NEW ZEALAND TRANSPORT AGENCY

CHRISTCHURCH SOUTHERN MOTORWAY

Stormwater Management System

Comparison with Proposed NZTA Stormwater Treatment Standard Requirements

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Executive Summary

Had the proposed NZTA Stormwater Treatment Standard been adopted for the Christchurch Southern Motorway project, it is unlikely that the specimen design solution would have changed. This is due to the fact that the stormwater management requirements under the proposed standard are generally the same as those set by the Christchurch City Council and Environment Canterbury. Because regional requirements must be met in order to satisfy resource consent conditions etc. the stormwater system must be designed to the more onerous criteria.

The main difference between the stormwater management system that would be required under the proposed NZTA Standard and the specimen design system is the additional requirement for peak flow control up to the 1% AEP event in cases where there are known flooding issues downstream. A summary of the effect of the proposed standard on the scope, time and cost of the project is given below;

Scope

Most objectives remain unchanged under the proposed NZTA Standard, with the exception of the peak flow control event volume which increases from the 2% AEP event under the existing design to the 1% AEP event with the requirement to reduce post development peak flows to 80% of pre-development peak flow rates under the proposed standard;

Cost

The change in the scope of the required detention/attenuation elements of the stormwater system under the proposed standard would have an impact on the overall cost of the system. This cost would primarily relate to the physical works required due to the increased device volumes/sizes. However as the project has currently only been taken to a specimen design stage it is difficult to quantify the true effect the proposed NZAT Standard would have on the overall cost of the project;

Time

The increase in attenuation/peak flow control volume discussed above would be expected to have little if any effect on the timing of the project. As the detailed design, construction and installation of the designed management systems is likely to occur concurrently with the other design elements of the project, increasing the volumes/sizes of the stormwater management devices is unlikely to change the duration of the overall project.

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Cover: Halswell Junction Road – Looking West from Springs Road Interchange

1 Introduction

Opus has been commissioned by Transit New Zealand (now New Zealand Transport Agency - NZTA) to provide a comparison between the existing design and consenting information for the stormwater system adopted for the Christchurch Southern Motorway project and the anticipated requirements under the draft NZTA Stormwater Treatment for Road Infrastructure document (from hereon referred to as the "proposed NZTA Standard").

The CSM project is being procured on a design and construct basis and the following information is based on the Specimen Design developed for the project in support of resource consents. Resource consents have not yet been secured and hence aspects of the stormwater solution could be varied by the outcome of the statutory processes.

This report is part of the Final Stormwater Management Standard and Valuation Review undertaken by NZTA

2 Environmental Factors

2.1 Description of Catchments

Under the existing design, the route of the CSM has been divided into catchments based on local topography and proposed discharge locations (refer **Appendix A** for Site Location Plan).. ***The proposed NZTA Standard would have no impact on the designation or nature of the selected subcatchments.*** The CSM catchment area comprises of both the new impervious areas area as well as the pervious corridor limit. These areas are presented in Table 1 below. Also see **Appendix B** Stormwater Management Concept Drawings.

Table 1: Subcatchment Area Summary

Catchment Practice	Location	Catchment Description	Catchment Area
HJR Basin	Ch2300	• Halswell Junction Road (Ch0000 – Ch2400) Total CCC Catchment	• A imp = 385,000 • A perv = 315,000 • Aimp new ~ 1.25ha
Mushroom Device	Ch2900	• Mainline (Ch2500 – Ch3100) including Springs Road intersection.	• A imp = 18,200 • A perv = 16,400
Lee Device	Ch3350	• Mainline (Ch3100 – Ch3550).	• A imp = 11,250 • A perv = 9,900

Catchment Practice	Location	Catchment Description	Catchment Area
Carrs Device	Ch4200	• Mainline (Ch3550 – Ch4160).	• A imp = 15,250 • A perv = 13,420
Carrs Attenuation Swales	Ch4160	• Mainline (Ch4160 – Ch4500)	• A imp = 8,500 • A perv = 7,480
Kirkwood South Device	Ch4950	• Mainline (Ch4500 – Ch5200) including Awatea Rd over bridge	• A imp = 23,425 • A perv = 38,169
Upper Heathcote Attenuation Swales	Ch5260	• Mainline (Ch5200 – Ch5600)	• A imp = 10,000 • A perv = 8,800
Musgroves Device	Ch5950	• Mainline (Ch5600 – Ch5980) including Nash Rd over bridge	• A imp = 14,675 • A perv = 20,941
Dry Stream Attenuation Swales	Ch 5980	• Mainline (Ch5980 – Ch6150)	• A imp = 4,250 • A perv = 3,740
Wigram East Attenuation Swales	Ch 6480 & Ch 6790	• Mainline (Ch6150 – Ch7300)	• A imp = 28,750 • A perv = 25,300
Curletts Device	Ch7700	• Mainline (Ch7300 – Ch7970) including contributing area from Curletts Road	• A imp = 24,520 • A perv = 22,490
Duplication AS(i)	Ch7950	• Mainline (Ch7950 – Ch8900)	• A imp = 15,625 • A perv = 21,800
Duplication AS(ii) & AS(iii)	Ch9280	• Mainline (Ch9000 – Ch9365)	• A imp = 5,813 • A perv = 10,220
Attenuation Swale AS(iv)	Ch9440	• Mainline (Ch9365 – Ch9430)	• A imp = 813 • A perv = 1,820
Attenuation Swale AS(v)	Ch9860	• Mainline (Ch9430 – Ch9710)	• A imp = 5,390 • A perv = 5,060
Attenuation Swales AS(vi) and AS(viii)	Ch9960 N	• Mainline (Ch9600 – Ch9900)N • Mainline (Ch9900 – Partial)N	• A imp = 8,500 • A perv = 7,725
Attenuation Swales AS(viii) Partial	Ch10150	• Mainline (Partial)N	• See AS(vi) and AS(viii) above
Attenuation Swales AS(vii) and AS(ix)	Ch9960 S	• Mainline (Ch9600 – Ch10330)S	• A imp = 14,395 • A perv = 12,330

The catchment area selection criteria used in the proposed NZTA Standard (Section 5.2.3) is similar to that given in the CCC Waterways, Wetlands and Drainage Guide and ***ARC publication TP10 to which the specimen design is based on. Therefore, each of the stormwater management devices chosen in the proposed system are still deemed to be appropriate under of the proposed NZTA Standard.***

In addition to the CSM corridor area, provision within the specimen design was made to convey flows from the upper catchment areas through the alignment. The catchment areas draining to each of the proposed mainline culverts are presented in Table 2 below. Also see **Appendix C** Stormwater Management - Catchment Areas.

Table 2: Upper Catchment Area Summary

Name	CSM Chainage	Area (Ha)	Design Discharge (Q - m3/s)	
Mushroom/Owaka Culvert	2940	27	1.76	3.95
Lee Basin Culvert	3350	1.1	0.13	0.25
Carrs West Culvert	4000	7.5	0.19	0.55
Carrs East Culvert	4160	88	3.10	6.47
Kirkwood Basin Culvert	4930	4	0.40	0.71
Upper Heathcote River - Bridge	5260		8.5*	13.5*
Musgroves Basin Culvert	5890	2.3	0.22	0.41
Dry Stream Culvert	5975	17.5	0.59	1.28
Haytons Drain Culvert	6480	1230	12.65*	19.75*
East Wigram East Culvert	6790	20	1.87	4.16
Curletts North Culvert System	7320	-	-	-
-Culvert A		~270*	7.67*	12.51*
-Culvert B			3.84	6.26
-Culvert C			3.84	6.26
Curletts Drain Culvert	7780	~270*	7.67*	12.51*

* Information supplied/verified by CCC Stormwater Engineers

2.1.1 Terrain

The Christchurch Southern Motorway project essentially comprises 10.5 km of proposed carriageway through varying land uses including pasture, residential, commercial and industrial. ***There is no difference, based on this parameter, between the management practices selected in the specimen design and those which would be selected under the proposed NZTA Standard.***

2.1.2 Area

The Christchurch Southern Motorway project essentially comprises the:

Upgrade Section: This section of the CSM extends approximately 2.5km from the Halswell Junction Road Springs Road intersection along Halswell Junction Road to Main South Road at the western limit.

Greenfield (New) Section: This section of the CSM is currently Greenfield. The proposal will extend approximately 5km west from Curletts Road, south of Wigram Aerodrome until it connects into Halswell Junction Road at its junction with Springs Road.

Duplication Section: This section of the CSM is approximately 3 km in length with its start located about 3 km south west of the city centre at the intersection with Barrington Street. The western end of this section terminates at Curletts Road.

A summary of the catchment areas within each section is given in table 1 above.

2.1.3 Topography

The route is located on the relatively flat alluvial flood plain of the Waimakariri River. The only significant river which crosses the route is the upper reach of the Heathcote River and this is incised by up to 3 m into the river plains. Other more minor streams and water courses include Haytons Stream and a small tributary of the Heathcote River. ***Section 5.2.2 of the Draft NZTA Standard describes how topography and slope influence the selection of stormwater management devices. When compared to the proposed NZTA Standard, the specimen design solution would not be altered because of this parameter.***

2.1.4 Drainage Features

The proposed CSM alignment traverses, or runs parallel to, a number of drainage features. A summary of these features follows:

Curletts Road Stream - runs parallel to the north side of the existing motorway and is piped across the motorway. It receives stormwater from a large industrial and commercial area with little or no existing stormwater treatment.

Haytons Stream - is a modified system with the section upstream of Wigram Road sized to accommodate large runoff from the catchment. Downstream of Wigram Road to Wigram Retention Basin the stream is more naturalised with extensive riparian planting.

Halswell Retention Basin - was constructed in 1992 by CCC to receive stormwater from the surrounding industrial and business area.

There are a number of dry remnant channels within the project area as follows:

Upper Jacksons Creek – flow varies greatly on a daily and weekly basis due to the Lane Walker Rudkin cooling water discharge.

Dry Stream – is down stream of the small pond at Musgroves. It feeds into the Heathcote River.

Upper Heathcote River – stormwater currently discharges into the Heathcote River from new subdivisions but there is no permanent flow until approximately 1.9km downstream.

Upper Knights Stream – in the vicinity of the CSM the stream is permanently dry. Periodic flow does not occur until approximately 2.3km downstream of Halswell Junction Road.

Section 3 of the of the proposed NZTA Standard outlines the potential issues associated with various receiving environments. However, it does not link the parameter to the selection of stormwater management devices.

2.1.5 Geotechnical Limitations and Opportunities

The groundwater regime in the area of the CSM comprises a series of predominantly unconfined aquifers in gravel layers which become confined by overlying and inter-layered fine sediments near the coast.

Groundwater levels decrease from about RL 15m (about 5m below ground level) at the Halswell Road Springs Road Intersection to about RL 10m (about 1.5m below ground level) at Barrington Street. The groundwater contours indicate groundwater flows are towards the southeast.

Limitations

Where the Christchurch Southern Motorway passes through historic landfill sites there is potential for the contaminants to be released from the landfill material and be transported to the aquifer. Disposal to ground is not possible over historic landfill sites.

Opportunities

Where the ground water is low there is an opportunity to utilise infiltration to ground. The design soakage rates for the Basins in areas of low ground water are presented in Table 2 below. The soakage rates are 1 dimensional with a safety factor of 3.

The proposed NZTA Standard would not have altered the selection of the stormwater treatment systems proposed for the CSM due to this parameter.

2.1.6 Soils

In the duplication section of the motorway, silt and sand alluvium up to 22 m thick and intermediate gravel layer of up to 6 m thick overlie the Riccarton Gravel formation. Ground water levels are between 1 m and 3 m depth below ground level.

In the extension section of the motorway, a surface layer of fine alluvium of up to 6 m thick was encountered which predominantly comprises silt, but with some thin layers of sand. This is underlain by gravel, with thin layers of silt and sand. Groundwater is indicated to be 3 m to 5 m below the ground surface.

The Proposed Natural Resources Regional Plan (Environment Canterbury (ECan), July 2007 – Variation 6), describes the motorway corridor as generally being characterised by the absence of an adequate surface confining layer and the absence of upwards groundwater pressure, i.e. underlain by an unconfined aquifer.

Because of the unconfined nature of the underlying aquifer the Christchurch Southern Motorway has the potential to have an adverse effect on the aquifer through transport of contaminates. The proposed treatment has been designed to provide the best practicable treatment method to protect the aquifer.

The proposed NZTA Standard would not have altered the selection of the stormwater treatment systems proposed for the CSM due to this parameter.

It is noted that due to the relatively fine draining soils in Canterbury, dry stormwater basins are commonly used as the preferred stormwater treatment systems. There is little design guidance given in the proposed standard on the design of dry basins.

2.1.7 Erosion Potential

Due to the site's flat topography and well draining soils, the risk of erosion from raindrop impact, sheet flows or concentrated water flows over most of the project length is relatively low. However, wind erosion is likely and dust control will be important. ***This parameter is not covered in the proposed NZTA Standard (i.e. there is no specific coverage of temporary stormwater management – E&S control).***

In terms of channel erosion potential the specimen design meets the proposed NZTA Standard due to the fact that the NZTA standard does not require extended detention when catchment slopes are slight and flow velocities are low. Furthermore, 'volume control' through infiltration practices will minimise any erosive flows (also refer to table 3).

2.1.8 Flooding

Owing to the particularly flat topography along the route and associated catchment area, the risk and consequence of flooding is relatively low (i.e. any surface flooding is generally shallow and low velocity). Localised flooding generally only occurs when the primary drainage/waterway systems are overwhelmed because storm peak flows exceed the capacity of the drainage systems. ***It is considered that the mainline culverts discussed in section 1.2 of this report will mitigate the risk of upstream flooding issues due to the motorway alignment .***

2.1.9 Design Storm Event

Water quality and quantity design rainfall events are shown in Table 3 below for both the specimen solution and NZTA standard.

Table 3: Design Rainfall Events

Objective	Design Rainfall Depth (Existing Design – Regional Guidelines)	Design Rainfall Depth (under proposed NZTA standard)
Water Quality	• First 25mm of rainfall	• 90th percentile rainfall depth = 15mm **(less than regional requirements)**
Channel Erosion Reduction	• No specific design criteria proposed within specimen design due to very flat catchments and low velocities within waterways. • However, infiltration devices by nature will provide 'runoff volume control'.	• The considerations under the proposed NZTA standard are inline with those of the existing design considerations as, under Section 6.2.3 of the NZTA standard, extended detentionis not required when catchment slopes are slight and flow velocities are low
Water Quantity Control (flow attenuation)	• Hydrologic neutrality for up to the 2% AEP critical duration storm.	• 50% and 10% AEP 24hr rainfall event (50mm and 75mm) peak flow rate to match pre-development rate. Down stream flooding risks require additional attenuation of the 1% AEP event to limit peak post development flow rates to 80% of pre-developed flow rates. **(Exceeds regional requirements)**

2.1.10 Vehicle Kilometres Travelled at Time of Opening

Table 4 below presents projected vehicle kilometres travelled for the year 2013 when the CSM is planned to be opened.

Table 4: Vehicle Kilometres per Day (2013)

Section	Average Daily Traffic (AADT) - vpd	Length of section	Vehicle kilometres per day
Upgrade	12,400	2.5km	31,000
Greenfield	21,600	5km	108,000
Duplication	41,000	3km	123,000
Total			**262,000**

The proposed NZTA Standard does not link this parameter to the selection of the stormwater management system. Therefore, the proposed NZTA Standard would not have altered the selection of the stormwater treatment systems proposed for the CSM due to this parameter.

2.1.11 Discharge Points

Primary Outfall Locations

A summary of proposed permanent discharges, including unique identifier, location, type of discharge, and identification of the receiving environment is shown in Table 5 below.

