more mature, colonising plant material will be able to provide.

Within the creek channel itself the selection of species suited to the following areas has also been developed;

- Riparian Wet Plants (wet terraces); a planting area that has the potential for somewhat seasonal flooding. In this zone, planting of specific species will be used adjacent to the creek edge to reduce erosion and to provide habitat for aquatic life, please see the ecological report for further information.
- Riparian Dry Plants (dry slopes); a planting area that will infrequently be flooded in events that are greater than regular seasonal events.

Following is a list of plant species proposed to be used within Zone B.

Table 2 - Zone B & C - Riparian Wet Plants

Zones B & C		
Riparian Wet Plants		
Botanical name	Common name	Mature Height (m)
Initial planting (stream bank erosion protection)		
Carex secta	Sedge	1
Cordyline australis	Cabbage tree	15
Cortaderia toetoe	Toetoe	3
Cyperus ustulatus	umbrella sedge	1.5
Phormium tenax	lowland flax	3
Initial planting (wet terraces)		
Coprosma robusta	Karamu	5
Hebe stricta var. stricta	Koromiko	4
Pittosporum eugenioides	Tarata (lemonwood)	10
Plagiantus betulinus	Manatu (lowland ribb)	15
Sophora microphylla	Kowhai	8
Year 3 enrichment (wet terraces)		
Carpodetus serratus	Putaputaweta	10
Streblus heterophyllus	Turepo	12
Syzygium maire	Swamp maire	15
Dacrycarpus dacrydioides	Kahikatea	40
Laurelia novae-zelandiae	Pukatea	30

Table 3 - Zone B & C - Riparian Dry Plants

Zones B & C (continued)		
Riparian Dry Plants		
Botanical name	Common name	Mature Height (m)
Initial planting (dry riparian slope)		
Coprosma robusta	Karamu	5
Hebe stricta var. stricta	Koromiko	4
Kunzea ericoides	Kanuka	15
Myoporum laetum	Ngaio	8
Pittosporum tenuifolium	Kohuhu	10
Year 3 enrichment (dry slopes)		
Grisilinea littoralis	Broadleaf (kapuka)	15
Hedycarya arborea	Pigeonwood	8
Olearia rani	Heketara	8
Melicytus ramiflorus	Mahoe	10
Alectryon excelsa	Titoki	15
Beilschmiedia tawa	Tawa	25
Elaeocarpus dentatus	Hinau	20
Rhopalostylis sapida	Nikau	10

5.5.3 Planting Zone C - Planting of native riparian species in riparian reserve to create a forest canopy over the creek in its new location.

This planting area is 114 metres long and will be comprised of a new earthworked stream channel. There will be a minimum of 300mm of good quality topsoil placed over the earthworks to create a good growing medium for the plantings. This area will be devoid of any existing planting. The amount of planting to be undertaken for ecological mitigation purposes in this zone is 169 linear metres length. The total length of stream that is subject to restoration in the form of ecological mitigation planting is 749 linear metres which includes the diversion length of the stream.

The overall goal for this enhancement planting is the same as Zone B which is to produce a riparian native forest canopy over the creek that matches pre-human habitation. The tree canopy which will form over the creek will provide valuable shade reducing the water temperature, increasing the oxygen content of the water and reducing the ability of weeds and algae to grow. This native riparian planting will provide a valuable habitat for native birds and other invertebrates.

The establishment of this native riparian forest canopy habitat is to be accomplished in a two staged fashion over a three (3) year period. Within the creek channel itself there are essentially two planting zones as described below, both will initially be planted with a fast growing nursery crop of trees, shrubs and sedges and will then have enrichment plantings of other native successional tree species at the three (3) year period. These enrichment trees unless specifically planted at these times might not naturally return to this environment by themselves. The rationale for this staged planting is to provide a better success rate for plant growth, namely many species react poorly to being planted in bare earth exposed to wind and frost and consequently become stressed, stunted and develop poor habits (abnormal form/shape). Therefore the native planting within the riparian corridor is to be composed of the following groups of species;

- **Pioneer/colonising Species.** The initial species to be planted are good pioneer/colonising plants which are hardy and can tolerate bare and often less fertile soils. They are also more tolerant of exposure to winds and frost.
- **Successional Species:** The enrichment species that are to be planted at year 3 require better shelter than the initial, now more mature, colonising plant material will be able to provide.

Within the creek channel itself the selection of species suited to the following areas has also been developed;

- **Riparian Wet Plants (wet terraces);** a planting area that has the potential for somewhat seasonal flooding. In this zone, planting of specific species will be used adjacent to the creek edge to reduce erosion and to provide habitat for aquatic life, please see the ecological report for further information.
- **Riparian Dry Plants (dry slopes);** a planting area that will infrequently be flooded in events that are greater than regular seasonal events.

Please see the list of plant species proposed to be used in the tables above as this planting will be the same as that is within Zone B.

5.5.4 **Planting Zone D – Brookside Park and Openspace planting**

The native planting of Brookside Park and the other open spaces will be lush and invigorate the spaces with colour, scent and a variety of foliage types and textures. The planting of swathes and groups of natives will be of an informal natural. By using relaxed organic shapes for the park planting area and pathways the spaces will have a relaxed natural feel to them.

As these areas will ultimately be maintained by PCC all planting areas that interface with grass areas will be bordered by timber edging and will be bark mulched to reduce the need for weeding. No mulching is to occur within the 100 year flood plain.

Following is a list of plant species proposed to be used within Zone D.

Table 4 – Zone D - Brookside Park and Openspace planting

Zone D		
Feature Tree Plantings		
Botanical name	Common name	Mature Height (m)
Alectryon excelsus	Titoki	8
Cordyline australis	Cabbage tree	8
Meryta sinclairii	Puka	6
Myoporum laetum	Ngaio	8
Pseudopanax ferox	Horoeka	6
Rhopalostylis sapida	Nikau	10
Shrub Plantings		
Carex buchananii	Buchanans sedge	1.2
Carex secta	Purei	1.5
Carex testacea	Carex	0.5
Chionochloa flavicans	Mini Toe toe	1
Corokia cotoneaster	Korokio	3
Cortaderia toetoe	Toetoe	3
Libertia grandiflora	NZ Iris	0.5
Muehlenbeckia astonii	Muehlenbeckia	2
Phormium green dwarf	flax	1.5
Phormium tenax	lowland flax	3

5.5.5 Planting Zone E – Feature planting of Brookside Entry Monument

The landscape in this area is dominated by the tidal Doc scenic reserve grasses, the regenerating bush on the hillsides to the east and west, with Shoal Place residential properties to the south.

The native planting of Brookside entry monument aims to accentuate the sense of arrival and entry to residential community through the following design techniques;

- developing an informal natural planting layout that fits well with the existing environment;
- using contrasting colours to those in the existing environment to highlight the entry;
- providing feature lighting of the monument sign, the new bridge and planting to tie all of these elements together: and
- screen planting that reduces the Shoal Place residential properties presence.

As these areas will ultimately be maintained by PCC all planting areas that interface with grass areas will be bordered by timber edging and will be bark mulched to reduce the need for weeding.

Following is a list of plant species proposed to be used within Zone E.

Table 5 – Zone E - Feature Planting of Brookside Entry Monument

Zone E		
Feature Tree Plantings		
Botanical name	Common name	Mature Height (m)
<i>Alectryon excelsus</i>	Titoki	8
<i>Cordyline australis</i>	Cabbage tree	8
<i>Pseudopanax crassifolius</i>	Lancewood	6
<i>Rhopalostylis sapida</i>	Nikau	10
<i>Sophora microphylla</i>	Kowhai	15
Shrub Plantings		
<i>Carex secta</i>	Purei	1.5
<i>Carex testacea</i>	Carex	0.5
<i>Chionochloa flavicans</i>	Mini Toe toe	1
<i>Corokia cotoneaster</i>	Korokio	3
<i>Libertia grandiflora</i>	NZ Iris	0.5
<i>Libertia peregrinans</i>	New Zealand iris	0.5
<i>Muehlenbeckia astonii</i>	Muehlenbeckia	2
<i>Phormium green dwarf</i>	flax	1.5
<i>Phormium tenax</i>	lowland flax	3

5.5.6 **Planting Zone F – Native planting of the vegetative treatment corridor**

The planting aim for the vegetative treatment corridor and stormwater quality ponds (forebay pond, dry pond and treatment field) is to provide a solution that will use native species to improve the water quality of stormwater that enters Duck Creek and ultimately the Pahautanui Inlet.

An informal pathway will be made through the corridor so that residents can choose to leave the 2.6m wide shared pathway and walk down amongst the native plantings, enjoy the smells and get off the beaten track. While wandering through this area there will be surprises with views to the creek itself. The existing bush that is on the easterly bank of the stream remains untouched and a good backdrop to this planted area.

In order to improve urban stormwater runoff quality this vegetative treatment corridor will consist of a forebay pond, a dry pond and a treatment field that will be an overland flow path that enables silts, heavy metals and other contaminants to be captured by the plantings and soils before entering the stream. The treatment corridor is approximately one hundred (100) metres long and will be a dry area for the majority of the time with a grade that will enable water to run from the southerly high end through the forebay pond to the dry pond and then over the treatment field to the northerly low end before water will enter Duck Creek. The vegetative treatment corridor will be located directly adjacent to the creek itself, and will have an appearance somewhat similar to a wetland and from a visual perspective link to the existing native Oioi species that are located within the Doc Scenic reserve to the north.

This area will be comprised of wet margin and dry margin planting areas. The wet margin area is to be densely planted using rushes, sedges and other species that are tolerant of being submerged in water for periods of time but can also survive in the dry. These plant species are incorporated into this environment to improve water quality, this occurs by the plants themselves absorbing and filtering metals and other containments out of the water. Other wet margin species such as flax, toe toe, karamu and cabbage trees will be planted around the edge of the wet margin areas for bank stability. The dry margin planting area will be a mainly tree species planted out of the floodable area and will be comprised of native trees, flaxes and toetoe.

Following is a list of plant species proposed to be used within Zone F.