Table 5: Discharge Locations

ID	Location (approx)	Coordinate (approx)	Discharge Type	Receiving Environment	Discharge Source/Catchment
DP1	Ch 2180	383826, 803430	• CCC reticulation	• Upper Knights Stream • Halswell River	• HJR Basin
DG1	Ch 2920	384355, 802899	• Ground	• Upper Knights Stream • Halswell River	• Mushroom Device
DP2i	Ch 3050	384457, 802803	• Surface Controlled discharge to CCC reticulation	• Upper Knights Stream • Halswell River	• Mushroom Device
DP2ii	Ch 3020	384563, 802688	• Future proposed Surface Controlled discharge to CCC reticulation	• Upper Knights Stream • Halswell River	• Mushroom Device • Lee Device
DG2	CH 3390	384848, 802864	• Ground	• Upper Knights Stream • Halswell River	• Lee Device

ID	Location (approx)	Coordinate (approx)	Discharge Type	Receiving Environment	Discharge Source/Catchment
DS1	Ch 4150	385603, 802814	• Surface Controlled discharge	• Nottingham Stream Headwaters • Halswell River	• Mainline
DG3	Ch 4230	385696, 802951	• Ground	• Nottingham Stream Headwaters • Halswell River	• Carrs Device
DS2	Ch 5260	386638, 803221	• Surface Controlled discharge	• Upper Heathcote River • Heathcote River	Kirkwood South Device (and attenuation bunds east)
DG4	Ch 5990	387200, 803722	• Ground	• Dry Stream • Heathcote River	Musgroves Device
DS3	Ch 5980	387150, 803737	• Surface Controlled discharge	• Dry Stream • Heathcote River	Dry Stream Culvert
DS4	Ch 6010	387218, 803735	• Surface Controlled discharge	• Dry Stream • Heathcote River	Musgroves Device
DS5	Ch 6360	387218, 803735	• Surface Controlled discharge	• Hayton Drain Tributary • Wigram East Basin • Heathcote River	A&P Subway
DS6	Ch 6480	387385, 804171	• Surface Controlled discharge	• Hayton Drain • Wigram East Basin • Heathcote River	Haytons Drain Culvert
DS7	Ch 6790	387599, 804377	• Surface Controlled discharge	• Hayton Drain Tributary • Wigram East Basin • Heathcote River	East Wigram East Culvert
DS8	Ch 7240	387963, 804634	• Surface Controlled discharge	• Curletts Road Drain Tributary • Heathcote River	Curletts West Culvert
DS9	Ch 7800	388456, 804839	• Surface Controlled discharge	• Curletts Drain • Heathcote River	Curletts East Culvert: Curletts Basin, and Attenuation Swale AS(i)
DP3	Ch 9290	389898, 804725	• CCC reticulation	• Cardigan Place network of Upper Wilderness Drain • Heathcote River	Attenuation Swales AS(ii) & AS(iii)

ID	Location (approx)	Coordinate (approx)	Discharge Type	Receiving Environment	Discharge Source/Catchment
DP4	Ch 9440	390043, 804693	• CCC reticulation	• Lincoln Road network of Upper Wilderness Drain • Heathcote River	Attenuation Swale AS(iv)
DP5	Ch 9860	390483, 804650	• CCC reticulation	• Edinburgh St - Upper Wilderness Drain • Heathcote River	Attenuation Swale AS(v)
DP6	Ch9960 (north)	390564, 804736	• CCC reticulation	• Barrington St Network of Upper Wilderness Drain • Heathcote River	Attenuation Swales AS(vi) and AS(viii)
DP7	Ch9960 (south)	390560, 804674	• CCC reticulation	• Barrington St Network of Upper Wilderness Drain • Heathcote River	Attenuation Swales AS(vii) and AS(ix)
DP8	Ch10140 (North)	390747, 804782	• CCC reticulation	• Jacksons Creek • Heathcote River	Attenuation Swale AS(viii) - Partial

Ultimate Outfall Locations

The ultimate discharge points are the Heathcote and Halswell River.

The proposed NZTA Standard would not have altered the approach/objectives relating to the type of discharge point (i.e. stream) for the CSM due to this parameter. The priority objectives outlined in the proposed standard for stream discharges in Section 3.1, 6.2 and 7.1.6 are generally consistent with regional guidelines.

2.1.12 Catchment Classification

(Refer to the Transit document: NSHS-2007)

The majority of project catchment can be classified as **peri-urban**, according to the SHS-2007 document.

This is where the adjacent properties have various land uses such as commercial, industrial low/medium density residential subdivisions and pasture land.

The exception to this is the upgrade section of Halswell Junction Road where the speed limit will be reduced to 60kph through an existing commercial/Industrial area.

The proposed NZTA Standard does not contain any reference to this parameter.

2.2 Sensitivity of Receiving Environment

This section is referred to the Transit Document, 2007: "Identifying Sensitive Receiving Environments at Risk from Road Runoff, Land Transport New Zealand Research Report 315". ***There is no direct reference within the proposed NZTA Standard with respect to rating the sensitivity of the receiving environment. However, Section 3 and 7.1.6 of the proposed NZTA Standard give some guidance as to the impact stormwater can have on various receiving environments.***

The proposed NZTA Standard would not have altered the selection of the stormwater treatment systems proposed for the CSM due to this parameter.

2.2.1 Schematic of SRE Rating Framework

The proposed method is based on a hierarchical system whereby the receiving environment (RE) is sequentially classified according to three attributes:

- Physical 'type sensitivity' (depositional vs. dispersive),
- Ecological values,
- Human use values (including cultural values).

Within each of the above attributes, the receiving environments are classified as being of 'high' (H), 'medium' (M), or 'low' (L) sensitivity and assigned a numerical score accordingly.

The overall sensitivity rating for each receiving environment is calculated by adding the scores for the type sensitivity, ecological value and human use value. The sensitivity rating is grouped under three broad categories, based on the total score, with high ratings indicative of high sensitivity, as follows:

- High sensitivity (high potential risk from road runoff): Total score >40
- Medium sensitivity (moderate potential risk from runoff): Total score 20-40
- Low sensitivity (low potential risk from road runoff): Total score <20

2.2.2 Sensitivity of Receiving Environment

Specific ecological surveys have been undertaken for the route alignment including identifying avian, terrestrial and freshwater ecological values, and human use values, etc, which supports the sensitivity classification presented in Table 6 below.

Table 6: Overall sensitivity rating (Summary)

Attributes	Sensitivity	Score
Sensitivity	High	30
Ecological Value	Low	5
Human Use Value	Low	2
Overall Sensitivity Rating (Sum)	**Medium**	**37**

Based on the scores found for each attributes the receiving environment along the CSM has a **medium overall sensitivity rating**.

Since the proposed NZTA Standard provided no guidance to assessing the sensitivity of the receiving environment, the overall sensitivity rating on the CSM project would not change if the proposed standard were adopted.

3 Designed Solutions

This section provides a brief description of:

- The design philosophy,
- The stormwater management devices method used for the design, positioning and construction,
- Cost and time.

3.1 Design Philosophy

3.1.1 Objectives

Assumptions

Opus objectives for developing the stormwater design were:

In general, the philosophy and objectives for Stormwater Management can be broken down into **short-term** (associated with the construction and earthworks activities) and **long-term** (permanent stormwater management solution) objectives, as follows:

Short-Term Stormwater Management

No guidance on short-term stormwater management (erosion and sediment control) objectives has been provided in the proposed NZTA Standard. Consequently all short-term stormwater management objectives for the CSM project under the proposed standard would be as per the existing design - i.e. would need to comply with regional guidelines (Environment Canterbury, 2007. *Erosion and sediment control guidelines for the Canterbury region*).

The principal short-term effect of the CSM proposal will be on water quality, arising from runoff during construction. During the works, there will be two main concerns:

(a) Erosion and Sediment Control to ensure that the discharge of sediment downstream, both from earthworks sites and road construction is minimised.

(b) Dust control, which will be principally by water sprinkling.

Proposed earthworks activities will be managed such that proposed E&SC measures will best practicably minimise erosion, sedimentation and dust generation. Four fundamental principles generally apply to the short-term stormwater management philosophy:

- Control run on water;
- Separate ‘clean’ water from ‘dirty’ water;
- Protect the land surface from erosion;
- Minimise sediment leaving the site.

An Erosion and Sediment Control (E&SC) Plan will be required in accordance with the Environment Canterbury, 2007. *Erosion and sediment control guidelines for the Canterbury region*. Report No. R06/23, Canterbury Regional Council.

As part of their Environmental Management Plan, the Contractor will prepare and obtain approval for the E&SC Plan for the construction phase of this project.

Long-Term Stormwater Management

Long-term stormwater management relates to the ‘day to day’ management of the quantity and quality of stormwater discharge. Effective carriageway drainage is essential for traffic safety and levels of service, as well as pavement durability.

In addition to these functions, the management of stormwater must also address quantity effects to control erosion and flooding, and quality effects as runoff is one of the principal mechanisms for transfer of road/traffic generated contaminants to the environment.

The high level philosophy and objectives for managing stormwater run-off have been developed to ensure relevant statutory duties and strategic priorities are achieved for permanent stormwater management including:

- Legislative and Environmental compliance (eg LTMA objectives for an integrated, safe, responsive and sustainable, roadway, and the Transit EMP objectives) ***No change expected if the proposed NZTA standard was adopted.***
- Provision of effective drainage; ***No change expected if the proposed NZTA standard was adopted. Note the proposed NZTA standard does not provide engineering standards for the collection and conveyance network.***
- Achieve hydrologic neutrality (i.e. pre-development discharges to mimic post-development discharges) ***Water Quantity requirements under the proposed NZTA Standard are less stringent than regional requirements, therefore regional requirements must be met (refer section 6.3.3 of the proposed standard)***;
- Achieve hydrologic connectivity (i.e. maintain groundwater levels, and flow regimes); ***No change expected if the proposed NZTA standard was adopted.***
- Treatment to meet (or exceed) regional/territorial standards. ***Water Quality requirements under the proposed NZTA Standard are less stringent than regional requirements, therefore regional requirements must be met (refer section 6.3.3 of the proposed standard)***;
- Centralised/Integrated stormwater systems preferable; ***No guidance is given in the proposed NZTA Standard with respect to this objective. Consequently, it is anticipated that this objective would remain the same under the proposed standard.***
- Site specific practices: eg no single solution panacea; ***No change expected if the proposed NZTA standard was adopted as this is consistent with the general philosophy of the proposed standard (i.e. selecting devices based on the suitability of the practice to the site constraints and expected contaminant types/levels)***
- Discharge to land is preferred, where practicable; ***No change expected if the proposed NZTA standard was adopted. Note the proposed NZTA standard does not provide any guidance for dry soakage basins.***
- The "treatment train" approach is preferable (eg grass swales, infiltration, etc); ***Consistent with proposed NZTA Standard (refer section 5.6 of the proposed standard).***
- Ensure efficient and effective maintenance; ***No change expected if the proposed NZTA standard was adopted.***

- Landscape: Naturalised eco-systems, and promoting variety of communities;
- Bird Habitat: Give judicious consideration to scope for habitat;
- Fish Passage: Restore or facilitate;
- Ecological Value and Passage: Protect, preserve, improve;
- Cultural & Heritage Values: Recognise values and kitianga mauri, etc, eg maintain (enhance) water quality, promote indigenous species, maintain flow regimes, etc;
- Recreation: Promote linkages and interface with stormwater (non contact);
- Education: Consider local communities (eg walkers), school groups (interpretive), casual visitors (interpretive), special interest groups (eg NZWERF, NZWWA).
- Partnerships: Integration with CCC, ECan, Iwi, etc;

Note: many of the above objectives are outside the scope of the proposed NZTA standard (e.g. recreational links and landscape consideration). However, as these are consistent with best practice it is anticipated that they would still be an integral part of any system designed under the proposed standard.

Sources of Information

- A Scheme Assessment Report ("SAR") was produced in June 2002 with an Addendum in December 2002 and June 2006. The SAR considered engineering, economic and environmental aspects influencing the alternatives considered in formulating this proposal. The SAR included a draft AEE that was finalised in March 2005.
- Opus International Consultations Ltd, 2007. Christchurch Southern Motorway Stormwater Management Report.
- Christchurch City Council, 2007 (Draft). Integrated Catchment Management Plan (ICMP) for the South-West Area Plan. First Draft at April 2007.
- Christchurch City Council, 2003. Waterways, Wetlands and Drainage Guide - Ko Ta Anga Whakaora mo Nga Arawai Repo. Part A: Visions. Christchurch City Council, Christchurch.
- Christchurch City Council, 2003. Waterways, Wetlands and Drainage Guide - Ko Ta Anga Whakaora mo Nga Arawai Repo. Part B: Design. Christchurch City Council, Christchurch.

3.1.2 Options Analysis

A Stormwater Scheme Assessment Report (SAR) was undertaken for the CSM proposal in 2000. During the intervening period new standards, policies, objectives, and expectations, of best practice stormwater management have become established, meaning that some findings of the scheme assessment have now been superseded.

The **2008 proposed stormwater specimen concept design** for each of the three sections of the CSM is as follows:

Upgrade Section: Due to the formalising nature of proposed works (i.e. standard kerb and channel, and footpath) for the Halswell Junction Road upgrade limit of proposed works, the surface drainage system will be a conventional pipe and catchpit system. The collection and conveyance system will effectively formalise the road stormwater system at Halswell Junction Road to connect with the principal pipe network within Halswell Junction Road. Scope for swale development here is limited primarily owing to the space (designation) constraints, and the nature of land use activity along this road (i.e. primarily industrial/commercial land) meaning a number of vehicle access crossings of swales would be required, and the risk and consequence of swale damage by heavy vehicles is high. Treatment will be at the proposed upgraded Halswell Retention Basin whereby the stormwater quality and quantity management improvements will inherently exceed local and regional standards and expectations (at no additional time or cost).

Greenfield Section: For the Greenfield section of works (Springs Road to Curletts Road), the principal means of collection and conveyance of surface runoff will be swales at the motorway mainline formation with some kerb and channel formation associated with the proposed interchange/connectivity locations. A kerb and channel solution was not selected owing to cost implications, conveyance capacity limitations and due to the availability of a healthy designation width to accommodate a swale system that best achieves a balance of objectives (i.e. including the collection; conveyance; water quality treatment; and the flow attenuation requirements, etc). Swales (standard and bunded attenuation) at the Greenfield section will also assist in the formation of a semi rural aspect to the motorway, and best achieve the vision of the urban design and landscape development concept. Final treatment will be provided in the form on dry and wet stormwater treatment basins.

Duplication Section: For the section of proposed duplication works (Curletts Road to Collins Street), surface runoff will primarily be by swales (standard and bunded attenuation) with some localised kerb and channel formation associated with the interchange/connectivity locations, and some bridge deck drainage. A kerb and channel solution was not selected owing to cost implications, conveyance capacity limitations of kerb and channel, and due to the availability of a wide designation width to accommodate a swale system. The proposed swale system at the duplication section can also achieve the principal stormwater management objectives of water quality treatment and flow attenuation.

The proposed NZTA Standard would have minimal, if any, impact on the preliminary specimen design process followed or the proposed stormwater management options selected for the specimen design.

3.1.3 Criteria

Water Quality

The stormwater management approach will be generally consistent with the ECan Proposed Canterbury Natural Resources Regional Plan (NRRP), CCC Feb 2003 document (Parts A & B) *Waterways, Wetlands and Drainage Guide* (WWDG), the CCC Integrated Catchment Management Plan for South-west Christchurch, and the Auckland Regional Council (ARC), 2003 Technical Publication No 10 (TP10) Stormwater Management Devices Design Guideline Manual.

(i) For design purposes the water quality design storm is defined as being 25mm depth of rainfall (i.e. first flush contaminant capture). T***he proposed NZTA Standard water quality depth would be 15mm (i.e. the 90th percentile rainfall depth for the Christchurch area based on the NIWA maps given in Appendix A of the proposed standard). However, since this is less stringent than the requirements under regional guidelines (25mm), the regional guidelines would take precedence over the proposed standard. Consequently, the water quality volumes used in the specimen design would not change.***

(ii) For the new works it is proposed to adopt a best practicable approach for water quality management whilst recognising the objectives for the Canterbury Region.

(iii) The preliminary designs upon which the consent applications are based comprise treatment of new pavement areas only. A general objective is also to provide up to 30% treatment efficiency to those areas of existing impervious surfaces that are modified by the proposed works and feed into the new stormwater system. It should be noted that there is no intention to retrofit the existing duplication system as part of this project. Should works on existing pavement areas be undertaken in the future, consideration may be given at that stage for retrofitting stormwater treatment in conjunction with an assessment of the effects of the untreated discharge on the environment.

Preferred management solutions that are considered suitable for stormwater quality control at the CSM include swales, ponds, and infiltration basins. Swale designs will either be standard grass, lined at landfills, or attenuation bunded swales.

Water Quantity

To be consistent with the local (CCC) and regional (ECan) approach, it is important to achieve hydrologic neutrality up to the critical duration 2% Annual Exceedance Probability (AEP) to manage the effects of erosion and flooding (i.e. post development discharge to best practicably mimic pre-development flows).

Management solutions suitable and preferred for stormwater quantity control at the CSM include swales (bunded for attenuation), ponds, infiltration/detention basins, and soakage disposal devices.

Water quantity design attenuation objectives are shown within the Table 7 below.

Table 7: Design Rainfall Events

Upgrade	Greenfield	Duplication
• 2% AEP for critical duration of 60hrs.	• 2% AEP for critical duration of 60hrs at discharge to Halswell River • 2% AEP for critical duration of 36hrs at discharge to Heathcote River	• 2% AEP hydrologic neutrality for critical duration of receiving pipe network, and attenuation to match 20% AEP capacity of existing CCC reticulation.

The attenuation/detention requirements specified in section 6.1 of the proposed NZTA Standard would require the attenuation of the 1% AEP event. Furthermore, the peak post development flow rates are required to be limited to 80% of pre-developed peak flow rates. This would increase the required size of all attenuation/detention devices on the project as the peak storage requirement of these devices would increase as a result of this more stringent criteria.

Based on HIRDSV2 the increase in rainfall depth and consequently runoff volume between the 2% AEP and 1% AEP is in the order of 22%. The designation area required for the attenuation/detention devices would increase proportionally. This would require additional land for many of the stormwater management devices and consequently lead to an increase in cost.

Stream Channel Erosion Criteria

To mitigate erosion, appropriate erosion control and energy dissipation measures will be incorporated into the site-specific design. This will include at the interface between natural streams or swales and pipe inlet/outlets, as well as culvert headwall/wing-wall interfaces.

Adequate erosion protection will be provided to facilitate the transition from pipe flow to natural channel flow.

All outfall structures will be positioned and designed to minimise erosion. Outfall structures will include appropriate bed protection measures and energy dissipation (where necessary). Outfalls will be designed and landscaped to blend with the natural environment and minimise aesthetic impact.

Furthermore, attenuation of the runoff within the swales and basins and controlled discharge will, as far as practical, minimise stream channel erosion.

The specimen design meets the proposed NZTA Standard due to the fact that the NZTA standard does not require extended detention when catchment slopes are slight and flow velocities are low. Furthermore, 'volume control' through infiltration practices will minimise any erosive flows.

3.1.4 General

The benefits of the proposed system include:

- Reduction in peak runoff flows to the receiving environment;
- Improved stormwater quality discharging into a natural waterway, in particular a reduction in suspended solids concentrations and in turn a reduction in pollutants.

3.1.5 References

References used for the stormwater specimen design:

- Section 77, Land Transport Management Act, 2003 (LTMA)
- Environmental Plan, Version 1, Transit New Zealand, November 2004. This Plan is an evolving document. Always ensure the current version is used. Refer to www.transit.govt.nz
- Transfund NZ, Integrated Stormwater Management Guidelines for the NZ Roading Network, Transfund NZ Research Report No 260, 2004.

- Christchurch City Council, 2003. Waterways, Wetlands and Drainage Guide - Ko Ta Anga Whakaora mo Nga Arawai Repo. Part A: Visions. Christchurch City Council, Christchurch.

- Christchurch City Council, 2003. Waterways, Wetlands and Drainage Guide - Ko Ta Anga Whakaora mo Nga Arawai Repo. Part B: Design. Christchurch City Council, Christchurch.

- Christchurch City Council, 2007 (Draft). Integrated Catchment Management Plan (ICMP) for the South-West Area Plan. First Draft at April 2007.

- Auckland Regional Council, 2003. Technical Publication No 10 (TP10) Stormwater Management Devices Design Guideline Manual. Auckland.

- Environment Canterbury, 2007. Erosion and sediment control guidelines for the Canterbury region. Report No. R06/23, Canterbury Regional Council, Christchurch, New Zealand. ISBN No. 1-86937-607-2.

- NRB, 1977. Highway Surface Drainage: A Design Guide for Highways with a Positive Collection (first edition).

- Transit New Zealand, June 2003. Bridge Design Manual. SP/M/022, Transit New Zealand, ISBN No. 0-478-04132-2.

- Ministry for the Environment, May 2004. Climate Change effects and impacts assessment. A guidance manual for Local Government in New Zealand. Prepared by the New Zealand Climate Change Office. ME No. 513. ISBN No. 0-478-18934-6.

- Pattle Delamore Partners Ltd, 2004. Groundwater Assessment for South-West Christchurch Planning Study: Stage 2, prepared for Christchurch City Council.

- Pattle Delamore Partners Ltd, November 2007. Christchurch Southern Motorway Extension: Additional Landfill Investigations for Specimen Design, prepared for Opus International Consultants.

- Te Runanga o Ngai Tahu Freshwater Policy (1999)

Other key documents for the specimen design process will include:

Transit Specifications and Guideline Notes
Transit has a number of specification and guidelines that are relevant to elements of the specimen (indicative) design, including:
- TNZ F/01, 1977. Earthworks Construction;
- TNZ F/02, 2000. Pipe Subsoil Drain Construction;
- TNZ F/03, 2000. Pipe Culvert Construction;

- TNZ F/05, 2000. Corrugated Plastic Pipe Subsoil Drain Construction;
- TNZ F/06, 2003. Fabric Wrapped Aggregate Subsoil Drain Construction;
- TNZ F/07, 2003. Changes to Geotextiles;
- TNZ HM/24, 2006. Drainage Improvements.

Christchurch City Council (CCC)
CCC has prepared a range of documents of direct relevance to the CSM stormwater management design including:

- *Proposed City Plan (Christchurch City Council, 1995.*
- *“Waterways Wetlands Asset Management Strategy, 1999.*
- *Services plans.*

Upgrade
- Historic plans/as-builts of HJR Pond

Greenfield
- "South West Christchurch Area Plan”. (DRAFT)
- Awatea block drainage (memorandum)
- Wigram Drain Storage area – upper Heathcote River (CCC memorandum)
- Paparua Stream upstream of Wigram Rd (CCC memorandum)
- The “Heathcote River Floodplain Management Strategy” (Christchurch City Council, 1998),
- “Heathcote River Flood Plain Management Strategy”
- “Waimakariri Proposed Regional Plans”

Duplication
- Upper Wilderness Drain Report (CCC memorandum)
- Curletts Rd Stream water quality improvements (CCC memorandum)
- Haytons Drain – Resource Consent (CCC memorandum)
- Haytons Stream below Washbournes Rd (CCC memorandum)
- Haytons stream diversion at Wigram Rd (CCC memorandum)
- Stormwater Investigation - Haytons Drain Catchment (Draft Report)
- In addition, CCC requires that no additional water be directed into the Heathcote catchment.

Other Council Design Guidelines
Auckland Regional Council (ARC) has developed a number of specific practice guidelines that should be given consideration during design of the CSM stormwater management system including:

- TP10 (2003) Stormwater Management Devices: Design Guidelines Manual;
- TP69 (1996) The Environmental Impacts of Accelerated Erosion and Sedimentation;
- TP90 (1999) Erosion and Sediment Control Guidelines for Land Disturbing Activities;
- TP124 (2000) Low Impact Design Manual for the Auckland Region;
- TP131 (2000) Fish Passage Guidelines for the Auckland Region;
- TP148 (2001) Riparian Zone Management: Strategy: Guidelines: Planting Guide;

Refer to the Auckland Regional Council (ARC) website [www.arc.govt.nz] for details and further references to these technical publications.

3.2 Stormwater Management Devices - Methods

3.2.1 Erosion and Sedimentation Control

Design Statement

As no specific guidance with respect to short term stormwater management (erosion and sediment control) is given in the proposed NZTA Standard, sediment and erosion control measures would be designed and implemented in accordance with the Environment Canterbury Erosion and sediment control guidelines. these measures include;

- ***Erosion Control Measures:*** runoff diversion channels and bunds, contour drains, check dams, level spreaders, pipe drop structure/flume, surface roughening, stabilised construction entrances, and stabilisation techniques such as geosynthetic erosion control systems, and/or revegetation techniques (eg topsoiling, seeding, hydroseeding, mulching, and turfing);

- ***Sediment Control Measures:*** sediment retention ponds, grit traps, silt fences, super silt fences, inlet protection, decanting earth bunds, and sump/sediment pits;

- ***Works in Waterbodies:*** temporary waterbody diversions, temporary waterbody crossings, dam and divert methodology;

- ***Dust Control Measures:*** watering of exposed areas, and/or stabilisation techniques such as geosynthetic stabilisation, revegetation, hydroseeding, mulching, or turf;

- ***Other Methods:*** wheel washdowns, etc.

There would be no change to the erosion and sediment control measures proposed for this project under the proposed NZTA Standard as no guidance is given.

3.2.2 Operational Stormwater Management (Permanent)

i. Collection

Stormwater will be collected via kerb & channel, catchpits and swales. ***There is no specific guidance given in the proposed NZTA Standard with respect to the stormwater collection system. No change to the specimen design would be anticipated if the proposed standard was applied to the CSM project.***

ii. Conveyance

Stormwater conveyance will primarily be by grass swales (standard and bunded attenuation) with traditional pipe network elsewhere. ***As for the collection system, no specific guidance is given in the proposed NZTA Standard for the design of the primary conveyance network. No change to the specimen design would be anticipated if the proposed standard was applied to the CSM project.***

iii. Attenuation

Attenuation will be provided by attenuation swales, basins and ponds.

Under the proposed NZTA Standard, the specimen design attenuation requirement would increase to include attenuation of the 1% AEP event to limit peak post development flow rates to 80% of pre-developed flow rates.

Based on HIRDSV2 the increase in rainfall depth and consequently runoff volume between the 2% AEP and 1% AEP is in the order of 22%. The designation area required for the attenuation/detention devices would increase proportionally.

iv. Treatment

The general philosophy for the stormwater management is to utilise a treatment train approach. The idea of the "treatment train" is to acknowledge the fact that individual stormwater management tools are unlikely to achieve all of the stormwater management objectives for any given site. The devices which may be utilised include:

- Catchpits/Sumps
- Swales (standard and bunded attenuation)

- Dry basins ***Note the proposed NZTA Standard does not provide any guidance on dry basin design.***

- Wet ponds

Since the WQV is governed by regional requirements there would be no change to design treatment volumes under the proposed standard.

3.3 Cost

3.3.1 Resource Consents

The approximate costs of the Stormwater related Resource Consents were:

- **$80,000** for the Consent Application and Processing Fees from ECan (note the application is still being processed so the amount is an estimate and based on a proportion (est. 40%) of the total costs for the CSM project),

- **$55,000** of Professional Fees for Consents application and documentation (includes AEE preparation, further information response, and evidence preparation). The estimate excludes the stormwater report.

This gives a total of **$135,000** including AEE, council Fees, other professional services. ***Adopting the proposed NZTA Standard is unlikely to have any effect on the consent preparation, lodgement and processing costs.***

3.3.2 Building and other consents

To be lodged at a latter stage.

3.3.3 Final Design

The final design is yet to commence. Therefore, the final design cost cannot be provided. The specimen design cost of the Stormwater management system (surface collection and conveyance, waterway crossing systems, treatment devices, and discharges, etc) including field investigations, concept design, and documentation, etc, was approximately **$130,000.**

As the design process and specimen design of the stormwater management system would be similar under the proposed NZTA Standard, it is unlikely that the proposed standard would affect the overall design costs of the stormwater management system compared to the existing specimen design.

3.3.4 Construction

It is not possible to segregate the construction cost into collection, conveyance, attenuation and treatment as most devices are multi functional e.g. attenuation swales collect, convey, attenuate and treat runoff. Since the CSM is yet to be constructed, the value below is an estimate only.

Total stormwater management cost for the CSM is estimated at **$11,300,000 (base estimate, exclusive of any P&G costs).**

Since the proposed NZTA standard is unlikely result in any more than minor changes to the design of the stormwater system, it is anticipated that there would be no more than minor changes to the associated construction costs.

3.3.5 Monitoring Costs

The cost of monitoring is unknown as the construction phase of the CSM is yet to start, and costs will be influenced by the conditions of consent which are still subject to a hearing process at the time of this report. ***Monitoring costs are unlikely to change under the proposed NZTA Standard as the regional authority (ECan) would be likely to require a similar level of control and monitoring on the project as required by the proposed NZTA standard.***

3.3.6 Operation and Maintenance - Estimated Annual Cost

Operational and maintenance costs have been excluded from consideration in this report as they are unknown at this time and will be determined during subsequent phases (i.e. conditions of consent, detailed design, construction, and commission).

The operation and maintenance monitoring requirements are covered by the checklists given in Appendix C of the proposed NZTA Standard. These checklists are almost identical to those given in ARC TP10. Therefore, the operational and maintenance monitoring requirements (and associated costs) are unlikely to change under the proposed standard.

3.4 Time

3.4.1 Resource Consents

Resource consent applications were lodged in late February 2008; a hearing is expected in late September 2008 followed by a decision by December 2008, barring any appeals. ***No change in consent processing times would be anticipated under the proposed NZTA Standard. However, if NZTA held the authority to issue resource consents for state highway projects (as per Section 7.1.1.1 of the proposed NZTA Standard), greater time efficiencies could be realised. However, these efficiencies are difficult to quantify and would depend on the nature of any agreement between the regional authority and NZTA regarding transference of consenting jurisdiction.***

3.4.2 Building and other Consents

To be lodged at a latter detailed design stage.

3.4.3 Final Design Time

The specimen design for the CSM project was undertaken over about 9 months. The final design will be carried out during the latter D&C phase of the project.

As the overall design of the stormwater system, if designed to the proposed NZTA Standard, would not change significantly from the specimen design, it is likely that the effect on total design time would be no more than minor.

3.4.4 Construction

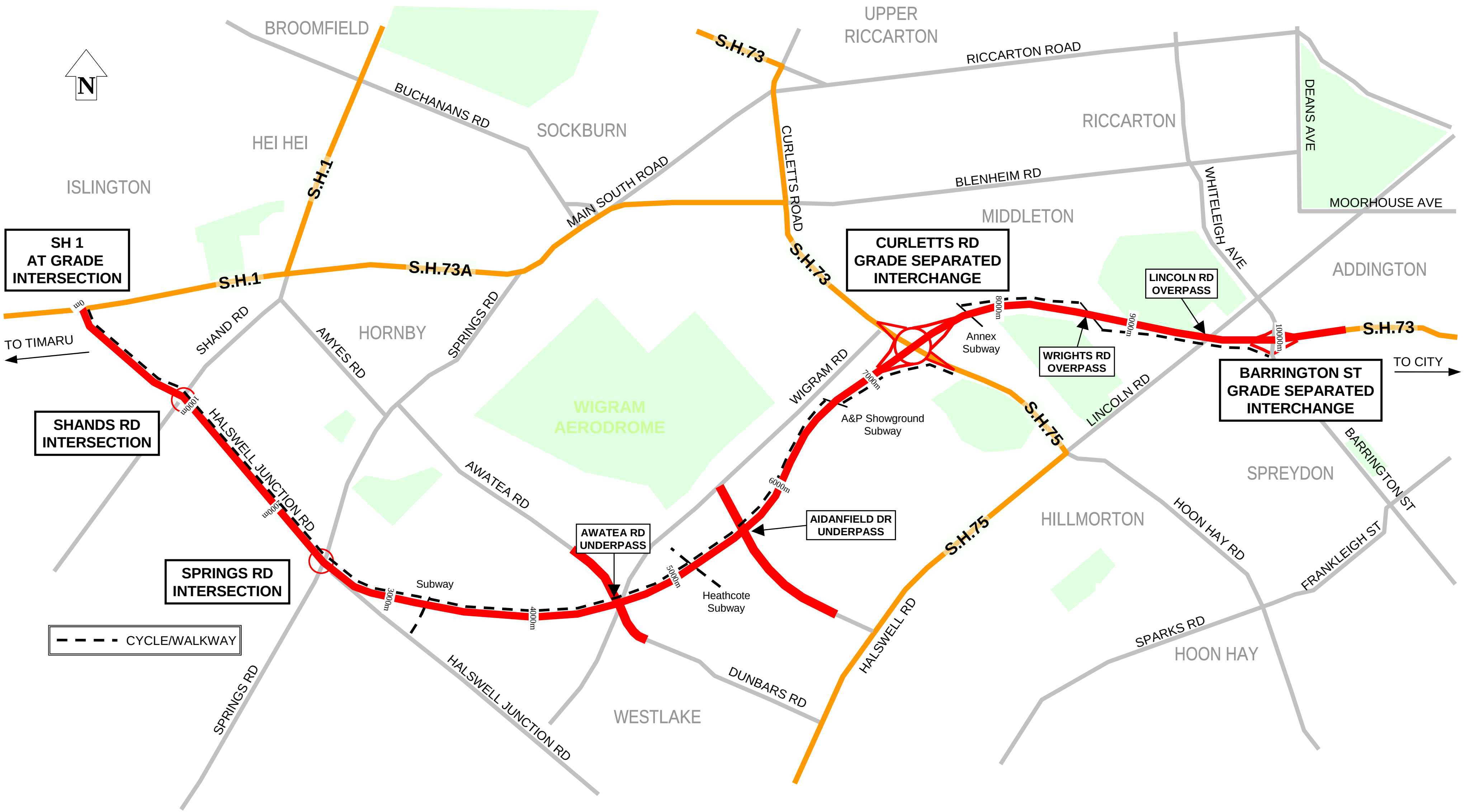
Physical works is yet to commence. The construction period is expected to be approximately 3 to 4 years. ***As the overall design of the stormwater system, if designed to the proposed NZTA Standard, would not change significantly from the specimen design (apart from the additional attenuation volume [22%] requirements for the stormwater basins and attenuation swales), the total construction time for the stormwater system would not change.***

3.4.5 Operation and Maintenance

Operation and maintenance timeframes have been excluded from consideration in this report as they are unknown at this time and will be defined and determined at the latter detailed design, construction and commissioning stage of the project.

The proposed NZTA Standard will not change this aspect of the stormwater management system design.