Table 6 – Zone F - Vegetative Treatment Corridor Plants

Zone F		
Vegetative Buffer Corridor Wet Margin Shrubs		
Botanical name	Common name	Mature Height (m)
Baumea articulata	Jointed twig-rush	2
Carex virgata	Pukio	1
Cordyline australis	Cabbage tree	15
Cortaderia toetoe	toetoe	3
Coprosma propinqua	Minigimingi	3
Cyperus ustulatus	Umbrella Segde	1.5
Juncus pallidus	Giant rush	2
Phormium tenax	lowland flax	3
Dry Margin Trees		
Alectryon excelsa	Titoki	15
Cordyline australis	Cabbage tree	15
Coprosma robusta	Karamu	5
Hebe stricta var. stricta	Koromiko	4
Pittosporum eugeniodes	Lemonwood	10

Table 7 – Zone F - Plants for bird food sources, smell and colour

Zone F			
Plants for Bird food sources, smell and colour			
Botanical name	Common name	Mature Height (m)	Features
Alectryon excelsa	Titoki	15	red fruit
Coprosma robusta	Karamu	5	orange/red fruit
Cordyline australis	Cabbage tree	15	cream flower
Corokia cotoneaster	Korokio	3	red fruit
Hebe stricta var. stricta	Koromiko	4	white flowers
Hebe wire mist	Hebe	1	white flowers
Phormium cookianum	dwarf mountain flax	1.5	yellow flower
Phormium tenax	lowland flax	3	yellow flower
Pittosporum eugeniodes	Lemonwood	10	yellow flower
Sophora microphylla	Kowhai	15	yellow flower

5.5.7 **Planting Zone G – Native Screen planting of the PCC Pump station**

The PCC pump station is located next to the Yardarm Ecosite and is not aesthetically pleasing to look at and will become even less appealing given it will now appear to be located in a large depressed area when the new roads and residential sections are created. The aim of the planting around this area is to densely screen the pump station by planting the borders of the site to hide it for the view of the community. Native trees and shrubs will be densely planted along the edge of the site to screen it from view. The species selected are also similar to those that exist within PCC's "The Yardarm" Ecosite #151 and so the area will feel somewhat like an extension of this bush area.

Following is a list of plant species proposed to be used within Zone G.

Table 8 – Zone G - Screen Planting of PCC Pump Station

Zone G		
Screen Tree Plantings		
Botanical name	Common name	Mature Height (m)
Alectryon excelsus	Titoki	8
Cordyline australis	Cabbage tree	8
Kunzea ericoides	Kanuka	15
Leptospermum scoparium	Manuka	10
Melicytus ramiflorus	Mahoe	10
Myoporum laetum	Ngaio	8
Pittosporum eugeniodes	Lemonwood	10
Pittosporum tenuifolium	Kohuhu	10
Shrub Plantings		
Carex secta	Purei	1.5
Cortaderia toetoe	toetoe	3
Chionochloa flavicans	Mini Toe toe	1
Phormium green dwarf	flax	1.5
Phormium tenax	lowland flax	3

5.6 Street Furniture Concepts

It is proposed to enhance the creek walkway/cycleway areas and other walkways with approved low maintenance street furniture that is in keeping with that which already resides in the local area and is approved for use by the Porirua City Council.

Three seating areas have been decided within the site and are denoted on the Landscape concept plan Located in appendix A as zone D. Seating will be located at these locations and be outside of the ten year flood event to lessen the potential of damage to the furniture. Access to the seating will either be in the form of a stone chip path/rock steps or a concrete footpath determined in the detailed design phase of the project.

To reduce the opportunity for motorised vehicles to enter the creek areas via the 2.6m wide walkway/cycleway the addition of fixed bollards adjacent to the entry points is suggested. At the entry points themselves removable bollards that allow bicycles and pedestrians to pass should be used to allow restricted access for maintenance vehicles as well. This will improve the level of safety of pedestrians who use this amenity.

It is suggested that at the other walkway linkage points within the development that bollards be used in the same fashion as outlined above to limit the access of motorized vehicles to improve the safety of these areas for local residents.

The possible use of light standards along the 2.6m wide walkways/cycleways that run adjacent to Duck Creek where there is no street lighting should be considered. This would enhance the ability of this part of the walkway system to be used at all times of day and night for the local residents and also improve the safety of this area. The provision of lighting will be dependent on available reserves funds.

5.7 Accessibility

All proposed pedestrian walkways/cycleways that run adjacent to the creek areas will be at a grade of no greater than 1 in 12 (8.3%) to facilitate the access of the widest range of persons within this community to the amenity.

5.8 Safety

Where possible adequate space has been left for access ways and linkages throughout the proposed community. The idea being to leave open sightlines as per the crime prevention standards Design Guidelines for Crime Prevention Through Environmental Design July 2009 (Upper Hutt City Council). Consideration should be given to use light standards for the walkway/cycleways which would greatly enhance the potential safety of the community that may use this amenity after dark and reduce the ability for loitering and unwanted behaviour to occur in these areas. Where possible planting in reserve areas will also be designed to leave open sightlines through areas to provide a higher level of safety for the community.

6 STAGING OF LANDSCAPE WORKS

6.1 Staging and implementation strategy overview

Once earthworked areas have been completed they will be grassed/planted as soon as is practicable thereafter. All Streetscape planting will occur soon after completion of construction. It is envisaged that the stream planting will be completed in the staged areas in the following planting season of June-August in order to give these plants the best possible start to their life in the Duck Creek North riparian corridor.

The riparian planting of Duck Creek North is to be developed in a staged fashion initially from the lower northern region heading towards the southern more elevated region of the site. This development will occur in a staged/phased fashion as shown in the figure and table below and on the next page.

Table 9 Duck Creek North Construction and Planting Staging Dates

Stages	Estimated Construction dates and streetscape Planting	Estimated Stream Planting Dates	Estimated 3 year Enrichment planting
1	December 2015	July 2016	July 2019
2	December 2016	July 2017	July 2020
3	December 2017	July 2018	July 2021
4	December 2018	July 2019	July 2022

In the event that future stages of the project are delayed the areas that have been earthworked will be fully stabilised and planting will be undertaken in accordance with the information contained within this document.



Figure 4 Duck Creek North Construction Staging

6.2 Staging and implementation strategy for the riparian corridor

6.2.1 Creation of the new stream bed and riparian corridor

The stream bed and banks that form the riparian corridor within the area of Duck Creek that is to be realigned are to be created using the following general methods. The methodology for the channel creation is the same as the one that was used for Duck Creek South. Please see Appendix B, Cardno Civil Plans, NZ0115065-PL-C251 for the locations of the new length of creek to be created.

The new stream is to be comprised of four main zones that repeat themselves along its length and are described as run, riffle, boulder cascade and pool areas. These areas will be identified on the earthworks plans and are to be constructed onsite using a standard cross section that will be modified to fit each individual location. The new creek that is to be created will transition from one of these areas to the other along its lengths. A diagrammatic representation of this system in plan view can be seen below, Figure 5 Diagrammatic Run, Riffle, Boulder Cascade and Pool Creek Areas and is described in the section “Duck Creek Diversion Design Standards”. Also sections depicting each of general areas follow with a general description of general construction.

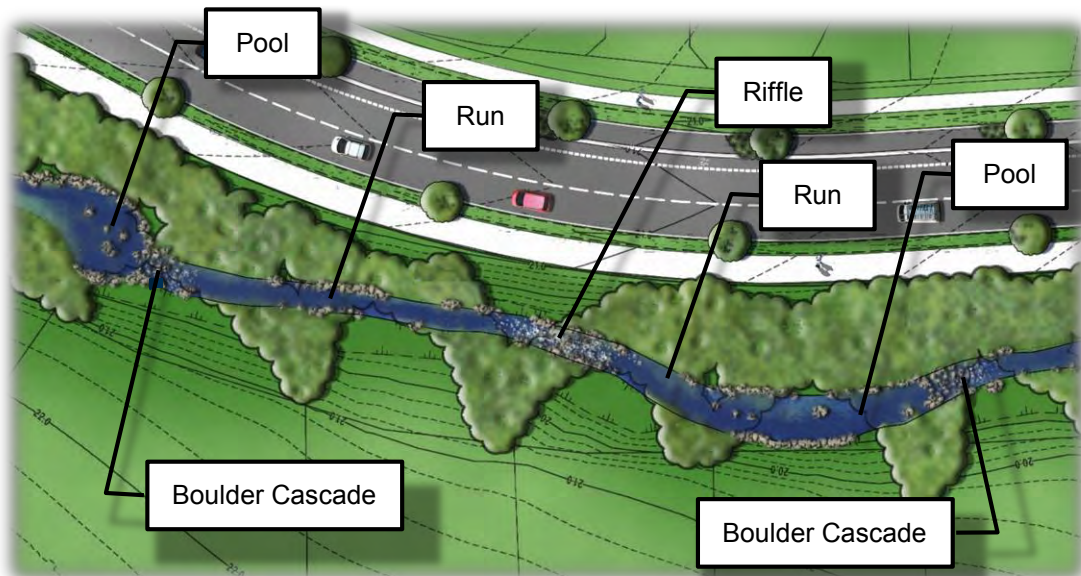


Figure 5 Diagrammatic Run, Riffle, Boulder Cascade and Pool Creek Areas

Creek bank armouring with rock may occur on some of the banks as defined by the creek modelling. The bank areas that could be prone to erosion in a storm event will have this armouring installed. Small areas of exposed areas of rock armouring will have other rocks strategically placed surrounding the area of armouring for aesthetic purposes to produce a more natural appearance. The rock size for the armouring would be an average of 250-350 mm average least diameter (ALD). As a percentage of the entire new stream alignment the rock armouring will occupy approximately 10 percent of the total area. Rock armouring will be integrated into the creek environment along the new alignment by having plant material planted on top of it. The rock armouring will be covered with 300mm of topsoil and planted with suitable shrubs and small trees.

It is proposed to install 300 mm of topsoil across the whole reserve/open space development. This will also occur within the riparian corridor except for the bed of the creek channel.

6.2.2 Duck Creek Diversion Design Standards

The Design Standards that follow have been derived from a “Stream Analysis” performed by Ecologists at Boffa Miskell Ltd and are detailed further in their Ecological Assessment and Recommendation’s that were produced for Duck Creek South. The characteristics of the Duck Creek North stream are essentially the same and so the same design standards are to be used when creating the 114m long Duck Creek North realigned channel.

Channel Length

To account for loss of channel length, development of meander within the floodplain is essential. Meander is vital for providing habitat diversity, channel complexity, and velocity reduction.

Width of wetted bed (between banks & including gravel bars) to match as closely as possible to the current environment.

- Mean 2.25 m
- Min 1.8 m
- Max 3.1 m

Water Depth to match as closely as possible to current;

- Mean depth: 15 cm
- Maximum depth: 60 cm
- (Depth will be determined by flow and habitat desired type).

Velocity to match as closely as possible to current;

- Run – pool; between 0.2 m/s to 0.4 m/s
- Riffle; between 0.4 to 0.6 m/s
- Boulder Cascade; to maximum of 0.8 m/s (note, boulder cascades will be a new habitat introduced into this environment)

Bed material to match as closely as possible to current;

- 10% sand
- 20% gravel
- 35% small cobble
- 30% large cobble
- 5% boulder

The placement of these different sized bed materials needs to be monitored and size will be determined by velocity and desired habitat.

Hyporheic Zone

When forming the diversion channel, the new bed will be cored to establish the depth of existing suitable gravels. If suitable gravel material does not exist within the 0.5m depth then additional material will be installed to obtain a 0.5m zone. This gravel substrate will then develop into a functioning Hyporheic zone. It has been assessed that currently the underlying substrate where the creek is to be diverted through contains gravels and cobbles so the degree to which this area will need to have additional gravels brought in will have to be assessed onsite as the areas are earthworked.