Appendix A
Stormwater Management – Site Location Plan



N
BROOMFIELD
UPPER RICCARTON
S.H.73
RICCARTON ROAD
BUCHANANS RD
SOCKBURN
HEI HEI
RICCARTON
DEANS AVE
ISLINGTON
S.H.1
MAIN SOUTH ROAD
CURLETTS ROAD
BLENHEIM RD
MOORHOUSE AVE
WHITELEIGH AVE
MIDDLETON
SH 1 AT GRADE INTERSECTION
S.H.73A
CURLETTS RD GRADE SEPARATED INTERCHANGE
ADDINGTON
LINCOLN RD OVERPASS
TO TIMARU
SHAND RD
AMYES RD
HORNBY
SPRINGS RD
Annex Subway
WRIGHTS RD OVERPASS
BARRINGTON ST GRADE SEPARATED INTERCHANGE
TO CITY
WIGRAM RD
LINCOLN RD
SHANDS RD INTERSECTION
HALSWELL JUNCTION RD
WIGRAM AERODROME
A&P Showground Subway
S.H.75
BARRINGTON ST
SPREYDON
AWATEA RD
AIDANFIELD DR UNDERPASS
HILLMORTON
HOON HAY RD
AWATEA RD UNDERPASS
SPRINGS RD INTERSECTION
Subway
Heathcote Subway
FRANKLEIGH ST
CYCLE/WALKWAY
SPARKS RD
HOON HAY
HALSWELL RD
DUNBARS RD
WESTLAKE

Appendix B
Stormwater Management – Concept Design

CSM – Stormwater Management Concept Design

Contents:

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M.ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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TITLE
S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
Cover Sheet

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
NTS	Feb 08	6/208/6	7504	SD 1	R1

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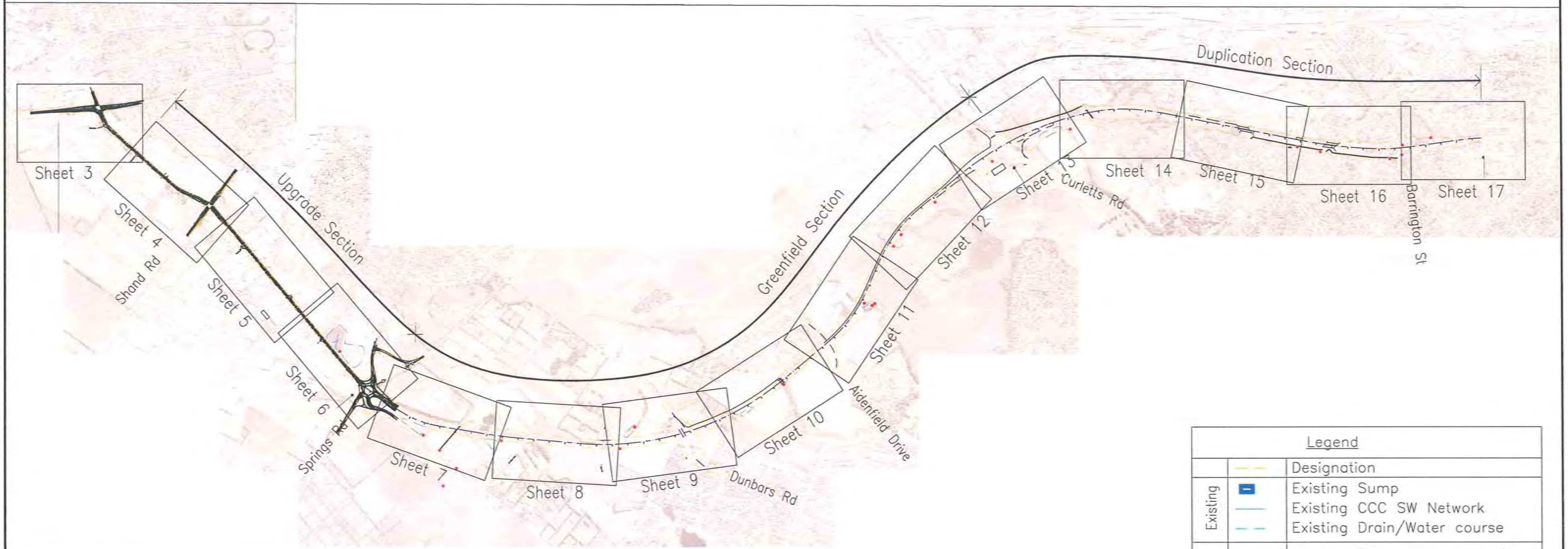

General Notes:

- Proposed design to be consistent with the CCC Waterways, Wetlands & Drainage Guide.
- Refer to CCC Infrastructure Design Standard (Draft – July 2007).
- The stormwater management design incorporates a 'six values' approach including consideration of; ecology, landscape, recreation, heritage, culture, and drainage values.
- Bunded swales with under drainage will form the Principal means of collection and conveyance, as well as the treatment and flow attenuation.
- Services data from CCC 2007

Legend

		Designation
Existing		Existing Sump
		Existing CCC SW Network
		Existing Drain/Water course
Proposed		K&C – (Gutter over bridge)
		Swale (Standard)
		Swale (Bunded & underdrain)
		Swale (Lined)
		Median Channel
		Secondary Flow
		Slot Drain
		Bunding
		Pipe
		MH
		Sump/Catchpit
		Headwall/Wingwall
	DS DG DP	Discharge Points (Surface, Ground, Pipe Network)

		BY	CHECKED	DATE
Minor improvements for consent application	TC 2/08	DESIGN	PM SC ME	P. MITCHELL	2/08
AMENDMENT	APP'D DATE	DRAWN	M.ENGLAND	P. MITCHELL	2/08
		APPROVED	A.J.COULMAN		2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
SHEET LAYOUT, NOTES & LEGEND

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE NTS	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD 2	REVISION R1

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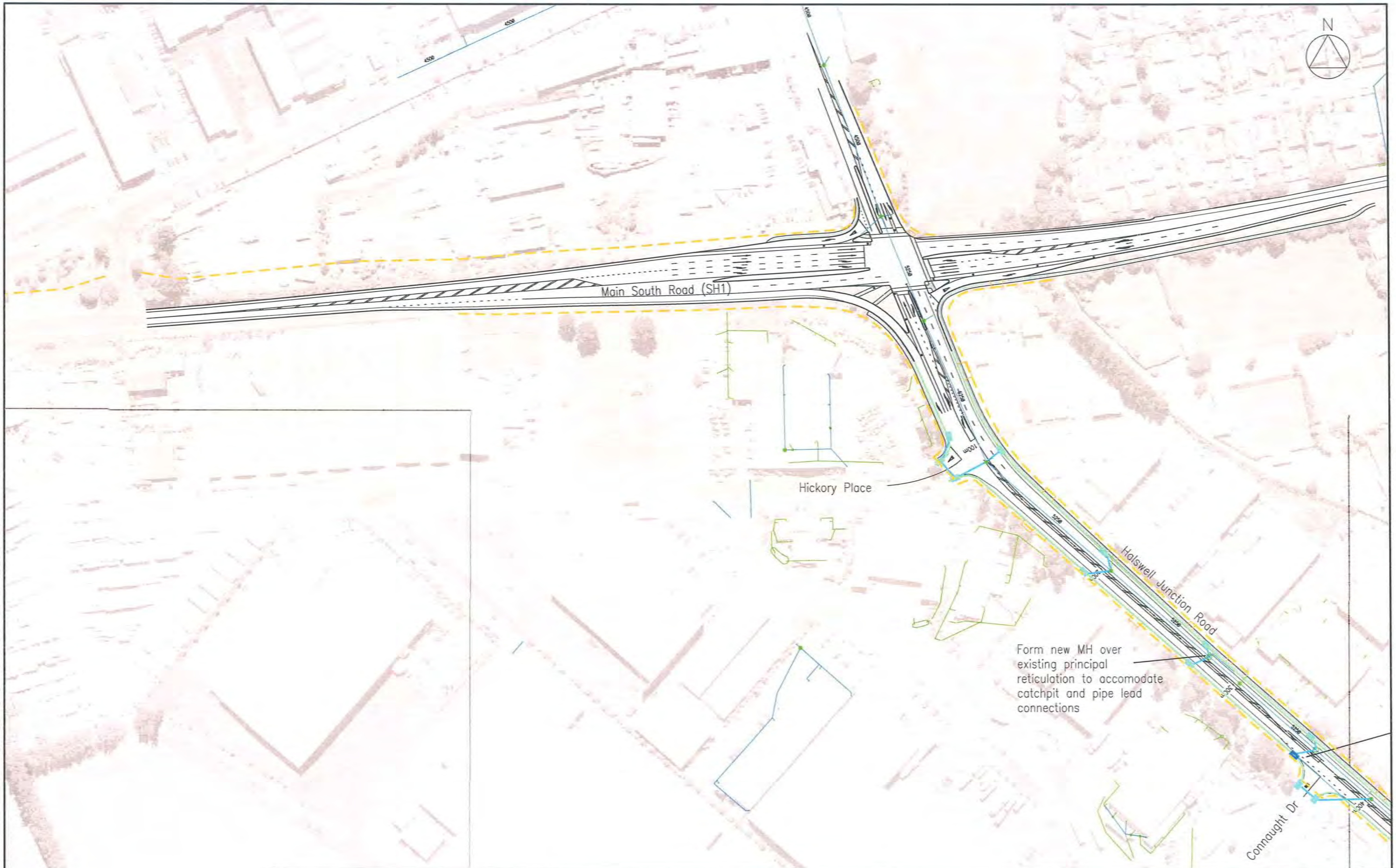

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DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M.ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 0m TO 350m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD 3	REVISION R1

* Refer to Sheet 2 for Legend & Notes

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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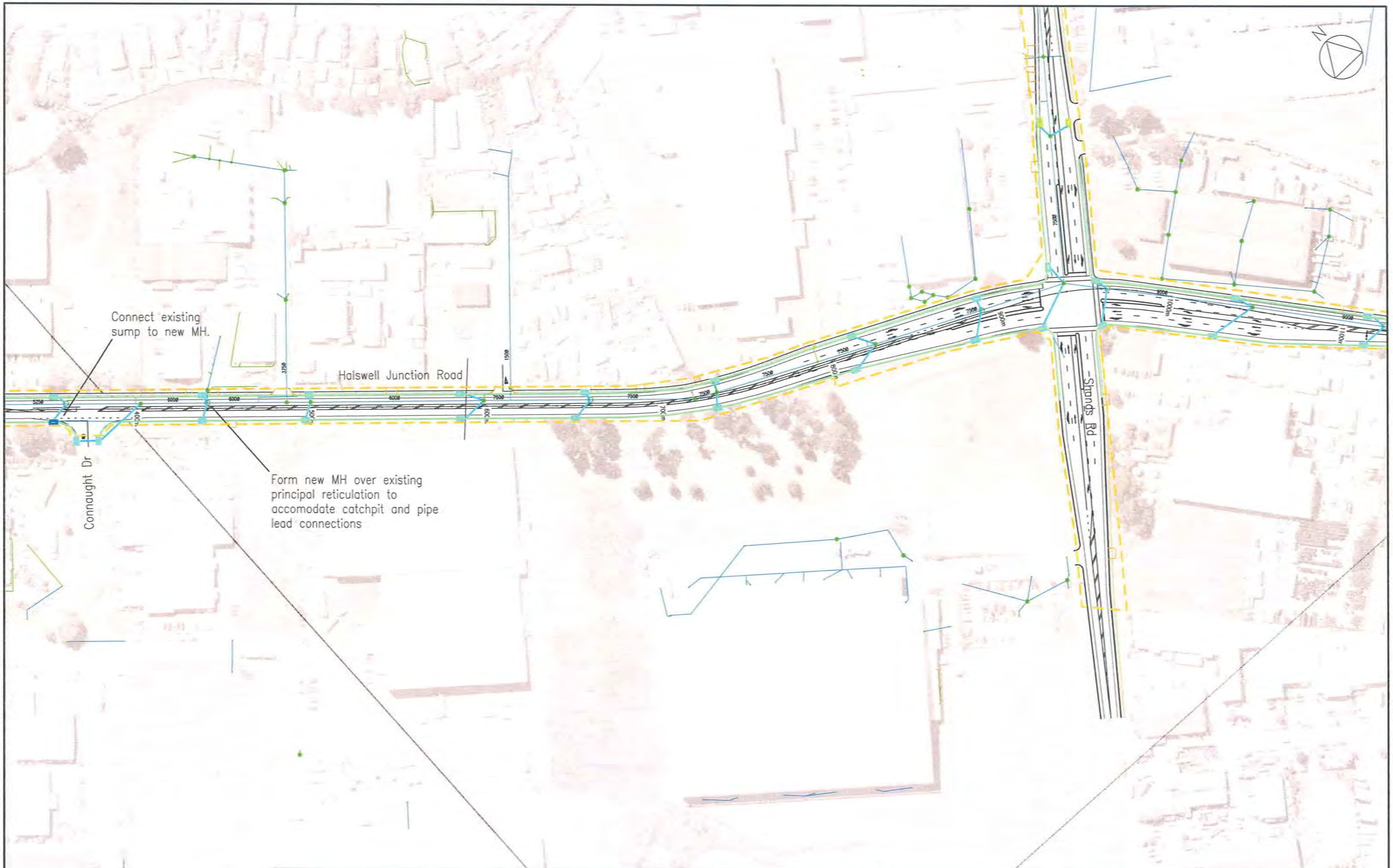

* Refer to Sheet 2 for Legend & Notes

Minor improvements for consent application	TC	2/08
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S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 350m TO 1100m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET
1:2000 (A3)	Feb 08	6/208/6	7504	SD 4

REVISION R1

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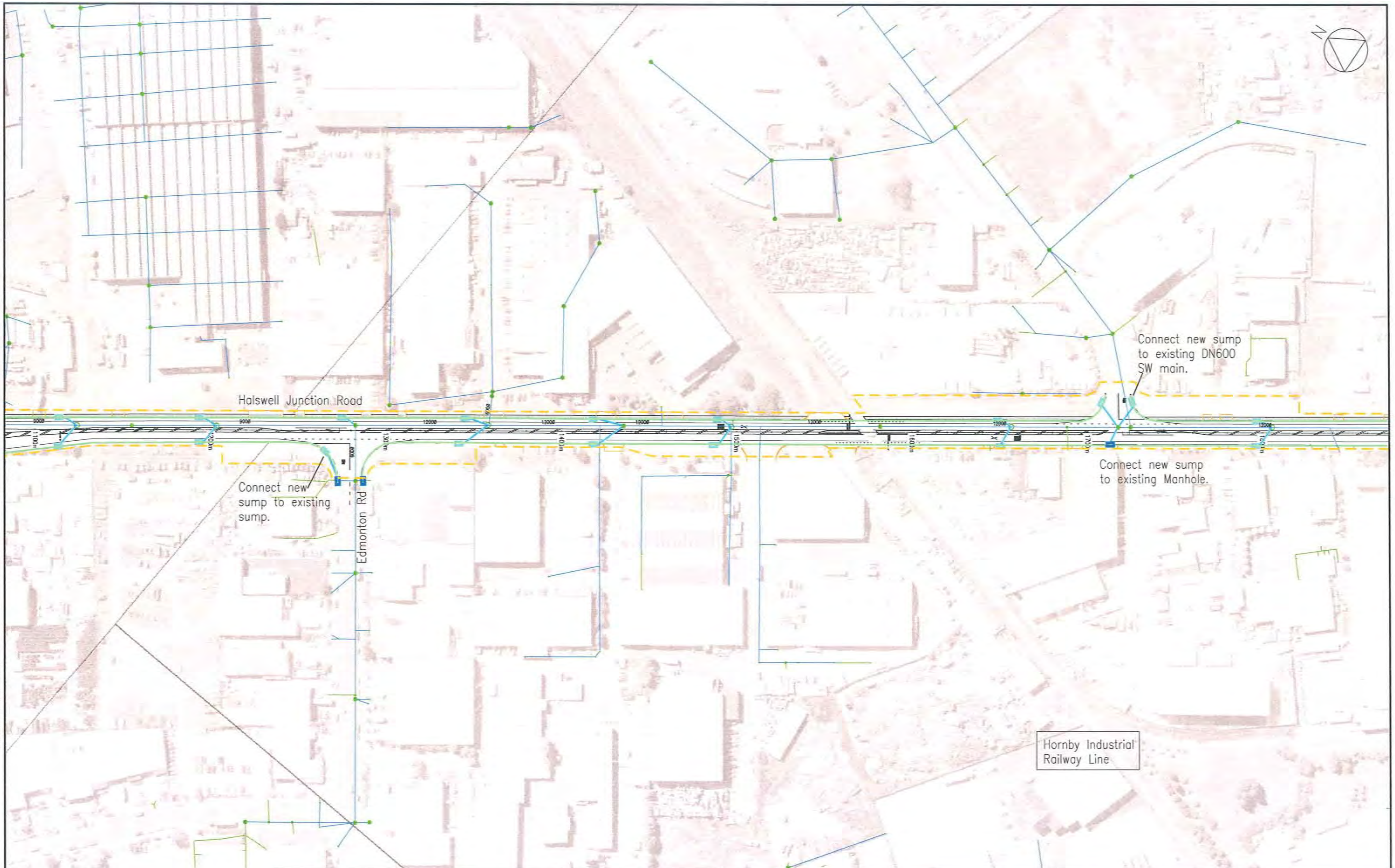

* Refer to Sheet 2 for Legend & Notes

Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 1100m TO 1860m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD 5	REVISION R1

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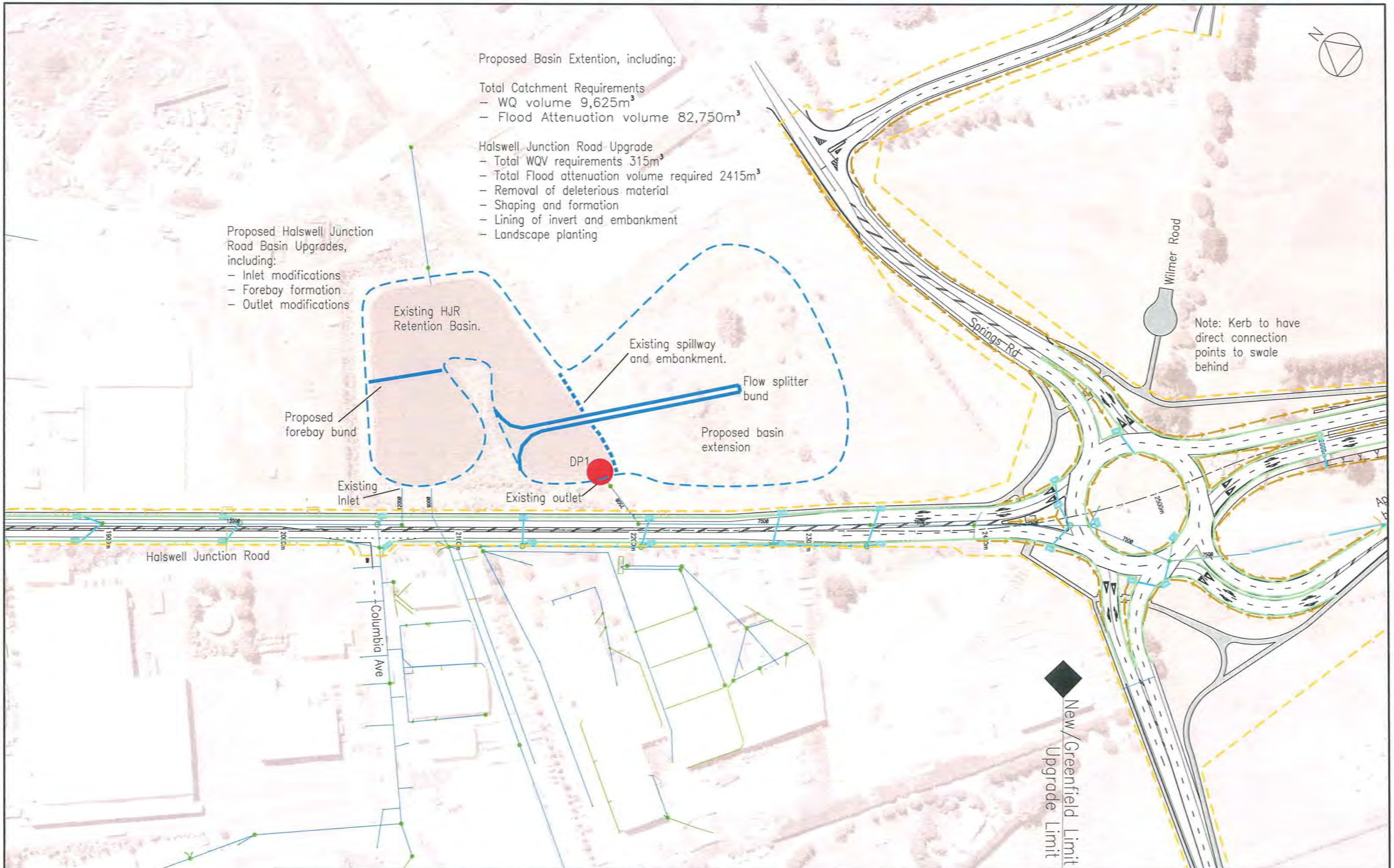

* Refer to Sheet 2 for Legend & Notes

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 1860m TO 2630m

STATUS		FILE	
SPECIMEN DESIGN		5C1124.00	

SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD 6	R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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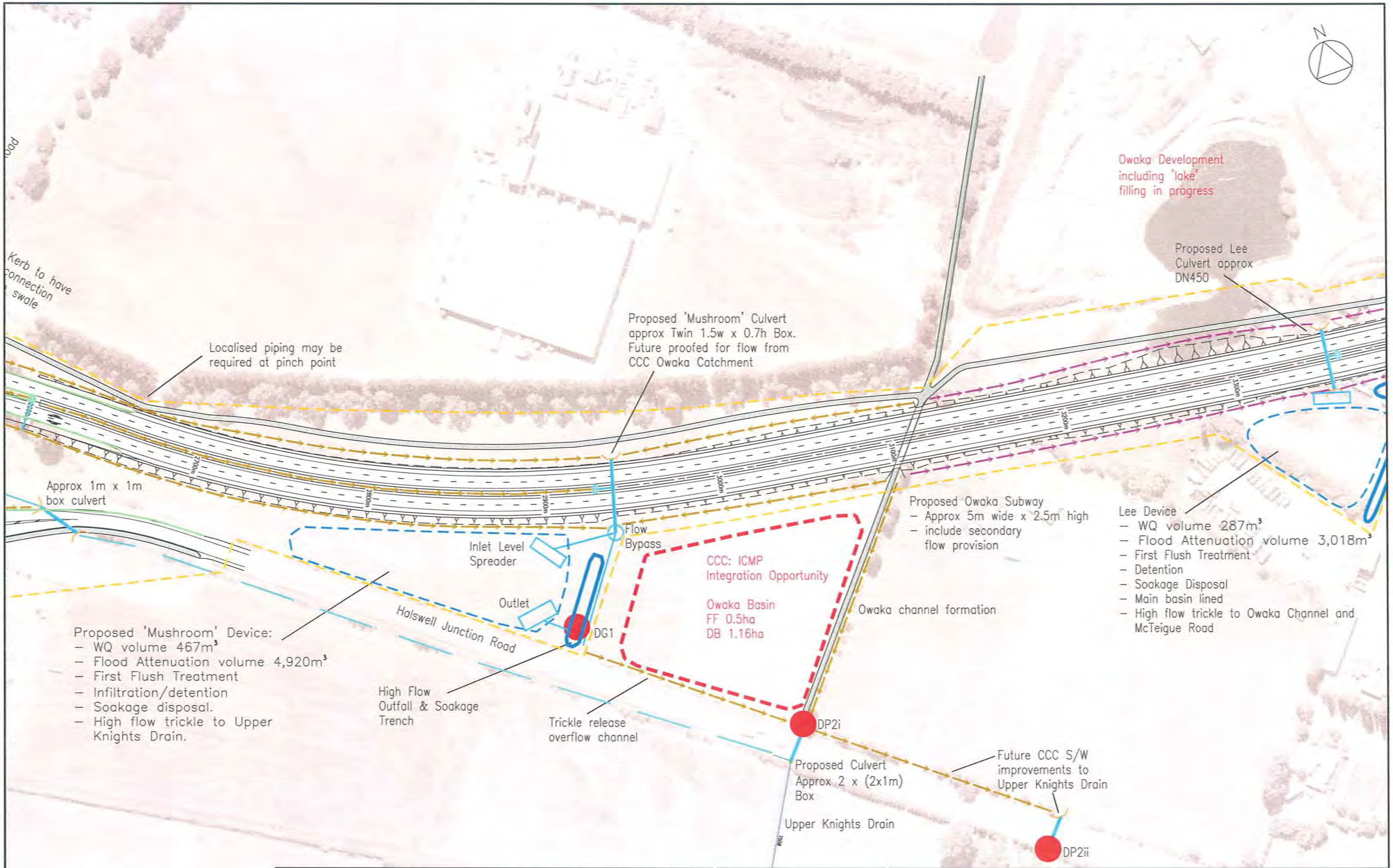

* Refer to Sheet 2 for Legend & Notes

Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P.MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 2630m TO 3370m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD 7	R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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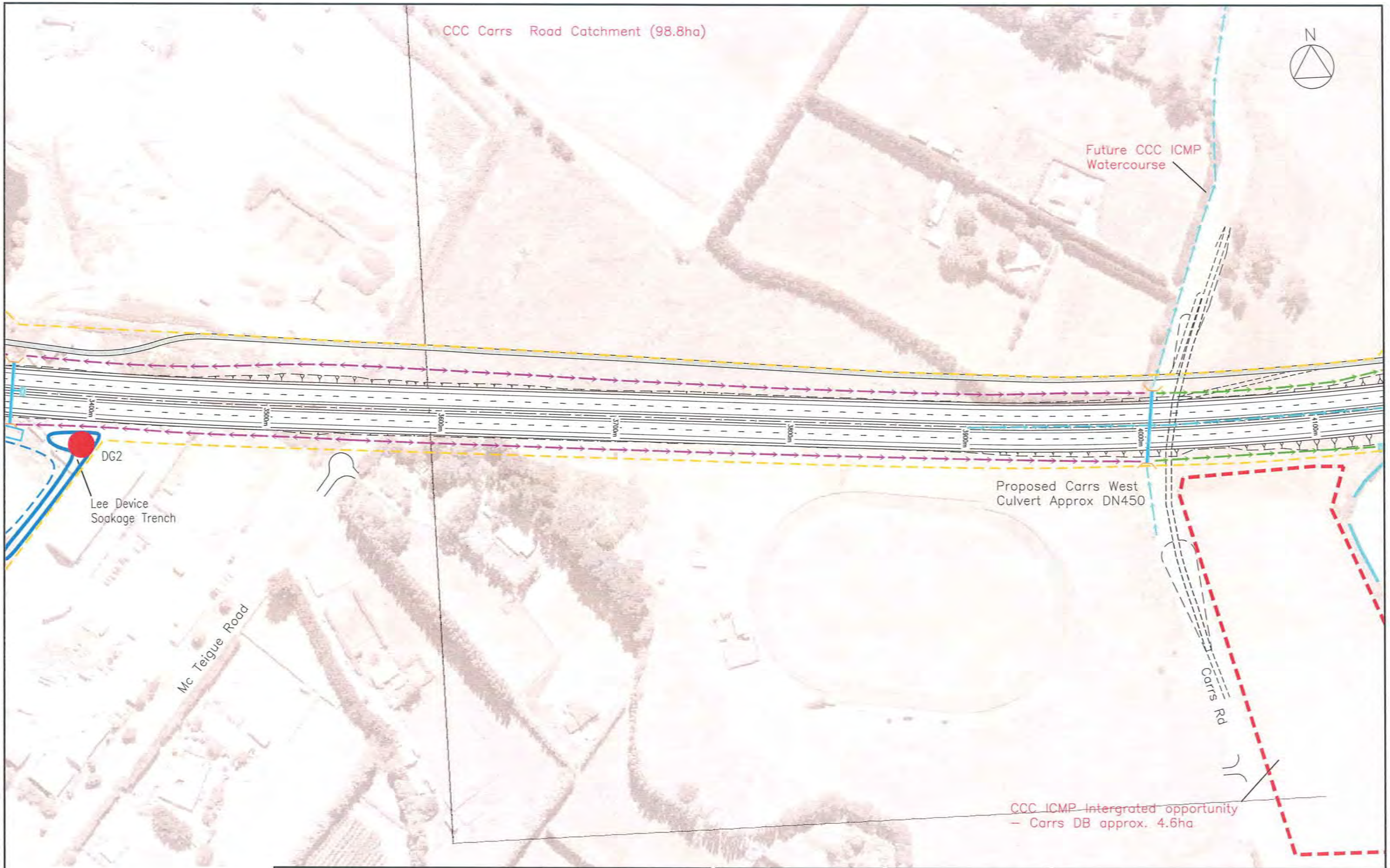

* Refer to Sheet 2 for Legend & Notes

	APP'D	DATE
Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 3370m TO 4100m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD 8	R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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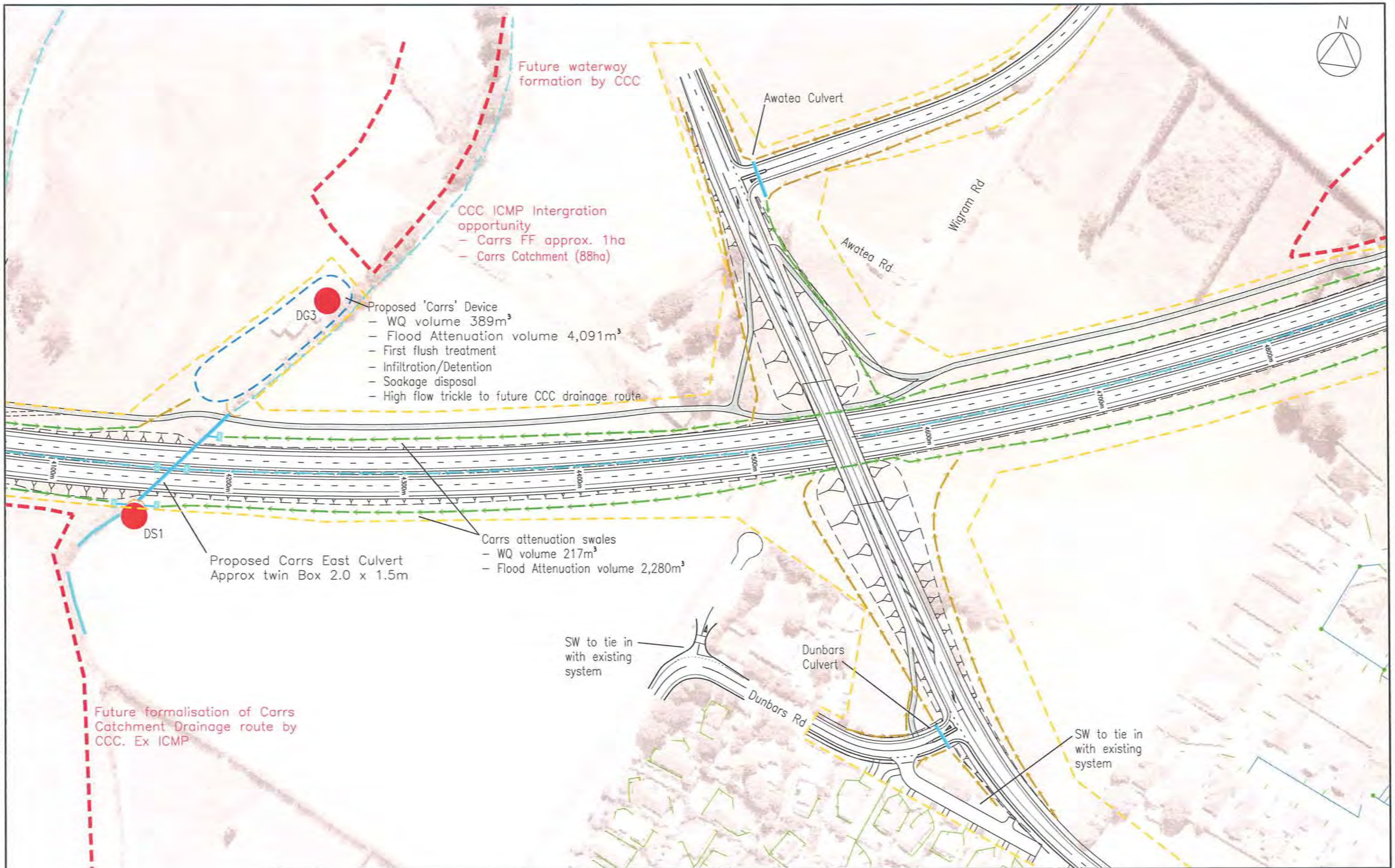