Channel complexity – 4 key habitats to match as closely as possible current;

- 5% Boulder Cascade (new)
- 15% Riffle
- 20% Pool
- 60% Run

Channel Habitat Diversity – expected to increase over time from 3 to 6 types including;

- Cobble riffle
- Run – Pool
- Boulder - bedrock Cascade (new)
- Root mat (from riparian vegetation)
- Undercut (bank)
- Boulder (new)

Shading

Currently the creek's area is shaded approximately 30% based on overhanging banks, weedlands, and weedy aquatic macrophyte. Upon the proposed planting establishment a minimum of 80% shade is expected based on a canopy of small trees and creek margin's grasslands developing.

Planting

Planting is aimed to achieve the following; erosion control by hydroseeding and interplanting immediately following earthworks. As the planting establishes at approximately the year 5 period there should be established riparian cover and creek shading. In the process of the planting establishment weed species should be eliminated by control measures and being shaded out by the developing riparian cover.

6.2.3 Boulder Cascade Areas (5%)

In order to create diversity of habitats, manage grade and provide visual amenity Boulder cascade areas are to be added to the newly created creek diversion areas. The Boulders could range in size up to a maximum of 400mm and will be placed to create pool areas upstream and manage the overall velocity and grade of the new creek diversion. These drop structures will still provide for fish passage and it is intended that if possible views to some of these areas will be included from the adjacent pathways or street.

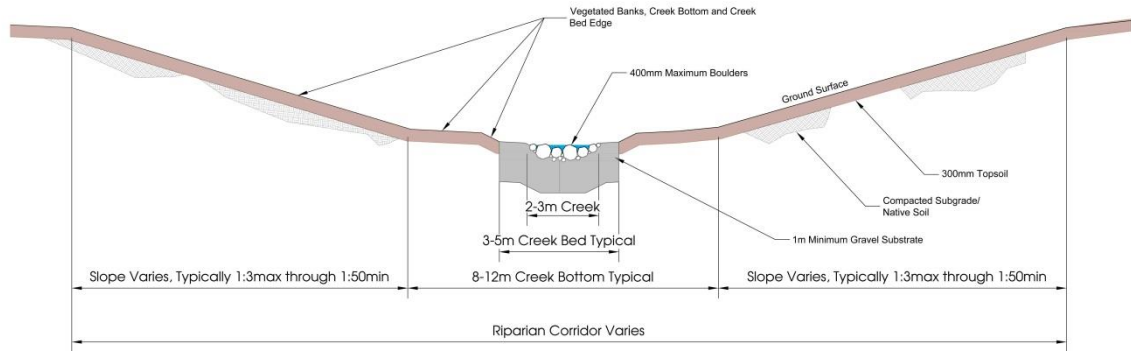


Figure 6 Boulder Cascade Section

6.2.4 Creek Channel Riffle Areas (15%)

These are areas which are practicably flat that have fast flowing water areas with broken water surface and large gravel cobbles. The use of coarse substrates such as cobbles and boulders will create water turbulence and microhabitats, increasing the instream diversity. The use of large cobbles and boulders will also help prevent erosion from occurring in this area. These creek areas produce an environment for species that have a high demand for oxygen.

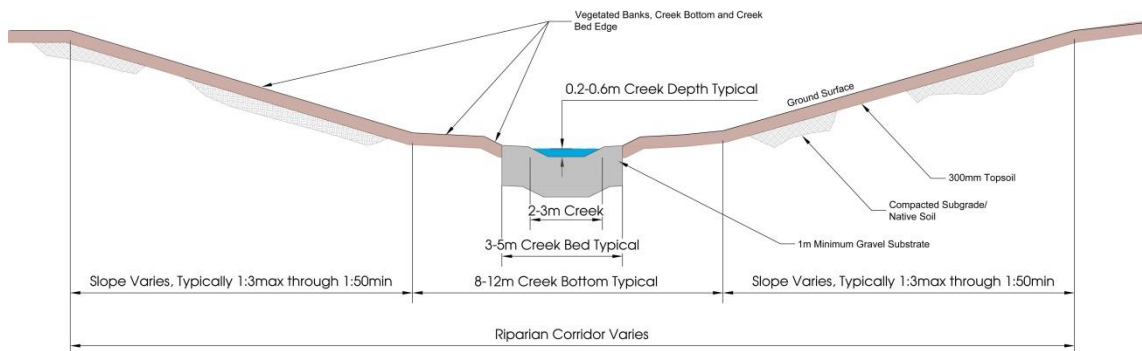


Figure 7 Creek Channel Riffle Areas

6.2.5 Creek Channel Run Areas (60%) and Pool Areas (20%)

These areas are characterised by slow moving areas of deeper water that contain deposits of finer substrates (sand or gravel) to cobble substrates, but generally consist of smaller particles than in the riffle sections. These areas act as important storage areas for organic material and as refuge areas for wildlife.

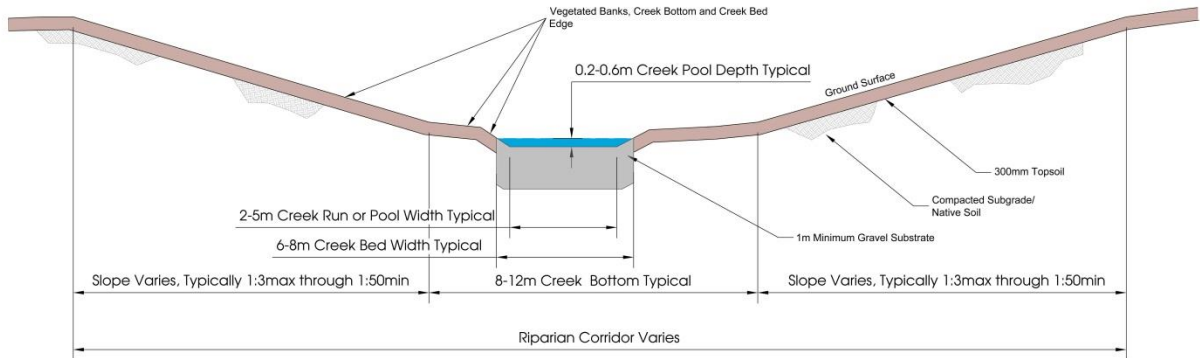


Figure 8 Creek Run or Pool Section

6.2.6 Duck Creek Typical Bank Rehabilitation

Within Existing Duck Creek portions of the creek bank edge are to be reformed. These areas are to be improved where practicable by the re-grading of the current creek’s side batter slopes which are almost vertical and very incised, to a flatter grade that will reduce further erosion and enable a wider range of habitat’s for local aquatic life. The creek location will not be altered in this process and immediately after earthworks the re-graded creek banks will be hydroseeded or sown in grass along with having jute mesh applied to the surface to reduce the possibilities of erosion. Further planting of this area with stabilise the banks and provide valuable shade for the creek. A typical section indicating the area of creek bank can be seen below. Please see Appendix B, Cardno Civil Plans, NZ0115065-PL-C251 for the locations of the bank regrading.

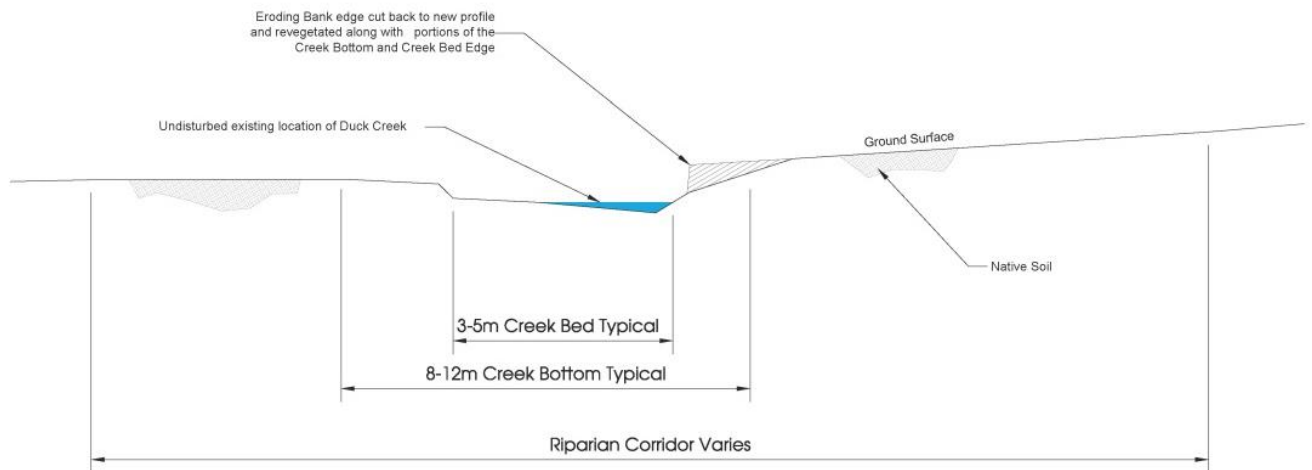


Figure 9 Typical Bank Rehabilitation

7 STREETScape ENHANCEMENTS AND STREET FURNITURE INSTALLATION

7.1 Paving Enhancements in the Streetscape

At the detailed design stage it is intended to produce street improvement plans which indicate the location of streetscape paving to highlight pedestrian crossing points and also to act as demarcations of significant community amenities. An example of this would be the adding of street paving adjacent to the road crossing points which will join the shared 2.6m pedestrian/ cycleway together. This will increase the significance of the walk within the community, highlighting its importance. A uniform group of surfaces is desirable to give a consistent feel to the community.

7.2 Seating

It is proposed to add some seating areas along the length of the 2.6m wide walkway/cycleway in appropriate locations where views to the creek are good and for rest stops. The seating areas will coincide with points of interest along the creek and the design type shall be approved by the Porirua City Council. The three proposed seating areas are shown the Landscape Concept Plan in Appendix A and denoted by "Zone D"

7.3 Bollards

The entry and exit points (as agreed by Porirua City Council) of pedestrian/cycleway paths that travel through reserve areas shall be fenced with the following:

- Approved steel bollards that have a maximum spacing of 1.4m apart.
- Approved removable top locking galvanised steel bollard and galvanized steel sleeve to be installed in the 2.6m wide pedestrian pathway/cycleway to allow for maintenance vehicle access.
- Concrete mowing surrounds shall be installed at the bases of bollards located in grass.

7.4 Lighting

The design style, colour and positioning of any proposed lighting standards is to be approved by Porirua City Council. The supply of electricity shall not compromise tree roots and future access for repairs within the creek reserve area. The design should be in keeping with local standards and unify the link along the length of Duck Creek to the Pauatahanui inlet.

8 Planting Implementation Strategy

8.1 Initial site

After earthworking of the development stage by the general contractor all exposed earth surfaces will be grassed to reduce erosion and opportunity for weed growth. All surfaces within the riparian corridor will also have jute mesh installed to further reduce the opportunity for erosion. Within the riparian corridor the grass will not be mown and will left to turn into rank grass. Additionally some areas that are more at risk due to erosion because of grade and the position of the creek bed will have specific erosion sediment controls in accordance with Greater Wellington Regional Council's Erosion Sediment Control Guidelines.