* Refer to Sheet 2 for Legend & Notes

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P.MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT - STA. 4100m TO 4830m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD 9	REVISION R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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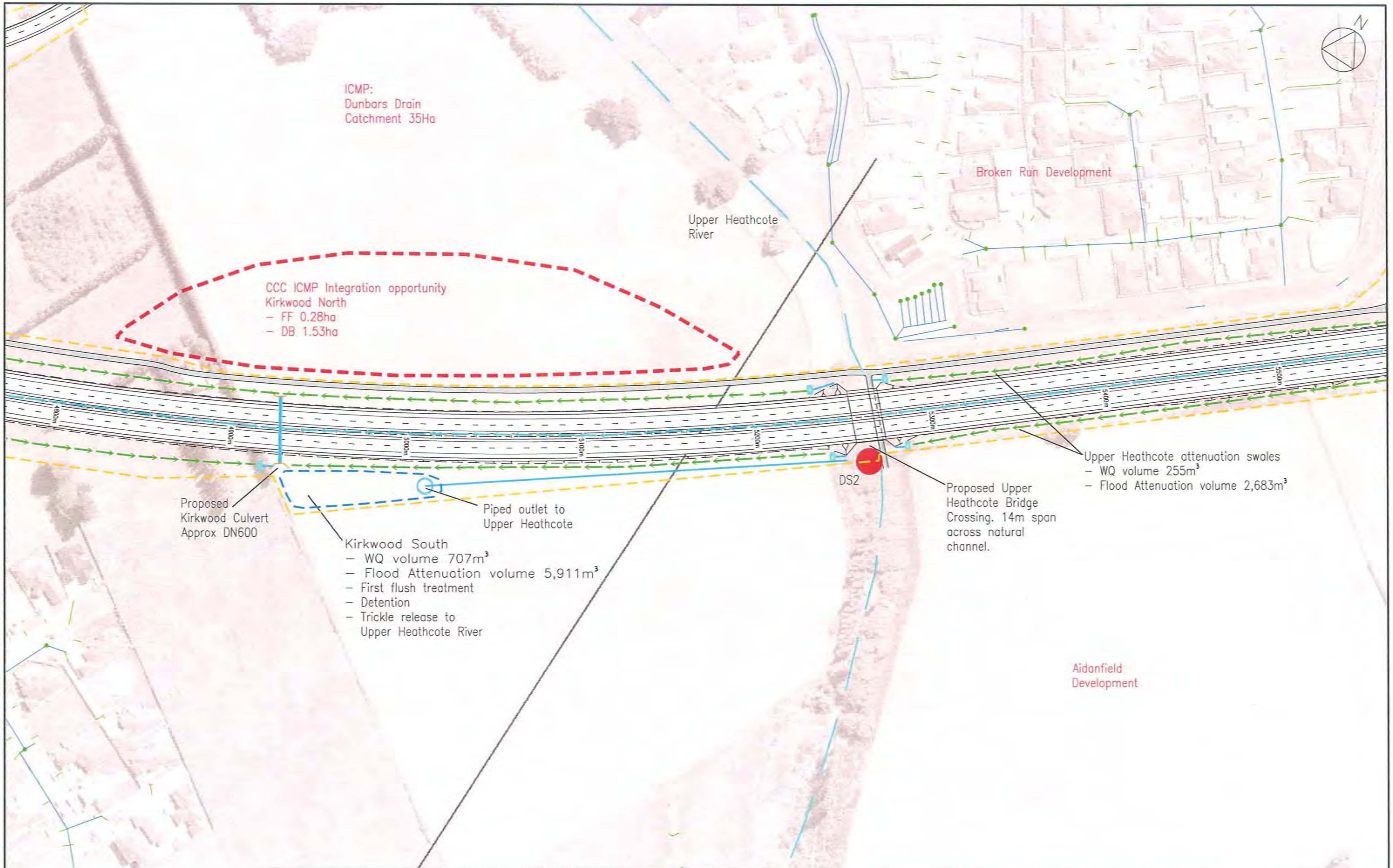

* Refer to Sheet 2 for Legend & Notes

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	12/08
APPROVED	A.J.COULMAN		2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 4830m TO 5540m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	**PLOT DATE**	**FEATURE IDENTIFIER**	**CODE**	**SHEET**
1:2000 (A3)	Feb 08	6/208/6	7504	SD10

REVISION R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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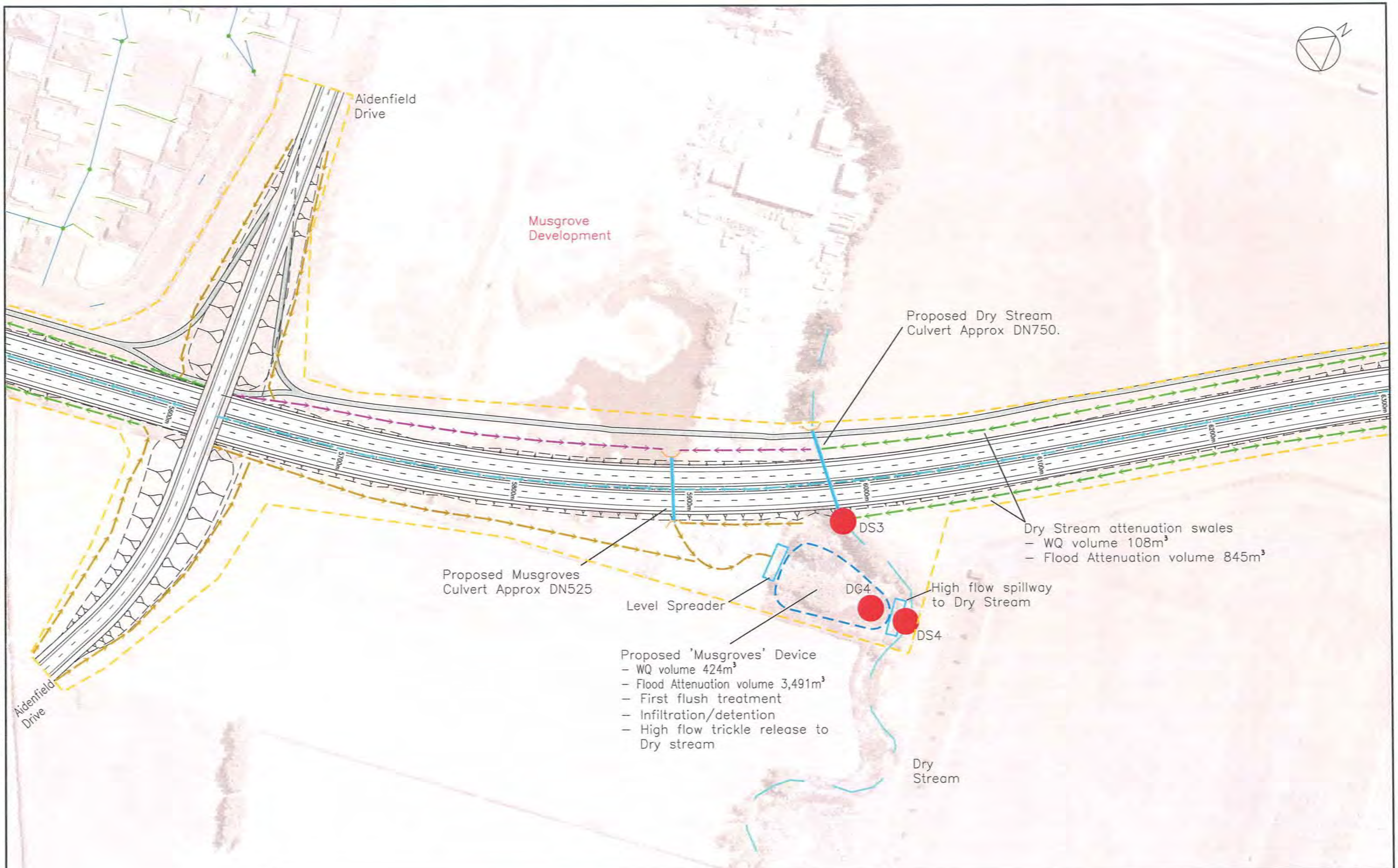

* Refer to Sheet 2 for Legend & Notes

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

				BY	CHECKED	DATE
			DESIGN	PM SC ME	P. MITCHELL	2/08
			DRAWN	M. ENGLAND	P. MITCHELL	2/08
			APPROVED	A.J.COULMAN		2/08
Minor improvements for consent application	TC	2/08				
AMENDMENT	APP'D	DATE				

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 5540m TO 6280m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD11	REVISION R1

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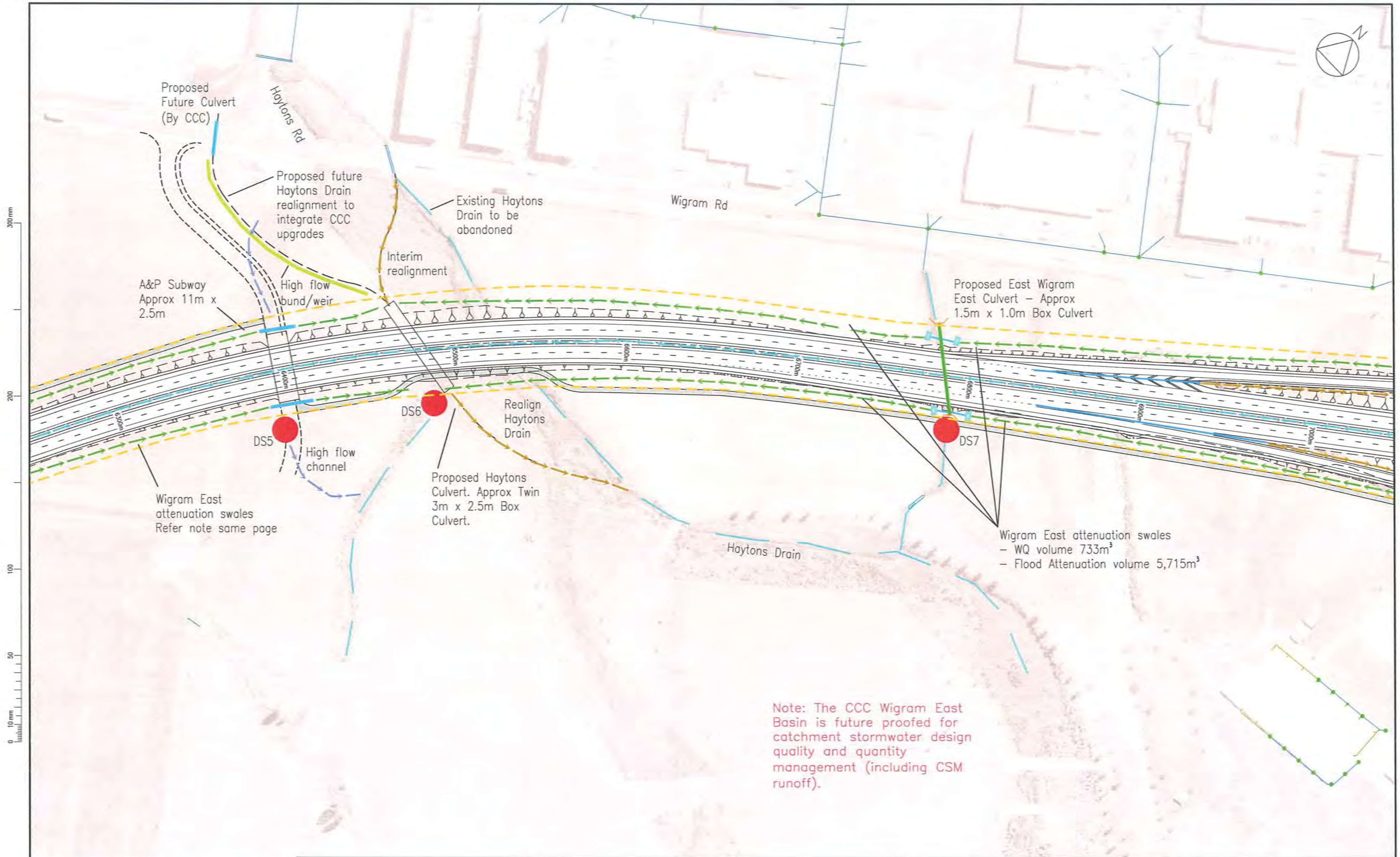

* Refer to Sheet 2 for Legend & Notes

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

	APP'D	DATE
Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 6280m TO 7030m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD12	REVISION R1

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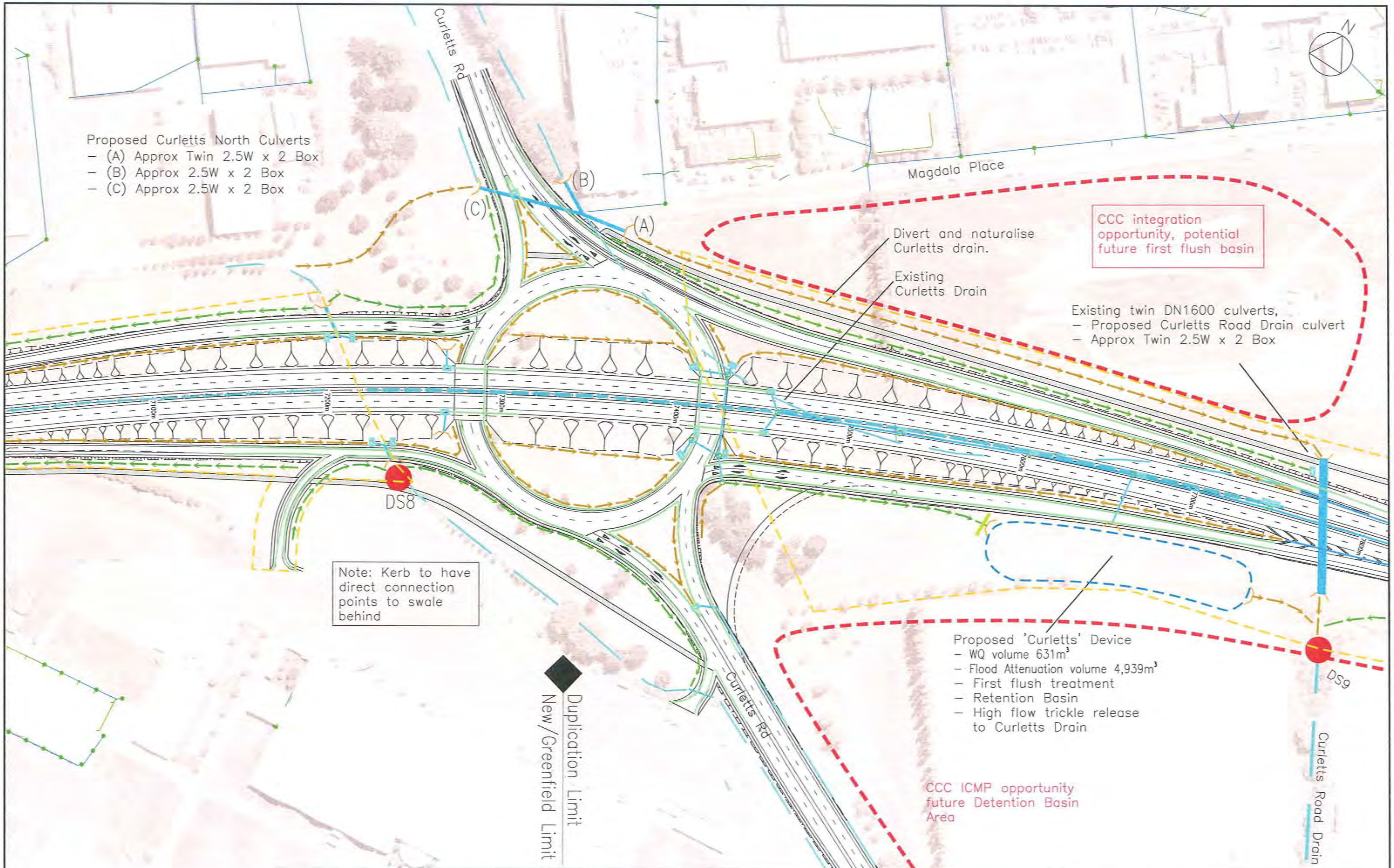

Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 7030m TO 7780m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE 1:2000 (A3)	PLOT DATE Feb 08	FEATURE IDENTIFIER 6/208/6	CODE 7504	SHEET SD13	REVISION R1

* Refer to Sheet 2 for Legend & Notes

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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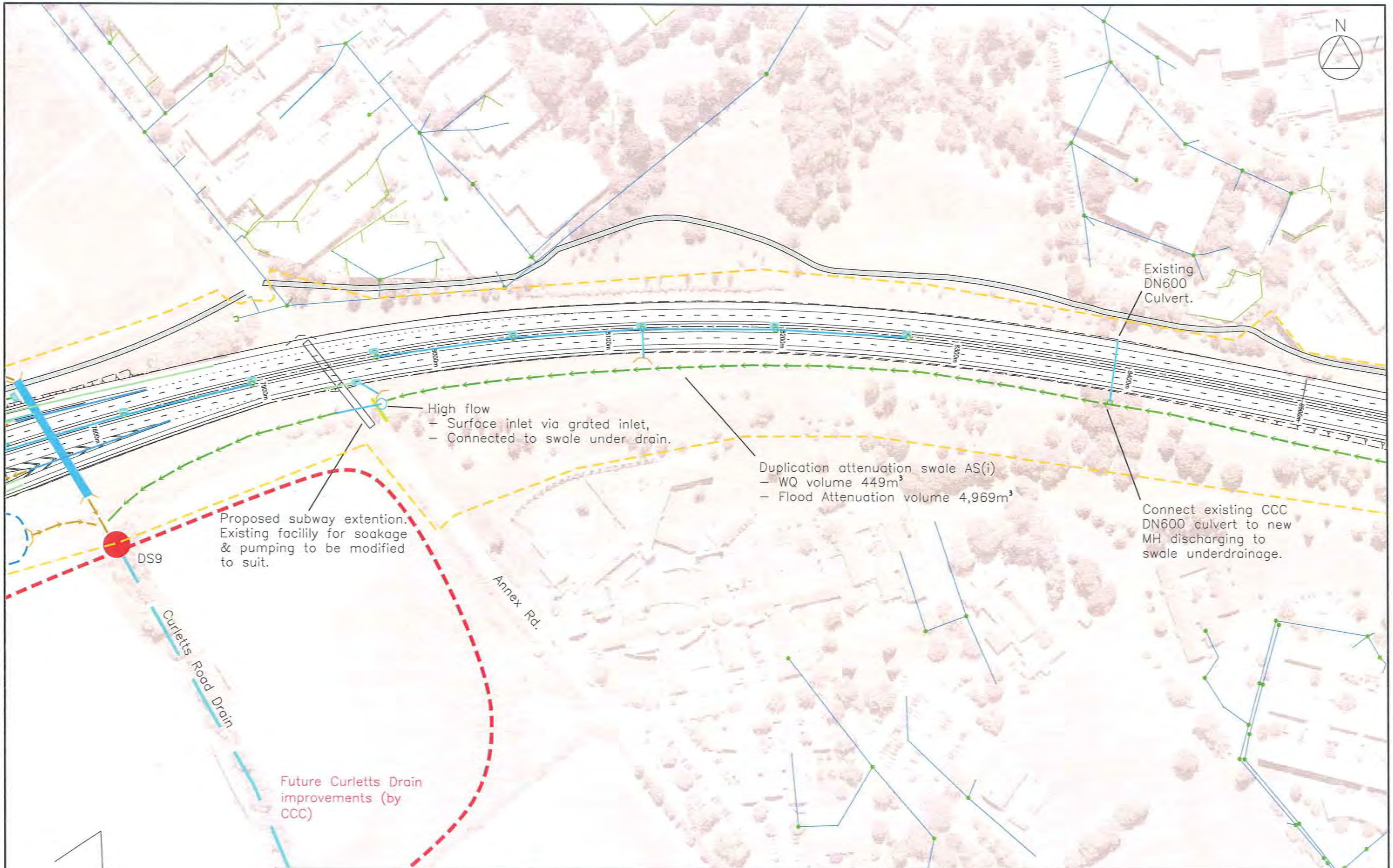