8.2 Animal control

It has been noted that rabbits, hares, possums and mustelids exist on the site and therefore need to be controlled. The landscape contractor who will be responsible for the agreed maintenance period should identify what the pest problems are and take actions accordingly, i.e. poisoning and or the use of animal control methods such as animal repellents applied at the time of planting. Problems with rabbits and hares should be controlled before seedlings are planted. There are several animal repellents available for short-term protection, but to be effective they need to be applied the day seedlings are planted, so that animals quickly learn that the seedlings are unpalatable.

The animal control applied by the landscape contractor shall be in accordance with the Greater Wellington Regional Pest Management Strategy.

8.3 Removal of weeds and protection of existing natives

Prior to planting and after earthworking activities have been completed for a staged planting area, all remaining weed species (gorse, blackberry, willows, poplars, etc.) should be identified and removed offsite by the earthworks or landscape contractor. Open earth areas left by the removal of the weeds and trees within the riparian area of Duck Creek should be initially planted in grass to limit the ability of weed species to return. Within the riparian planting area a bed of rank grass is desired to install the plants into as this will limit the invasion of other weed species. A professional tree feller may be required to remove any large trees so that damage to other plants and safety risks are minimised. Within the riparian planting zone all the existing native plants are to be identified and should be tagged and protected in place. The root zone areas of these plants should not be disturbed.

8.4 Planting patches within the riparian zone of Duck Creek

Clear all existing vegetation from the location of a planting patch as designated by the planting plans to a one meter diameter by spot-spraying or screefing/scraping (skimming off surface vegetation with a spade or grubber), to reduce competition for water and light. Avoid over-clearance as weeds will re-invade any disturbed ground (Porteous 1993). Do not damage other plant roots that are to be retained, or remove too much topsoil. Plant promptly there after (within a week, preferably sooner).

If the cleared plant patches are not planted promptly, they should be spot sprayed at the time of planting. Alternatively, they can be left to allow other weed seeds to germinate before final spraying and planting (Porteous 1993).

Use of a glyphosate-based herbicide is recommended within the creek riparian corridor and the contractor should;

- Follow manufacturer's recommendations carefully.
- Follow recommended safety precautions to avoid harming people or contaminating Duck Creek waterways.
- Spray only in calm conditions.
- Use a wetting agent to improve adherence and results.
- Protect non-target plants by shielding them with cardboard, plastic board or plastic bags with the bottom cut out (Porteous 1993).

8.5 General Site Soil Conditions and Soil Amelioration

Areas that are to be earthworked to form the new creek banks will be installed with sufficient good quality topsoil (approximately 300 mm) in order to promote the growth of thriving plants. If the landscape contractor finds any areas of unsuitable soil for plant growth that may jeopardise the success of planting then this should be brought to the owner's attention and methods undertaken to remedy the site conditions before planting, i.e. soil amelioration.

Soil amelioration is the process of modifying soils to provide what the native soils do not naturally provide. The soil amelioration most commonly applied to Wellington soils which are typically sour (alkaline) is to add the iron sulphate or peat moss to bring the pH down to a more neutral level of 7 which most plants will thrive in. Most native plants prefer a pH range of 5.8-6.5 and so creating this environment would be favourable for the growth of natives.

It is expected that the landscape contractor as a professional will make sure to advise the owner's representative of any soil amelioration that needs to be undertaken in order to provide the correct soil conditions for plants to thrive in.

If no issues are raised then any failure of plant material due to adverse or poor soil conditions will be at the landscape contractor's expense. Any plant material that is required to be replaced will be re planted at a grade similar to the other existing species that area actively growing. i.e a PB3 plan will not be replanted, instead a plant the same size as existing plants that area growing well shall be planted, with this cost to be borne by the contractor. At the time of replanting the contractor shall also supply a better quality topsoil so that the plant has a proper growing medium that will support its growth.

8.6 Quality of plant material and inspection

All plants shall have a habit of growth that is normal to the species and are to be sound, healthy, vigorous nursery grown stock. All plants are to be free of insect pests, plant disease, sun scalds, abrasions and other disfigurements and shall be pruned if necessary to achieve a standard form for the specific plant. All plants shall have normal and well-developed branch systems, and vigorous and fibrous root system which are neither root nor pot-bound.

Prior to planting the contractor is to arrange an inspection by the owner's representative. Plants not meeting these requirements will be rejected by the owner's representative and removed from site and replaced at the contractor's expense. All plants should be protected from damage, sun, rain and wind before being planted. Damage may be cause for rejection of the planting even after the initial approval of a plant.

All plants shall be sourced from naturally occurring populations within the ecological domain of the site. The contractor shall be responsible for checking all stock prior to delivery from the supplier to ensure it is healthy, pest and disease free, is of the correct grades, and is sufficiently hardened off. It is in the best interest of the contractor to use his/her professional judgment to protect the installed plant material to ensure its survival.

8.7 Delivery of planting and temporary storage sites

In so far as is practicable, plant material shall be planted on the day of delivery. Prior to planting the material needs to be inspected by the owner's representative. Plants that cannot be planted immediately shall be protected from damage, sun, rain and wind before being planted in a temporary location as designated by the owner's representative. No permanent stockpiling of material will be allowed.

8.8 Size and spacing of plant material

Within the riparian zones of Duck Creek mulch is not to be installed. Regular maintenance and animal pest control of this area is seen as crucial to the survival of the installed planting. Competition with grasses for light and moisture will be encountered, therefore to increase the survival rate of plants regular spraying and or hand releasing of weeds will be necessary. Plant material within this zone is to be installed at a minimum PB3 size according to availability of material. Root trainer stock may have to be used if PB3's are not available to maintain the stock being sourced locally.

The material to be planted within the riparian corridor will average 1.1 metre spacing's overall, and is expected to create near canopy cover within a five year time frame. Near canopy cover in this term of reference does not mean that full size adult plants will be in place but that the material planted will have grown sufficiently to cover the majority of the bare ground adjacent to it. Within this framework the following strategy for planting will occur. Spacing's of 4-10 metres will be used for large canopy and podocarp trees, 3 metre spacing's will be used for small trees (kohuhu), and 2-1.5 metre spacing's for shrubs and large tussocks (korimiko, toetoe) with rushes and sedges being planted at approximately 1.0-0.6 metre spacing's on the creek banks or in wetland areas. The goal is to create a canopy that shades out weed species and establishes a well rooted substrate to reduce the possibility of erosion. Also this careful layered planting will reduce the need for thinning out of species as they mature. Screen planting around the PCC pump station will be implemented by the planting of small trees such as the kohuhu around the border of the site.



Figure 10 Restored forest showing different spacing's of large and small plants, this figure is indicative of a longitudinal section down the creek.

The planting plans show the locations of the enrichment plants that are to be installed at year three (3).

8.9 Species substitutions

All plants shall be of the species, variety, size and condition as specified on the approved drawings. No plant substitutes shall be allowed without the written approval of the owner's representative.

8.10 Timing of Planting

Animal control measures are to be in place well before the time of planting to eradicate any browsing animals from the planting site. Animal repellents need to be applied the day seedlings are planted, so that animals quickly learn that the seedlings are unpalatable.

Initial planting are best planted between the months of June to August, when seedlings are dormant and can best withstand handling (see the table

Table 9 Duck Creek North Construction and Planting Staging Dates).

The aim should be to plant immediately before the soil warms up sufficiently for the seedlings to make new root growth². This will allow maximum root development while moisture is available.

Initial planting shall begin no later than 6 months following the completion of the earthworks for the creek diversion and shall be completed in advance of water being released through the channel, or otherwise within a timeframe authorised in writing by the Manager, Environmental Regulation, Wellington Regional Council.

Further to this the year three (3) enrichment planting of successional species is to occur in the riparian planting zone and should occur between June through August on the third year of maintenance.

8.11 Planting holes

Planting holes shall be twice the size of the plant container, score the sides and loosen soil in the bottom of the hole to a depth of 150 mm using the tines of a fork. All rubble, inorganic material and roots exceeding 20 mm shall be removed and not placed back into the planting hole and disposed of appropriately. The bottom of each hole shall be filled with a minimum depth of 50 mm of pre-mixed compost and should contain an 18 month slow release fertilizer. A slow release fertilizer tablet should be placed in each hole with the plant. The plant should then be backfilled with 50/50 native soil and organic compost and firmly compacted down.

Note: No mulch is to be used within the flood plain zone area of the creek.

8.12 Plant setout prior to planting

Plants shall be spotted/laid out adjacent to the hole they are to be planted into in accordance with the planting plan. The contractor shall arrange for the owner's representative to inspect the plant setting out and approve it. The owner's representative may vary the location and grouping of trees/shrubs locally as the planting proceeds requiring the contractor's co-operation, input and agreement.

8.13 Planting Installation

All trees and shrubs are to be planted to the depth that best suits the ground conditions that they are to be planted into as describe below.

² <http://www.nzffa.org.nz/farm-forestry-model/resource-centre/farm-forestry-association-leaflet-series/no-3-successful-establishment-of-tree-seedlings/>

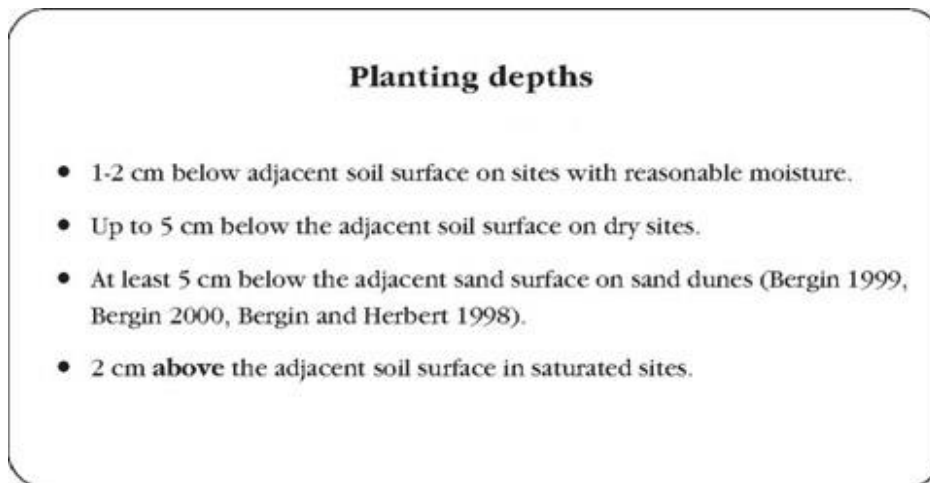


Figure 11 Planting depths

All plants are to be firmly heeled into the ground. All planting shall be carried out in accordance with best horticultural practices. All plants are to be thoroughly watered several hours prior to planting by immersing the root ball. Always cut off the bottom 2-4 cm of roots before planting if planting root trainers. With planter bag material slicing down vertically with a knife and around the circumference of the root bundle helps, but the only sure way to ensure the future stability of the tree is to remove the container, gently shake or wash the soil out, tease out any tangled roots, and trim off any long or badly twisted ones with a sharp pair of shears³. All plants shall be planted in well prepared planting holes as outlined above.

Once planted, except in the riparian planting zone, a 100 mm layer of mulch shall be applied to retain soil moisture and reduce weed growth. The building up of mulch against the tree or plant stem should be avoided. Street trees are to have a 500 mm diameter mulch area installed at their base.

8.14 Watering

All plants are to be adequately watered before planting and again after planting should ground and weather conditions prove it necessary. The contractor is responsible for the supply of all watering to ensure the survival of the plant material until the end of the twenty four (24) or thirty six (36) month maintenance period. Watering of plant material should not be necessary from year two onwards. Over watering can cause excessive soft growth and reduce a plant's hardiness⁴. The contractor should not use water from the creek itself for watering of the plant material to reduce the possibility of damage to the creek.

8.15 Mulching

No mulching of plants is to occur within the 100 year flood plain zone adjacent to Duck Creek. Homeowner's that have lots which are adjacent to the creek and have a portion of the lot lying within this 100 year flood plain zone will also be instructed to not use mulch in this area. This is to avoid the possibility of flooding washing away the mulch and causing blockages in the stormwater system.

8.16 Root barriers

All street trees that are to be planted within 2 metres of a concrete surface shall have root barriers installed adjacent to the hard surface. The root barriers are to be installed to manufactures specifications.

³ <http://www.nzffa.org.nz/farm-forestry-model/resource-centre/farm-forestry-association-leaflet-series/no-3-successful-establishment-of-tree-seedlings/>

⁴ Protecting and restoring our natural heritage – a practical guide, Mark Davis – freelance ecologist and Dr. Colin Meurk – Landcare Research plant ecologist; Department of Conservation; June 2001; Page 60

8.17 Guarantees

All plants and planting are to be guaranteed for thirty-six (36) months from the time of Practical Completion to the Final Inspection. The contractor shall replace any damaged, defective, dead or missing plants at his/her cost within ten (10) working days by notification of the owner's representative. Plants that lose more than thirty percent (30%) of their original leaves shall be replaced. All riparian plantings shall have a minimum survival rate of 95% overall. No one area larger than 10 m² shall have a survival rate less than 50%. The contractor shall replace missing, dead, or diseased plants to the minimum survival level of 95% using the species that are indicated on the plans. The contractor shall replace missing damaged, defective or dead plants to the survival levels, specified, at his/her cost during the contract installation and maintenance period. This also includes all material that is lost to flooding, drought, fire or any other event natural or otherwise. During the period of the contract, all work carried out is to be maintained.

8.18 Clean up

The site is to be kept tidy at all times during installation, with all unwanted materials, rubbish and contaminated materials to be removed from site. The contractor is responsible for the disposal off site of all cleared materials in a safe and legal manner, including payment of any associated fees as required. Upon practical completion of the work prior to start of the thirty six (36) month maintenance period the contractor shall remove all tools, supplies, materials and equipment, etc. from the site to the satisfaction of the owner's representative.

8.19 Plant replacement/Blanking

It is inevitable that some plant material will be lost in the planting process. One month after the initial planting the landscape contractor should assess the site and replace all material that has been lost. After the completion of this planting and having completed all other landscape works the contractor should then be able to arrange for an inspection by the owner's representative to have a certificate of practical completion issued.

8.20 Practical completion

During the period of the contract, all work carried out is to be maintained. A written certificate of practical completion shall not be issued until the staged landscape works are fully completed, including but not limited to the following; all rubbish removal, reinstatement of grass areas, paths and other structures, surfaces damaged by the landscape works or temporary works and supply of as-built information. This certificate will then start the agreed maintenance period. A copy of this certificate will be forwarded to Jagger NZ Limited as well as the Manager, Environmental Regulation, Wellington Regional Council.

9 MONITORING OF PLANTED AREAS

9.1 **Duck Creek Riparian Corridor – 3 Year Monitoring.**

During the period of the contract, all work carried out is to be maintained by the Landscape Contractor. The specified maintenance and monitoring period shall begin immediately after written certification of practical completion by the owner's representative and shall be for a period of thirty six (36) months. Within this time the Landscape Contractor will be responsible for all maintenance and monitoring of the planting area (ensuring survival and reasonable growth of the plantings) as designated by the plan for the three (3) year period of maintenance and monitoring. After this time the planting should be at a level that it is self-sustaining.

Maintenance of all areas as designated on the plans is to ensure the development of thriving plants and the creation of a safe usable environment and shall include but not be limited the following;

9.1.1 **Year One**

9.1.1.1 ***Maintenance***

Monthly or more frequently

- At the beginning of the maintenance period, pest and disease control of the planted areas by monitoring the site on an on-going basis and implementing the appropriate control is necessary. The contractor shall notify the owner's representative prior to implementing any control/r eradication program which shall be specific to the task;
- Watering to establish healthy plants upon planting and watering of plant material in times of drought. Water should not be taken from the creek under any circumstance;
- Silt trap fencing is to be installed by the earthworks contractor at suitable distances along the creek bed to further ensure that sediment does not enter the water ways. These may require periodic clearing of debris, sediment, silt and or rubbish. This material should be disposed of offsite;
- If any street furniture that is installed as part of the landscape contract is found to be unsafe it shall be removed and replaced as quickly as possible;
- Graffiti that is found within the development shall also be removed as quickly as possible; and
- Any dumped rubbish or debris that is found within the development shall also be removed as quickly as possible.

Quarterly

- To ensure the successful establishment of the plant material a total of four (4) releases of the planting by spot spraying of weeds with a chemical —glyphosate-based herbicide or equivalent is to occur.

Bi-annually

- General removal of rubbish and cleaning of paved areas adjacent to or within the planting and grassed areas (timed to be just before the inspections); and
- Removal offsite of all dead, diseased or unwanted plant material.

Yearly

- Replacement of any dead, damaged, missing or diseased plants or grass areas to occur just prior to the growing season;
- Inspection, cleaning, repair, replacement of any damaged, worn or vandalised street furniture that has been installed as part of the landscape contract;
- Pruning and thinning of any plants necessary to maintain unobstructed walkways.

Additional

- In addition to the routine maintenance programmed above, responsive monitoring and repairs as necessary should be carried out following a storm event and after prolonged dry or wet periods.
- The contractor shall keep a record of all monitoring and maintenance undertaken over the previous year (approximately 1 June to 31 May) and submit these details in a Planting Monitoring Report to the owner's representative and the Manager, Environmental Regulation, Wellington Regional Council. The report shall be submitted by 15 July each year and shall include, but not be limited to, the following:
 - a) Plant success rates;
 - b) Details of the number of plants replaced, including species, location and date replaced;
 - c) Photos covering planted areas; and
 - d) Recommendation of any on-going maintenance.

9.1.1.2 ***Inspections***

There are to be two (2) inspections scheduled throughout the year by the owner's representative. The inspections are to be scheduled to occur after the release for weeds at the sites. The first inspection is to occur at the end of the growing season and next approximately six months later. These inspections should be scheduled with the landscape contractor at the start of the maintenance period.

A landscape maintenance walk of the site with the landscape contractor will occur at these specified times to inspect the condition of the plant material and general condition of the site. A punch list of items that need to be remedied will be generated by the owner's representative and delivered to the landscape contractor within three (3) working days of the walk. This list will address any items that need maintenance, e.g. pruning, thinning, replacement of dead, diseased, missing plants etc. The landscape contractor will have ten (10) working days to remedy these action items and another walk will be scheduled to verify that the items have been completed. Replacement of plant material or grass shall be evaluated on the inspection and if feasible delayed until just before the growing season. The contractor will then be issued a letter specifying that they have completed all the items that needed to be remedied. If this is not the case another punch list will be generated and need to be completed by the contractor and so on.

9.1.2 **Year two**

9.1.2.1 **Maintenance**

Monthly or more frequently

- Silt trap fencing is to receive periodic clearing of debris, sediment, silt and or rubbish. This material should be disposed of offsite.
- If any street furniture that is installed as part of the landscape contract is found to be unsafe it shall be removed and replaced as quickly as possible;
- Graffiti that is found within the development shall also be removed as quickly as possible; and
- Any dumped rubbish or debris that is found within the development shall also be removed as quickly as possible.

Quarterly

- Pest and disease control of the planted areas by monitoring the site on an on-going basis and implementing the appropriate control. The contractor shall notify the owner's representative prior to implementing any control or eradication program which shall be specific to the task;
- A total of four (4) releases of the planting by spot spraying of weeds with a chemical—glyphosate-based herbicide or equivalent is to occur.

Bi-annually

- General removal of rubbish and cleaning of paved areas adjacent to or within the planting and grassed areas (timed to be just before the inspections); and
- Removal offsite of all dead, diseased or unwanted plant material.

Yearly

- Replacement of any dead, damaged, missing or diseased plants or grass areas to occur just prior to the growing season;
- Pruning and thinning of any plants necessary to maintain unobstructed walkways;
- Inspection, cleaning, repair, replacement of any damaged, worn or vandalised street furniture that has been installed as part of the landscape contract; and
- Removal and replacement of the mulch layer in the rain gardens as indicated in the Duck Creek Stormwater Strategy Document (to occur every second year).

Additional

- Watering of plant material should not be necessary in year two. Over watering can cause excessive soft growth and reduce a plant's hardiness⁵; and
- In addition to the routine maintenance programmed above, responsive monitoring and repairs as necessary should be carried out following a storm event and after prolonged dry or wet periods.
- The contractor shall keep a record of all monitoring and maintenance undertaken over the previous year (approximately 1 June to 31 May) and submit these details in a Planting Monitoring Report to the owner's representative and the Manager, Environmental Regulation, Wellington Regional Council. The report shall be submitted by 15 July each year and shall include, but not be limited to, the following:
 - a) Plant success rates;
 - b) Details of the number of plants replaced, including species, location and date replaced;
 - c) Photos covering planted areas; and
 - d) Recommendation of any on-going maintenance.

⁵ Protecting and restoring our natural heritage – a practical guide, Mark Davis – freelance ecologist and Dr. Colin Meurk – Landcare Research plant ecologist; Department of Conservation; June 2001; Page 60

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9.1.2.2 ***Inspections***

There are to be two (2) inspections scheduled throughout the year by the owner's representative. The inspections are to be scheduled to occur after the release for weeds at the sites. The first inspection is to occur at the end of the growing season and next approximately six months later. These inspections should be scheduled with the landscape contractor at the start of the maintenance period.

A landscape maintenance walk of the site with the landscape contractor will occur at these specified times to inspect the condition of the plant material and general condition of the site. A punch list of items that need to be remedied will be generated by the owner's representative and delivered to the landscape contractor within three (3) working days of the walk. This list will address any items that need maintenance, e.g. pruning, thinning, replacement of dead, diseased, missing plants etc. Replacement of plant material or grass shall be evaluated on the inspection and if feasible delayed until just before the growing season. The landscape contractor will have ten (10) working days to remedy these action items and another walk will be scheduled to verify that the items have been completed. The contractor will then be issued a letter specifying that they have completed all the items that needed to be remedied. If this is not the case another punch list will be generated and need to be completed by the contractor and so on.