* Refer to Sheet 2 for Legend & Notes

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

Minor improvements for consent application	TC	08
AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 7780m TO 8530m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD14	R1

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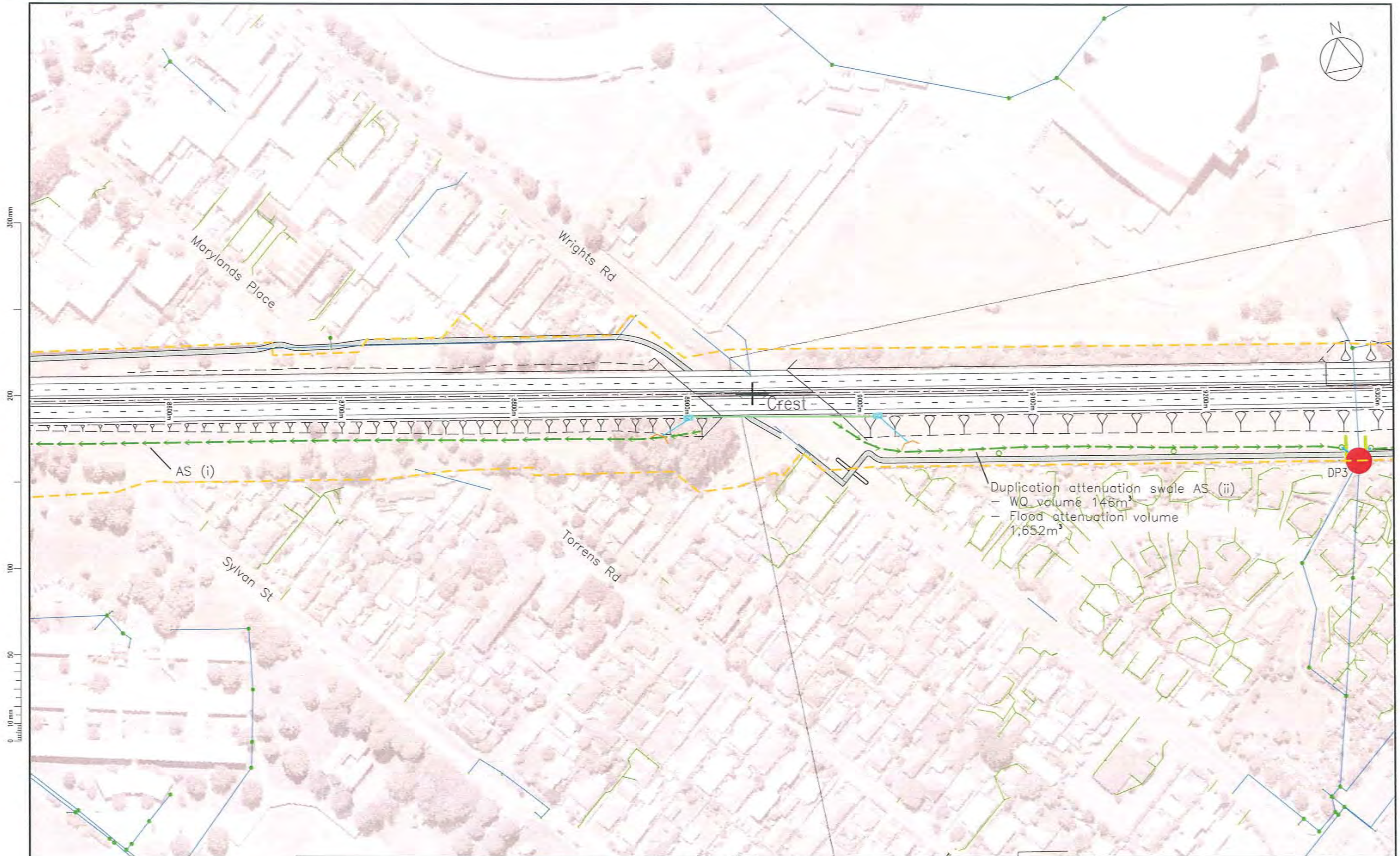

* Refer to Sheet 2 for Legend & Notes

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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TITLE
S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 8530m TO 9250m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD15	R1

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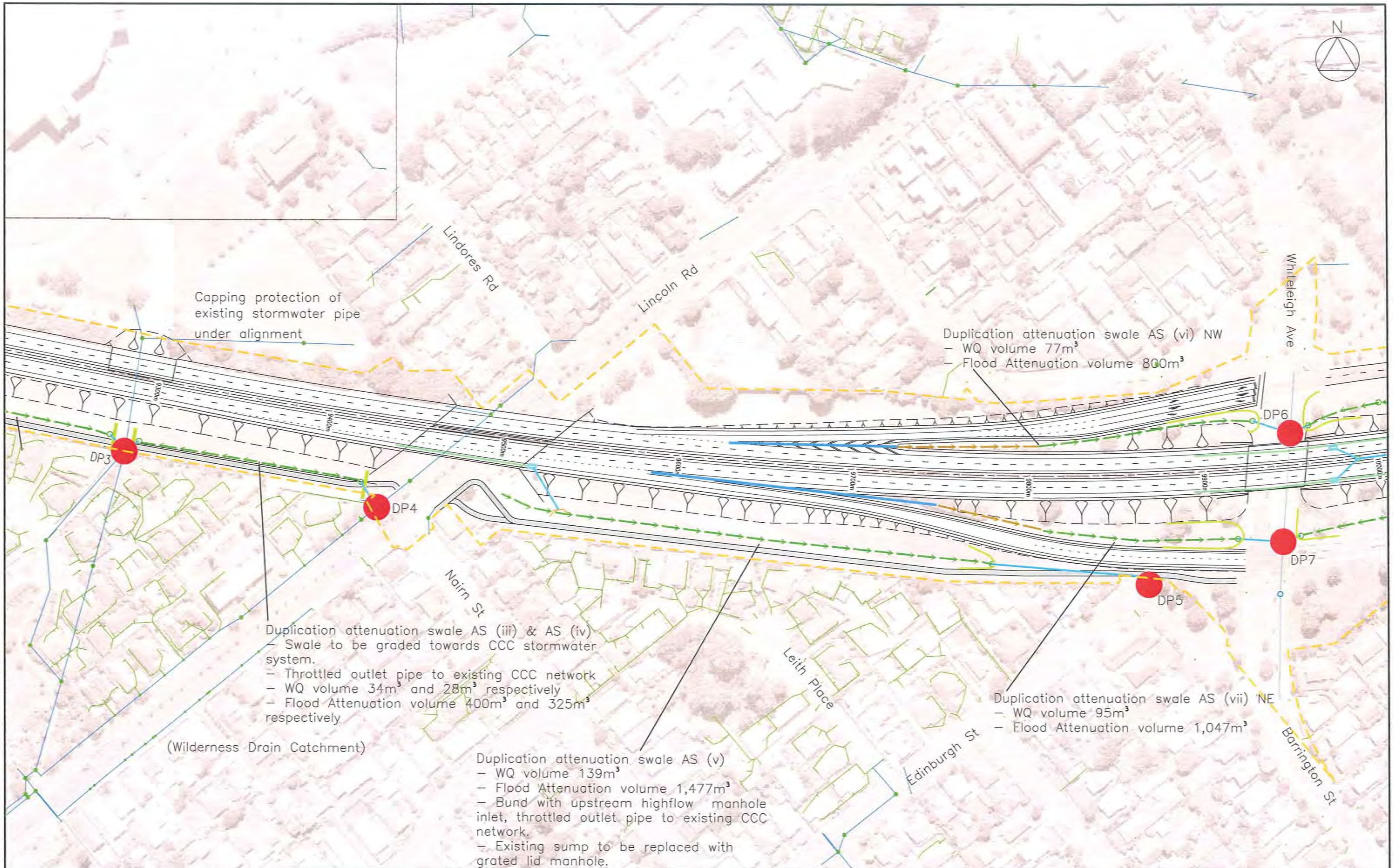

* Refer to Sheet 2 for Legend & Notes

Minor improvements for consent application	TC	2/08
AMENDMENT	APP'D	DATE

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DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 9250m TO 9990m

STATUS	SPECIMEN DESIGN	FILE	5C1124.00		
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD16	R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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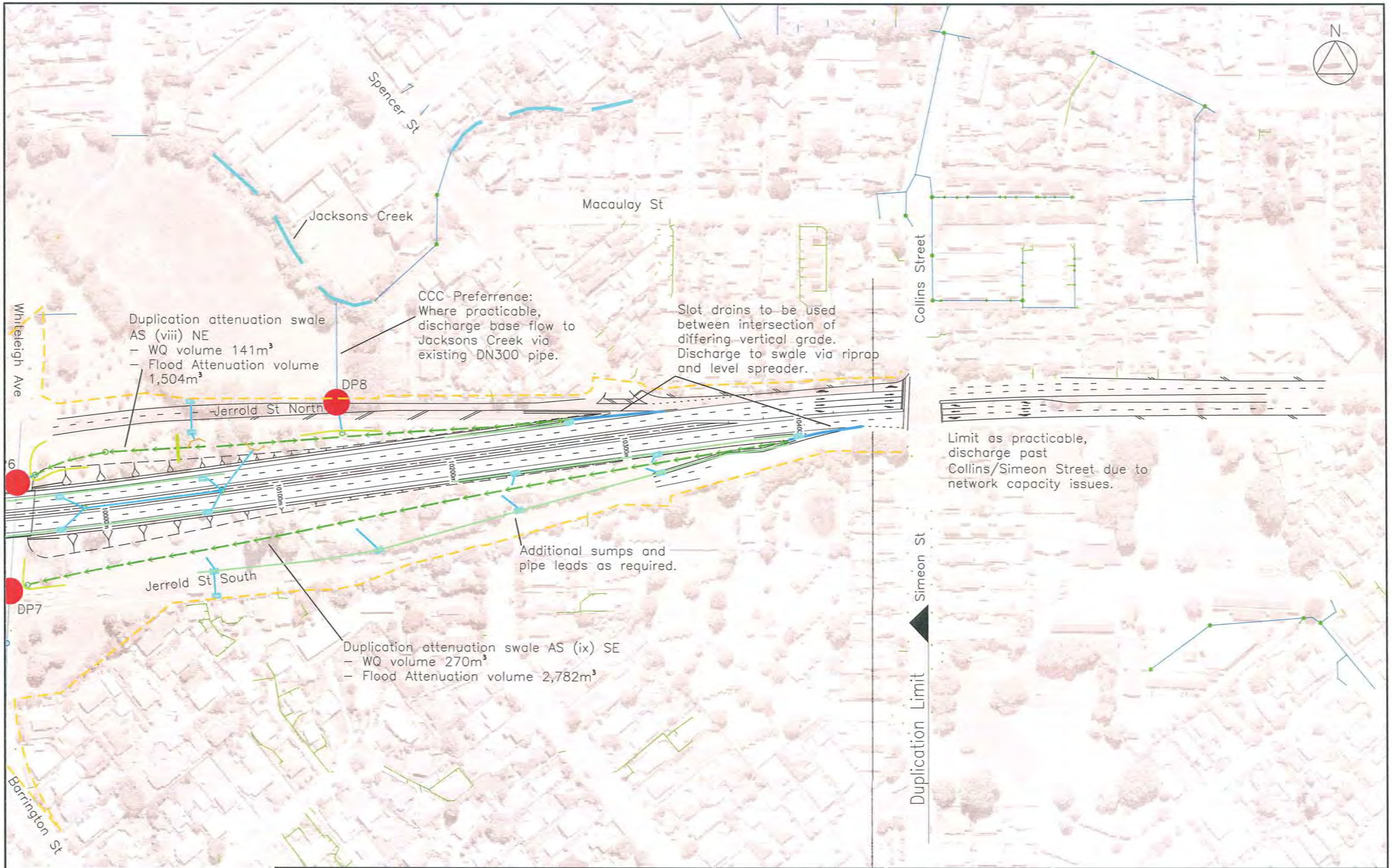

* Refer to Sheet 2 for Legend & Notes

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. MITCHELL	2/08
DRAWN	M. ENGLAND	P. MITCHELL	2/08
APPROVED	A.J.COULMAN		2/08

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CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
PLAN ALIGNMENT – STA. 9990m TO 10900m

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:2000 (A3)	Feb 08	6/208/6	7504	SD17	R1

GRAPHIC SCALES 1:1000 0 10 20 30 40 50 60 70 80 90 100 m

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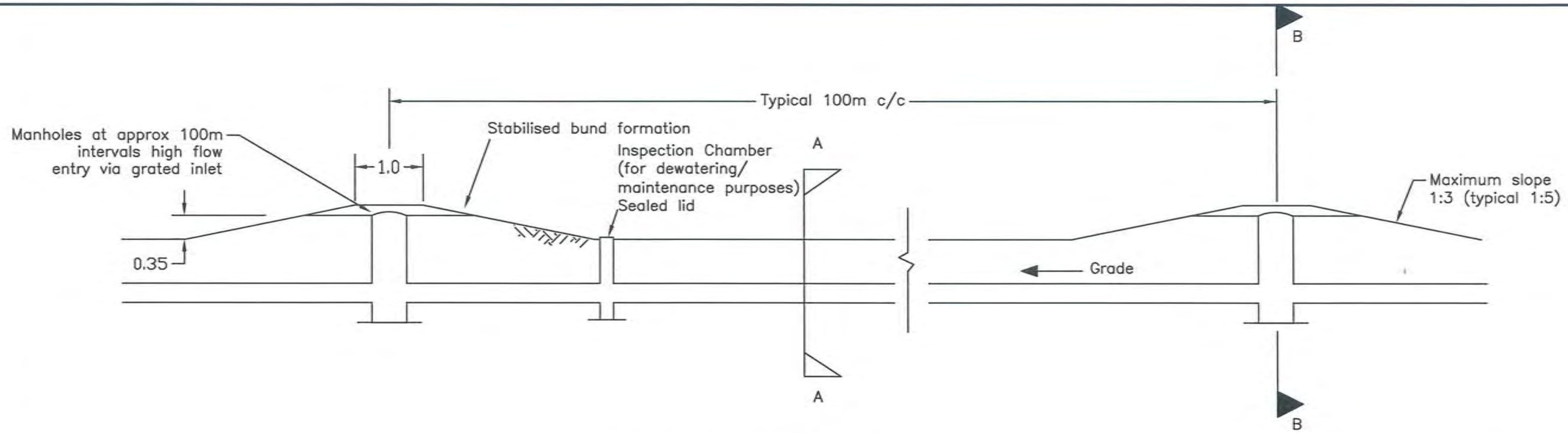
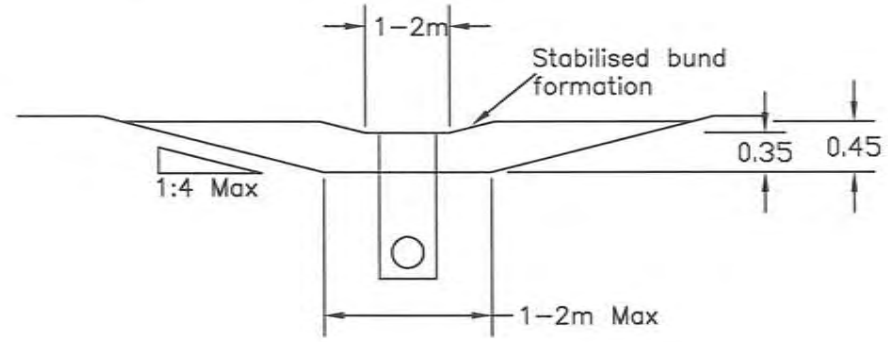
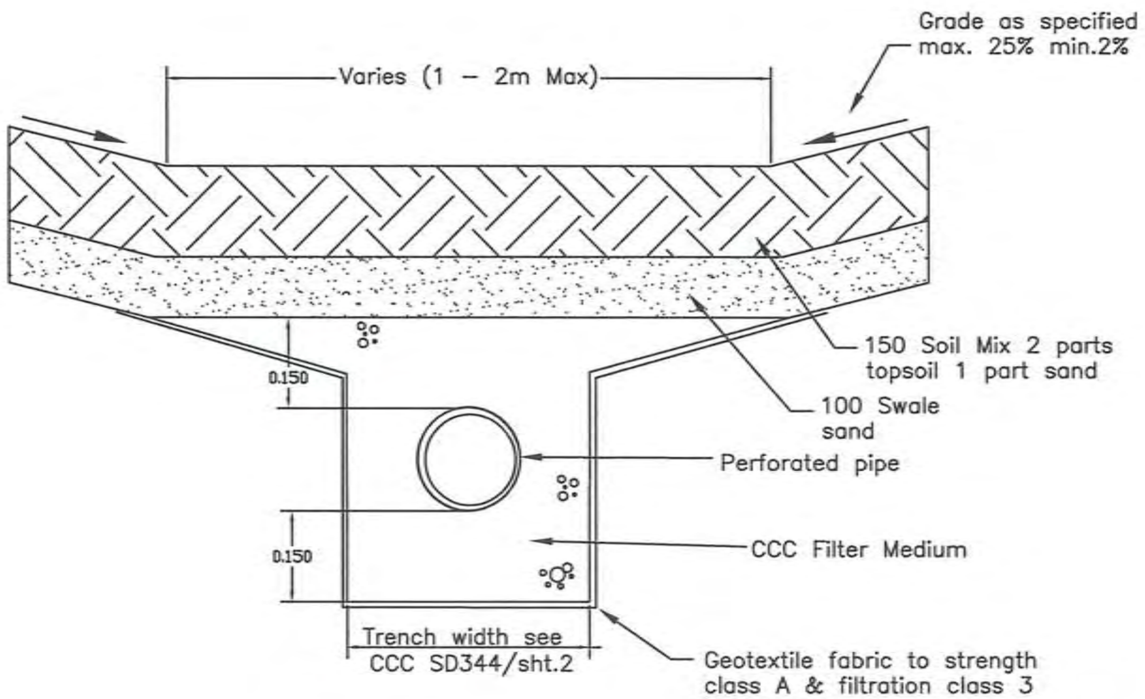