9.1.3 **Year three**

9.1.3.1 ***Maintenance***

Monthly or more frequently

- Silt trap fencing is to receive periodic clearing of debris, sediment, silt and or rubbish. This material should be disposed of offsite.
- If any street furniture that is installed as part of the landscape contract is found to be unsafe it shall be removed and replaced as quickly as possible;
- Graffiti that is found within the development shall also be removed as quickly as possible; and
- Any dumped rubbish or debris that is found within the development shall also be removed as quickly as possible.

Quarterly

- Pest and disease control of the planted areas by monitoring the site on an on-going basis and implementing the appropriate control. The contractor shall notify the owner's representative prior to implementing any control or eradication program which shall be specific to the task

Bi-annually

- General removal of rubbish and cleaning of paved areas adjacent to or within the planting and grassed areas (timed to be just before the inspections).

Yearly

- A total of one (1) release of the planting by spot spraying of weeds with a chemical—glyphosate-based herbicide or equivalent is to occur. Any large weeds should be disposed of offsite. This release should occur at the end of spring. The contractor shall indicate to the owner's representative the methods to be employed prior to implementation;
- Replacement of any dead, damaged, missing or diseased plants or grass areas;
- Removal offsite of all dead, diseased or unwanted plant material;
- Pruning and thinning of any plants necessary to maintain unobstructed walkways; and
- Inspection, cleaning, repair, replacement of any damaged, worn or vandalised street furniture that has been installed as part of the landscape contract.

Additional

- The contractor shall keep a record of all monitoring and maintenance undertaken over the previous year (approximately 1 June to 31 May) and submit these details in a Planting Monitoring Report to the owner's representative and the Manager, Environmental Regulation, Wellington Regional Council. The report shall be submitted by 15 July each year and shall include, but not be limited to, the following:
 - a) Plant success rates;
 - b) Details of the number of plants replaced, including species, location and date replaced;
 - c) Photos covering planted areas; and
 - d) Recommendation of any on-going maintenance.

9.1.3.2 ***Inspection***

There is to be one (1) inspection scheduled for the year by the owner's representative. The inspection should be scheduled with the landscape contractor to occur in the middle of year three.

A landscape maintenance walk of the site with the landscape contractor will occur at these specified times to inspect the condition of the plant material and general condition of the site. A punch list of items that need to be remedied will be generated by the owner's representative and delivered to the landscape contractor within three (3) working days of the walk. This list will address any items that need maintenance, e.g. pruning, thinning, replacement of dead, diseased, missing plants etc. Replacement of plant material or grass shall be evaluated on the inspection and if feasible delayed until just before the growing season. The landscape contractor will have ten (10) working days to remedy these action items and another walk will be scheduled to verify that the items have been completed. The contractor will then be issued a letter specifying that they have completed all the items that needed to be remedied. If this is not the case another punch list will be generated and need to be completed by the contractor and so on.

9.1.4 **Year three enrichment planting**

To develop a pre-human habitat within the riparian corridor planting at Duck Creek a planting of successional species has been staged to occur at year three (3). The enrichment plantings are to be strategically located within the initial plantings, defined by a planting plan which is to be created. It is not expected that there will be any need plant growth to thin or remove any other species to establish this planting when this will take place.

9.1.5 **Final inspection and completion**

A final inspection of the staged landscape works will be made at the conclusion of the thirty six (36) month maintenance period and after planting of the year three (3) enrichment planting. If the planting areas are deemed deficient in any way or any other portion of the project shows signs of poor maintenance then the maintenance period for that area will continue until such items are remedied to the satisfaction of the owner's representative. If the work is deemed satisfactory the landscape contractor will be issued a letter of final completion and released from his/her obligation to maintain the project (see appendix G for an example of a letter of final completion)..

9.1.6 **Maintenance and enrichment planting post the thirty six (36) month establishment period**

9.1.6.1 ***Maintenance***

It is aimed that after thirty six (36) months of intensive maintenance as describe above and the installation of the year three (3) enrichment planting that the staged plantings of the native riparian corridor of Duck Creek should be at a point where they are self-sustaining. Near canopy cover of the installed planting should have been reached at this point and the plant material should be of a suitable size as to not warrant continued weed control because it will be overtopping the existing weeds. Near canopy cover in this term of reference does not mean that full size adult plants will be in place but that the material planted will have grown sufficiently to cover the majority of the bare ground adjacent to it.

Therefore at this time these staged planting areas of the site are then to be turned over to the Porirua City Council for maintenance purposes.

It is then expected that a once yearly maintenance regime of the following undertaken by the Porirua City Council could then occur to sustain the sites:

- Replacement of any dead, damaged, missing or diseased plants or grass areas;
- Pruning and thinning of any plants necessary to maintain unobstructed walkways;
- Removal offsite of all dead, diseased or unwanted plant material;
- General removal of rubbish and cleaning of paved areas;
- All tree maintenance is to be in accordance with accepted arboriculture standards, practices and procedures and approved by an Arborist; and
- Inspection, cleaning, repair, replacement of any damaged, worn, unsafe or vandalized street furniture that has been installed within this area.

Additional

- The emptying of any litter bins and monitoring of the development for unsafe items such as damaged street furniture should occur on a weekly basis.
- There will be an agreement to be confirmed between Todd Property Whitby Development Ltd and Porirua City Council whereby Porirua City Council takes over maintenance and monitoring as required by Greater Wellington Regional Council consent conditions. This agreement will involve Porirua City Council keeping a record of all monitoring and maintenance undertaken over the previous year (approximately 1 June to 31 May) and submitting these details in a Planting Monitoring Report to the owner's representative and the Manager, Environmental Regulation, Wellington Regional Council every year from the commencement of planting until five years following the completion of the 5 year enrichment planting for each stage. The report shall be submitted by 15 July each year and shall include, but not be limited to, the following:
 - a) Plant success rates;
 - b) Details of the number of plants replaced, including species, location and date replaced;
 - c) Photos covering planted areas; and
 - d) Recommendation of any on-going maintenance.

REFERENCES

Establishment and performance of planting trials with indigenous woody shrub species in the Rotorua district; David Bergin; 2008.

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The Pedestrian Planning and Design Guide is New Zealand's comprehensive official guide to planning and design for walking. <http://www.nzta.govt.nz/resources/pedestrian-planning-guide/>

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Report Number W09157_006

Tonkin and Taylors Stream Ecological Valuation and Ecological Assessment. Report prepared for Jagger
NZ Limited;

Duck Creek North Erosion Sediment control plan,

Duck Creek Land, Whitby: Proposed Rooding Standards, Tim Kelly Transportation Planning Ltd

Comprehensive Development Proposal, The Duck Creek Land, Whitby, Porirua City, Cardno,

Brookside

APPENDIX

A

LANDSCAPE CONCEPT AND STREAM
SECTION ELEVATIONS

LANDSCAPE CONCEPT INTENT

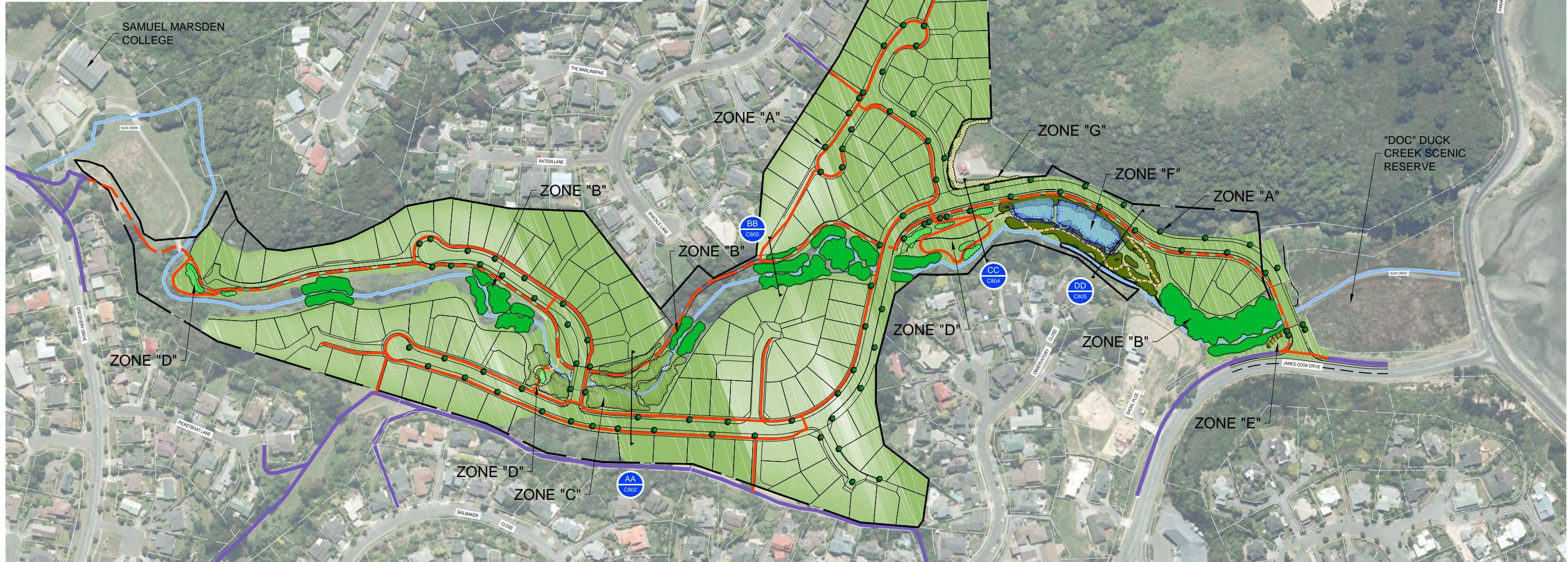
The intent of the landscape concept for "Brookside" is to develop a high quality residential subdivision that incorporates attractive tree lined streetscapes and a community walkway system that enables access to the majority of Duck Creek North. The entrance to Brookside subdivision will be defined by an attractive entry monument located to east of the first bridge which will include theme lighting. There will be an attractive park and a series of passive recreation facilities for the community located on the creek banks. A large portion of the creek will have generous amounts of native plantings that will develop sound ecological habitats for local wildlife.

Brookside Park will feature a large grass openspace, attractive planting, seating and an on-street parking area. Brookside will provide good connectivity from Discovery Drive to the Pauatahanui Inlet via a 2.6m wide pedestrian and cycleway access to the riparian esplanade reserve the length of Duck Creek. Linkages to the greater Whiti pedestrian walkway systems and reserves have also been included within the design. Passive recreation opportunities which include seating will be provided enabling the community to enjoy the creek at close quarters at key locations.

The majority of Duck Creek North will remain in its current natural form with the new realigned section of creek to provide fish passage and a series of diverse habitats along with an attractive riparian canopy of native trees which will provide shade and shelter along Duck Creek. This planting and other planting along the creeks length will help to create a habitat that is more conducive for aquatic and bird species to inhabit this area.

Low maintenance plant species which have fast growth rates that will aid in reducing soil erosion along the creek corridor will be chosen. A successional planting regime is to be undertaken over an approximately three (3) year period to establish the beginnings of a native forest canopy environment within the riparian esplanade reserve.

A vegetative buffer corridor area is proposed adjacent to the creek that will treat stormwater and reduce sediment and other elements from entering the creek system and the nationally significant and environmentally sensitive Pauatahanui Inlet. An informal walkway will be provided in this area to provide access to the creek.



FEATURE AND PLANTING ZONES

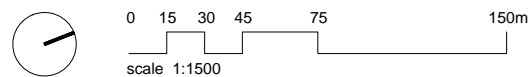
- A** Street tree planting which creates a strong unified community theme.
- B** Planting of native riparian species in esplanade reserve to create a forest canopy over the creek in its original location undertaken for ecological mitigation purposes (580 linear metres).
- C** Native riparian planting in riparian reserve to create forest canopy over the realigned creek undertaken for ecological mitigation purposes (169 linear metres).
- D** A mix of native plantings and openspace grassed areas for the proposed creek side park and passive recreation areas.
- E** Feature planting of Brookside Entry Monument adjacent to the first bridge with theme lighting.
- F** Native plantings of the vegetative treatment corridor that will help to improve the quality of water entering Duck Creek (composed of a forebay pond, dry pond and treatment field).
- G** Native screen/ buffer planting of the existing PCC pump station.

LEGEND

- FF** Elevation or Detail Area shown with twenty (20) years of planting growth. See Sheet Numbered
- LC-12** Area of plan view
- Location and direction of elevation view
- Proposed 2.6 metre wide pedestrian walkway/cycleway
- Proposed footpath
- Proposed informal pathway
- Existing footpath

NOTE

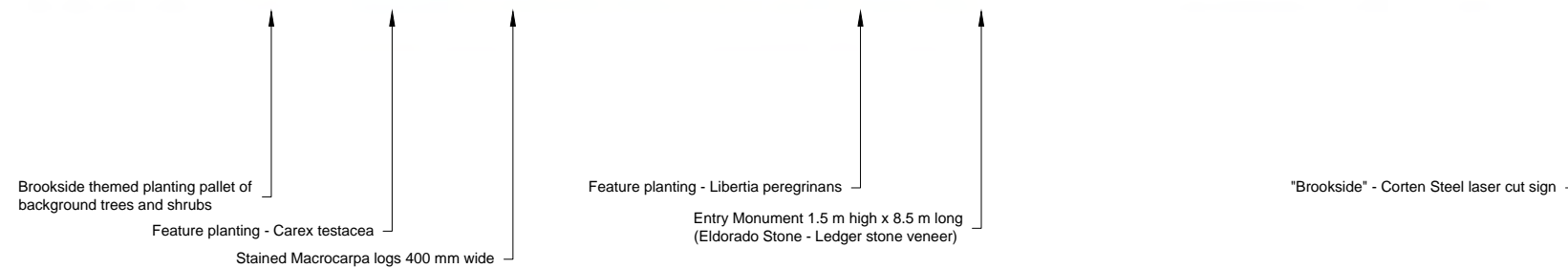
The total length of stream that is subject to restoration in the form of ecological mitigation planting is 749 linear metres which includes the diversion length of the stream.



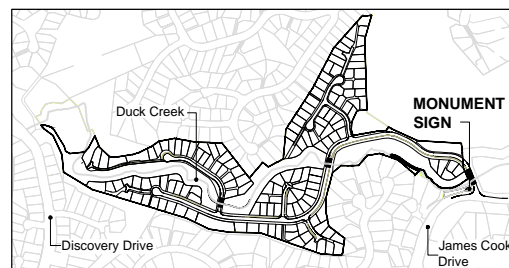
JAGGER NZ LTD | **BROOKSIDE** | LANDSCAPE CONCEPT

scale: 1:1500 @ A1 | date: 01-09-15 | drawing no: NZ0115065-PL-C800 | sheet: 1 of 6 | issue: 7
 p 64 4 478 0342 | e wgn@cardno.co.nz www.cardno.com | Level 5, IBM Building, 25 Victoria Street, Petone, Lower Hutt, New Zealand 5012

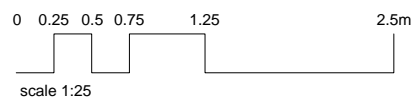




**BROOKSIDE ENTRY MONUMENT - SECTION ELEVATION
ROAD 1 & JAMES COOK DRIVE INTERSECTION**



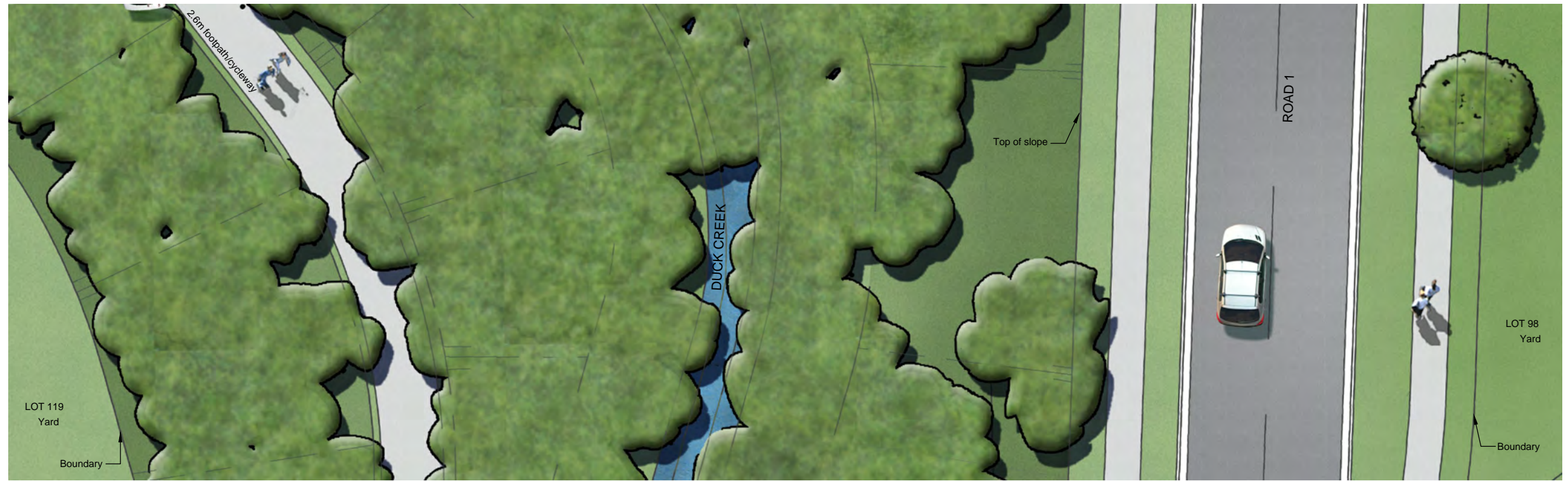
KEYMAP
NOT TO SCALE



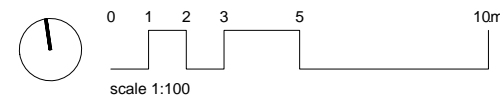
JAGGER NZ LTD | **BROOKSIDE** | ENTRY MONUMENT SIGNAGE CONCEPT

scale: 1:25@ A1 | date: 28-06-15 | drawing no: NZ0115065-PL-C801 | sheet: 2 of 6 | issue: 1
p 64 4 478 0342 | e wgn@cardno.co.nz www.cardno.com | Level 5, IBM Building, 25 Victoria Street, Petone, Lower Hutt, New Zealand 5012

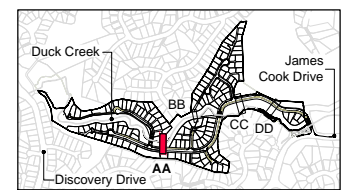




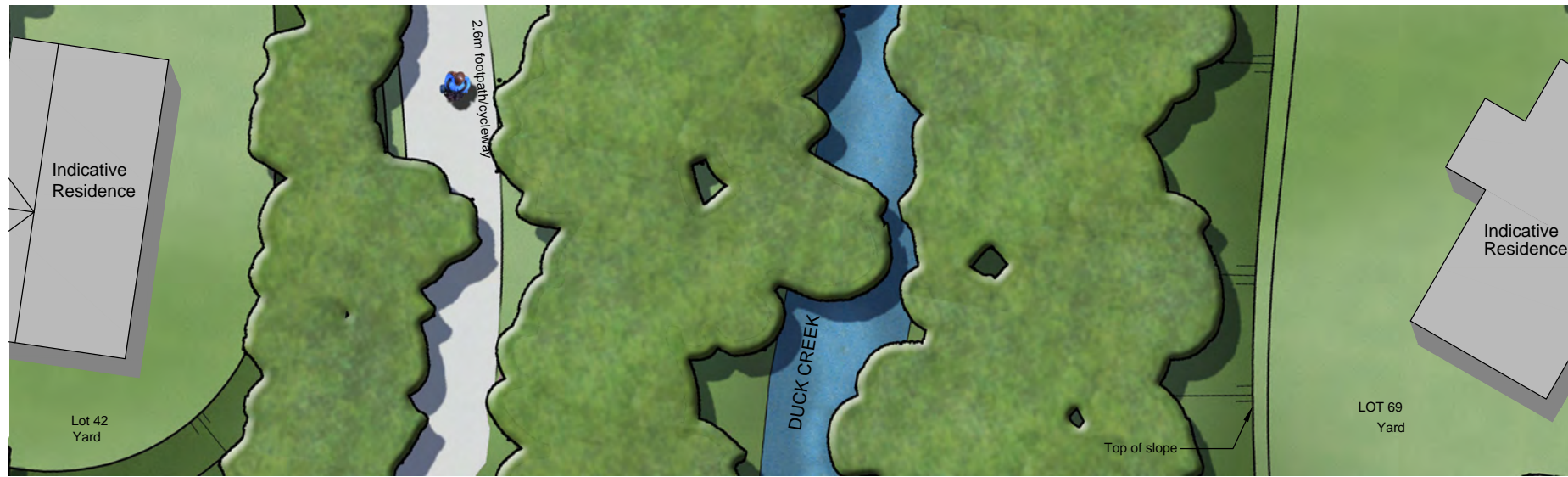
STREET, CREEK AND RESIDENTIAL LOT PLAN VIEW AA
ROAD 1



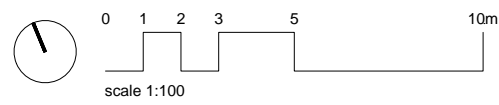
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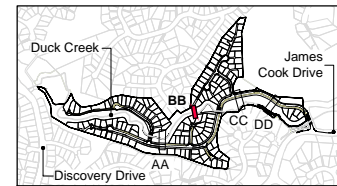
STREET, CREEK AND RESIDENTIAL LOT ELEVATION AA (showing twenty (20) years of plant growth)
ROAD 1



CREEK AND RESIDENTIAL LOTS PLAN VIEW BB
DUCK CREEK



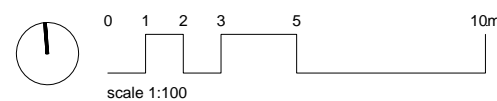
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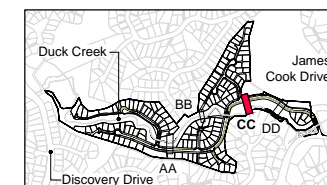
CREEK AND RESIDENTIAL LOTS ELEVATION BB (showing twenty (20) years of plant growth)
DUCK CREEK



STREET, BROOKSIDE PARK & CREEK PLAN VIEW CC
ROAD 1



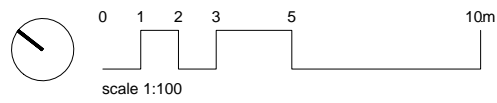
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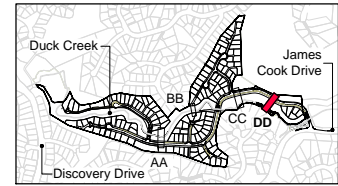
STREET, BROOKSIDE PARK & CREEK ELEVATION CC (showing twenty (20) years of plant growth)
ROAD 1



STREET, VEGETATIVE BUFFER CORRIDOR & CREEK PLAN VIEW DD
ROAD 1



KEYMAP
NOT TO SCALE



STREET, VEGETATIVE BUFFER CORRIDOR & CREEK ELEVATION DD (showing twenty (20) years of plant growth)
ROAD 1

Brookside

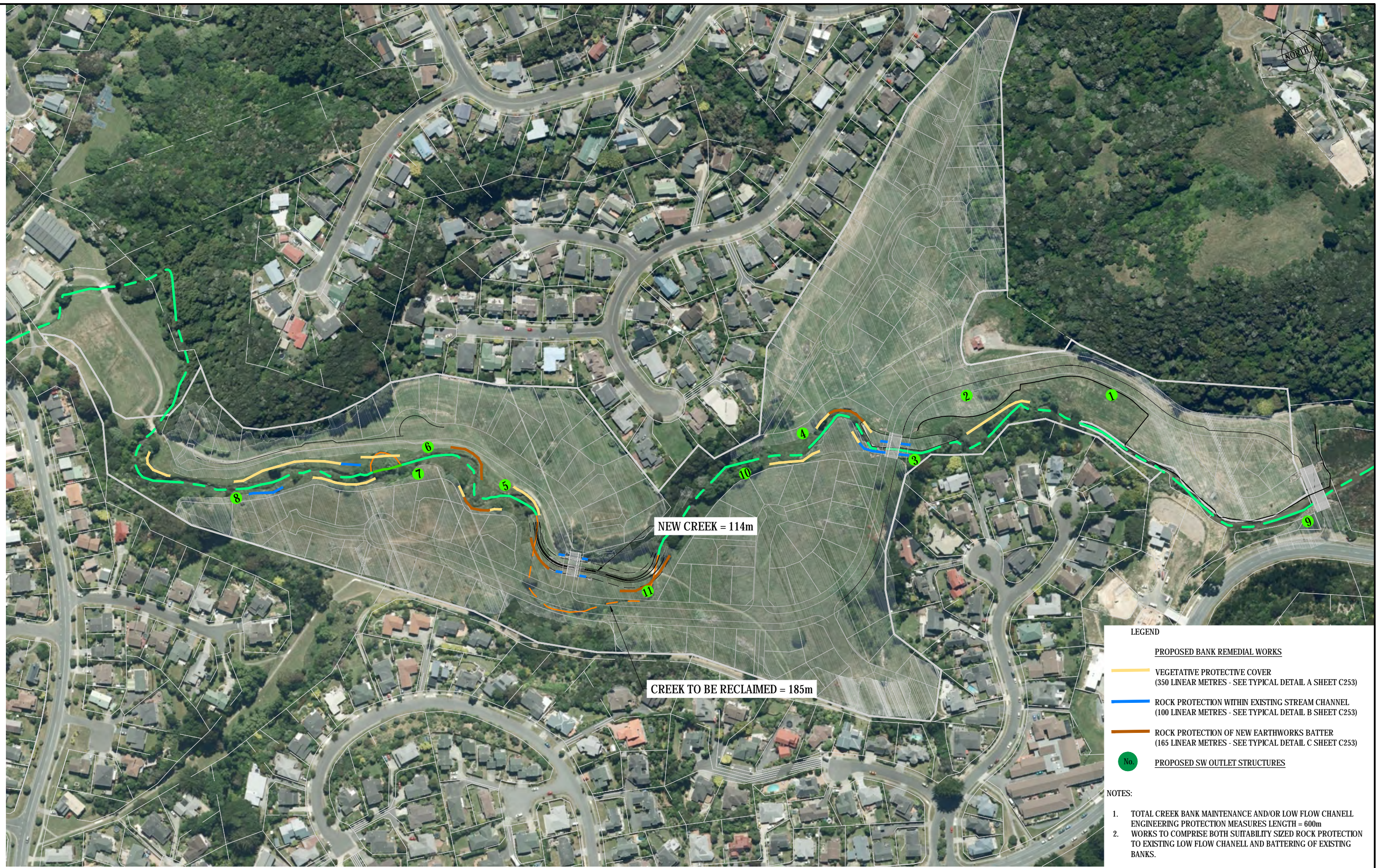
APPENDIX

B

CARDNO CIVIL DRAWINGS

DATE PLOTTED: 1 September 2015 3:29 p.m. BY: MAY MACINTYRE

XREFS: NZ0115065-X-BDY_ABRUTS; NZ0115065-X-BDY_INTRNL; NZ0115065-X-SERVICES; EX: NZ0115065-X-CONT_EX; NZ0115065-X-PR-STRINGS-01; NZ0115065-X-PR-EW_DEPTHS-01; NZ0115065-X-PR-EW_CUTFILL-01
 CAD FILE: EX: 2015\NZ0115065\CAD\NZ0115065-PL-C250-CREEK-01.dwg



NEW CREEK = 114m

CREEK TO BE RECLAIMED = 185m

- LEGEND**
- PROPOSED BANK REMEDIAL WORKS**
- VEGETATIVE PROTECTIVE COVER
(350 LINEAR METRES - SEE TYPICAL DETAIL A SHEET C253)
 - ROCK PROTECTION WITHIN EXISTING STREAM CHANNEL
(100 LINEAR METRES - SEE TYPICAL DETAIL B SHEET C253)
 - ROCK PROTECTION OF NEW EARTHWORKS BATTER
(165 LINEAR METRES - SEE TYPICAL DETAIL C SHEET C253)
 - PROPOSED SW OUTLET STRUCTURES

- NOTES:**
1. TOTAL CREEK BANK MAINTENANCE AND/OR LOW FLOW CHANNEL ENGINEERING PROTECTION MEASURES LENGTH = 600m
 2. WORKS TO COMPRISE BOTH SUITABILITY SIZED ROCK PROTECTION TO EXISTING LOW FLOW CHANNEL AND BATTERING OF EXISTING BANKS.

Rev.	Date	Description	Des.	Verif.	Appd.
2	25/08/2015	PCC SECTION 92 REQUEST			DRM
1	3/07/2015	FOR CONSENT APPLICATION			DRM

BROOKSIDE

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Cardno (NZ) Limited
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 Tel: 04 478 0342
 Web: www.cardno.co.nz

Drawn	Date	Client
DRM	22/06/2015	JAGGER NZ LTD
Checked	Date	Project
BB	3/07/2015	BROOKSIDE (DUCK CREEK NORTH)
Designed	Date	Whitby
DRM	22/06/2015	PORIRUA
Verified	Date	Title
BB	3/07/2015	CREEK WORKS & STRUCTURES PROPOSED DIVERSION AND BANK REMEDIAL WORKS
Approved	Date	
DRM	3/07/2015	

Datum	Council Ref	Scale	Size
Wgn2000		NTS	A1
Drawing Number	Revision		
NZ0115065-PL-C251	2		

Status: **FOR APPROVAL**
 NOT TO BE USED FOR CONSTRUCTION PURPOSES

XREFS: NZ0115065-X-BDY_ABRUTS; NZ0115065-X-BDY_INTRNL; NZ0115065-X-BDY_INTRNL; NZ0115065-X-CONT_EX; NZ0115065-X-CONT_EX; NZ0115065-X-PR_EW_DEPTHS-01; NZ0115065-X-PR_EW_CUTFILL-01
 CAD FILE: NZ0115065-X-PR_EW_DEPTHS-01; NZ0115065-X-PR_EW_CUTFILL-01; NZ0115065-X-PR_EW_DEPTHS-01; NZ0115065-X-PR_EW_CUTFILL-01; NZ0115065-X-PR_EW_DEPTHS-01; NZ0115065-X-PR_EW_CUTFILL-01



- CREEK DIVERSION METHODOLOGY**
- PRE-DIVERSION**
1. INSTALL APPLICABLE WATER DIVERSION BUNDS AND SILT CONTROL FENCES.
 2. CONSTRUCT NEW CREEK HIGH FLOW CHANELL
 3. INSPECTION BY ENGINEER AND ECOLOGIST
 4. SETOUT AND CONSTRUCT LOW FLOW MEANDER
 5. CONFIRM RIFFLE / RUN / POLL LOCATIONS
 6. CONSTRUCT LOW FLOW CREEK
 7. INSPECTIONS BY ENGINEER AND ECOLOGIST DURING CONSTRUCTION
 8. CREEK ASBUILTS
 9. STABILISATION (FLEX-TERRA AND APPLICABLE MATTING)
 10. ECOLOGIST ADVISORY NOTICE TO GWRC CONFIRMING SUITABILITY FOR FISH PASSAGE
- DIVERSION**
11. REMOVE DOWNSTREAM COFFER DAM REMAINING
 12. DIVERT CREEK INTO NEW ALIGNMENT
 13. FISH CAPTURE AND REPORTING OF OLD ALIGNMENT (BY OTHERS)
 14. TRANSFER OF EXISTING CREEK GRAVELS FROM EXISTING CHANNEL TO NEW CREEK BED AT DIRECTION OF ECOLOGIST
- POST DIVERSION**
15. ASSOCIATED INSPECTIONS AND POST DIVERSION REPORTING TO GWRC
 16. ONGOING CONSENTING REQUIREMENT WITH RESPECT TO DIVERSION

NOTES:

1. TOTAL CREEK BANK MAINTENANCE LENGTH = 530m

Rev.	Date	Description	Des.	Verif.	Appd.
1	22/06/2015	FOR INITIAL COUNCIL REVIEW	DRM	DRM	DRM

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Drawn	DRM	Date	22/06/2015
Checked		Date	
Designed	DRM	Date	22/06/2015
Verified		Date	
Approved	FDEE	Date	

Client	JAGGER NZ LTD
Project	BROOKSIDE (DUCK CREEK NORTH)
Whitby	PORIRUA
Title	CREEK WORKS & STRUCTURES PROPOSED DIVERSION AND BANK REMEDIAL WORKS

Status	PRELIMINARY			
NOT TO BE USED FOR CONSTRUCTION PURPOSES				
Datum	Wgn2000	Council Ref	Scale	1:250
Size				A1
Drawing Number	NZ0115065-PL-C252			Revision
				1