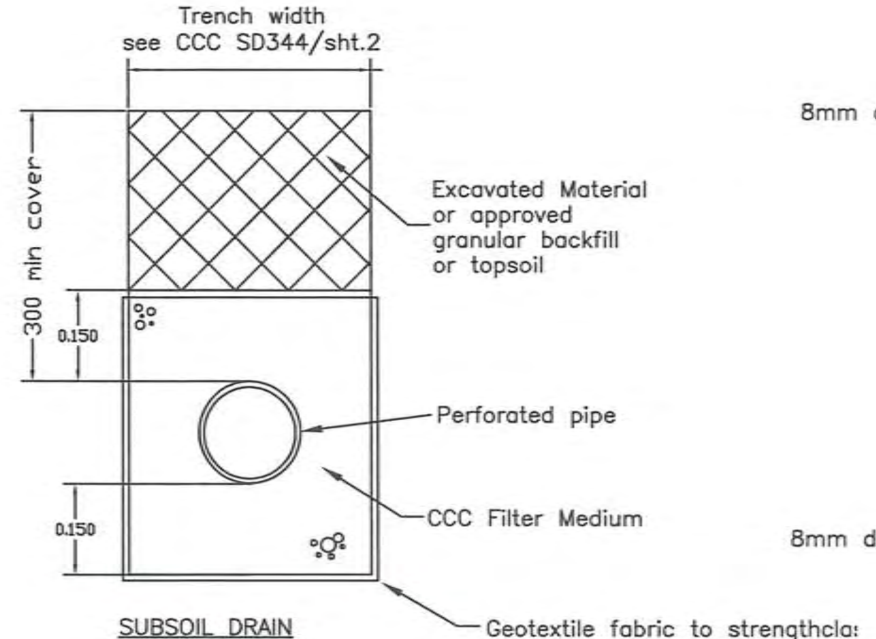
TYPICAL BUNDED SWALE DETAILS (Elevation)
Scale: NTS



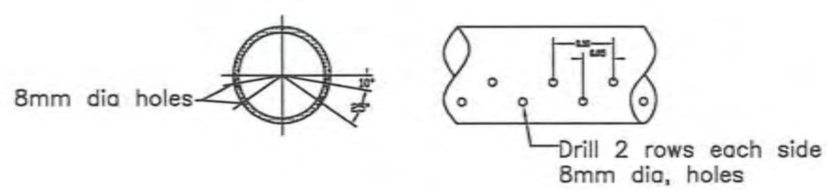
SECTION BB
Scale: NTS



SECTION A–A
SWALE & SUBSOIL DRAIN
Scale: NTS



SUBSOIL DRAIN
TYPICAL SECTION
Scale: NTS



Underdrain Detail
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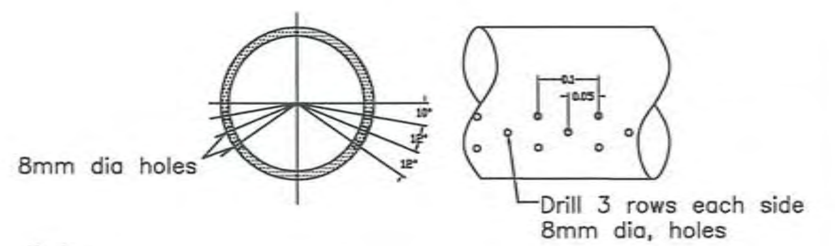
Scale: NTS



Underdrain Detail
>/= DN200

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. Mitchell	2/08
DRAWN	M. England	P. Mitchell	2/08
APPROVED	A.J.COULMAN		2/08

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

Typical Details
Swale & Under Drainage

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET / REVISION
AS SHOWN	Feb 08	6/208/6	7504	SD20 / R1

GRAPHIC SCALES

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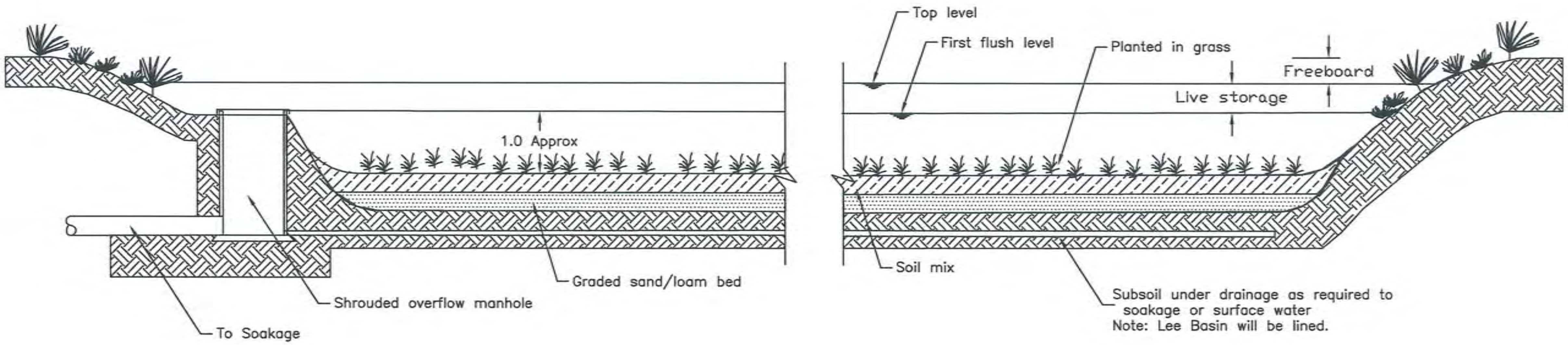
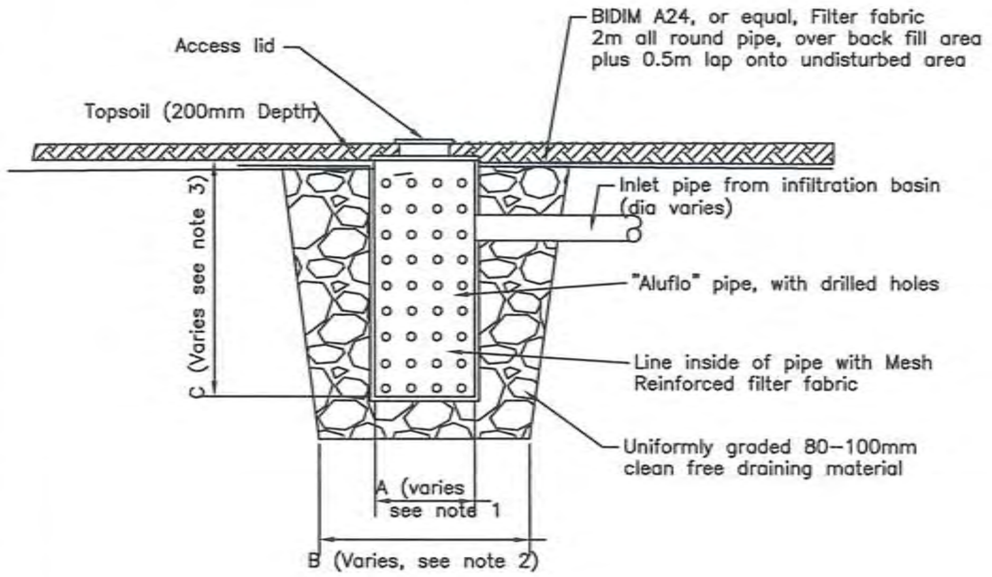
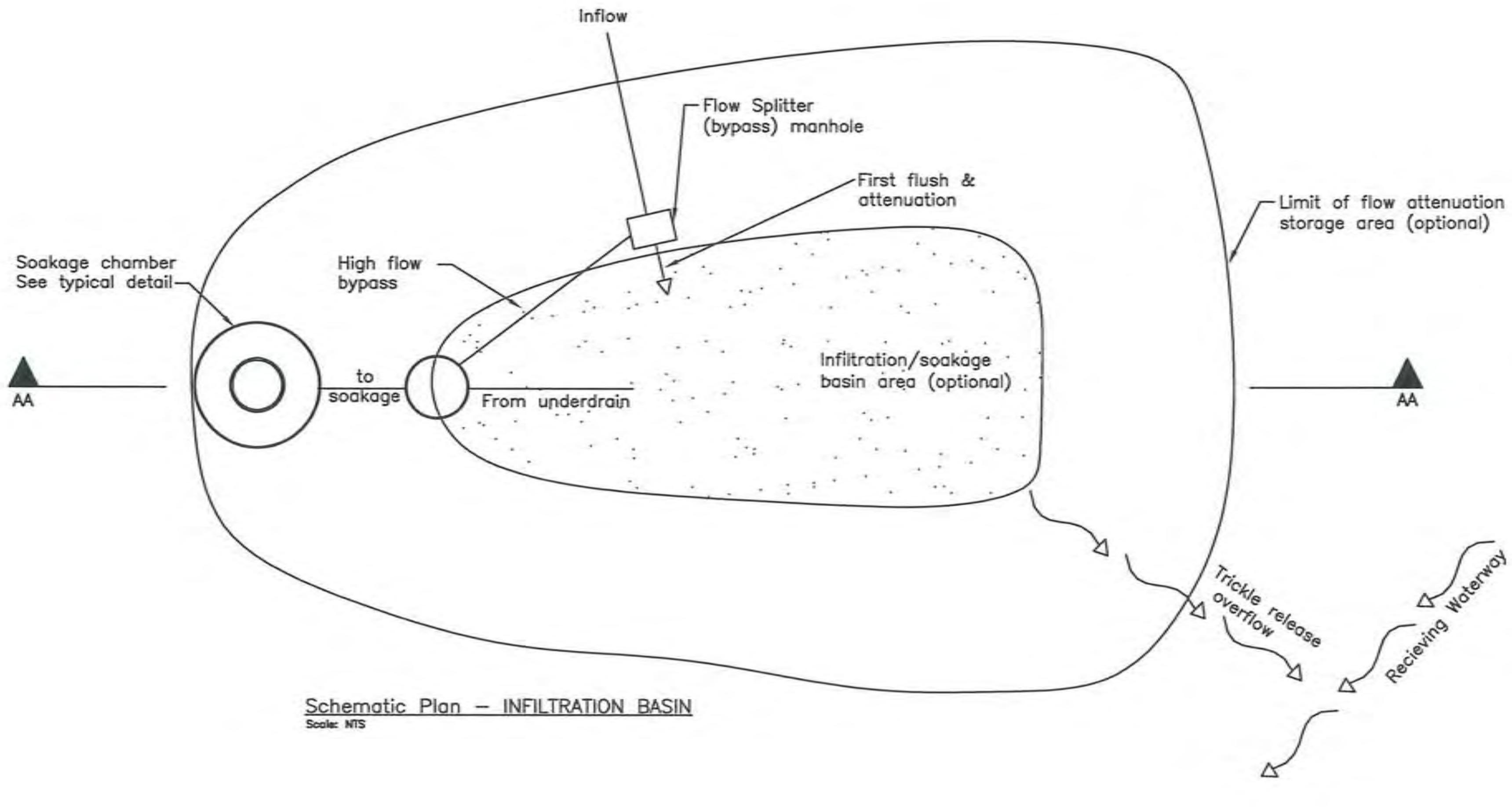


Section AA
TYPICAL INFILTRATION BASIN DETAIL
Scale: NTS



TYPICAL SOAKAGE CHAMBER DETAILS
Scale: NTS



Schematic Plan – INFILTRATION BASIN
Scale: NTS

Note
1. Diameter A of "Aluflo" pipe varies. Subject to final design
2. Diameter B of soakage hole varies subject ot final design
3. Depth C varies according to availability of free draining gravels at each site. Infiltration testing required.
4. Concept only. Subject to final design

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

	BY	CHECKED	DATE
DESIGN	PM SC ME	P. Mitchell	2/08
DRAWN	M. England	P. Mitchell	2/08
APPROVED	A.J.COULMAN		2/08

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Typical Details
Basin & Soakage Details

STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			
SCALE	**PLOT DATE**	**FEATURE IDENTIFIER**	**CODE**	**SHEET** / **REVISION**
AS SHOWN	Feb 08	6/208/6	7504	SD21 / R1

GRAPHIC SCALES

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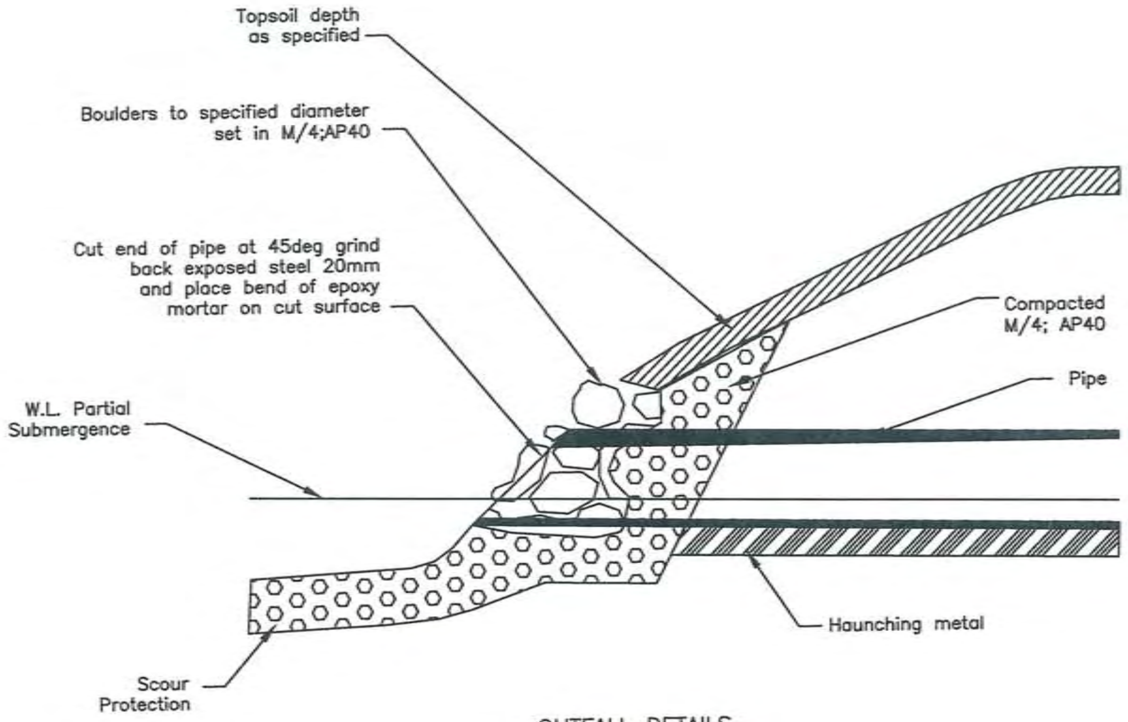
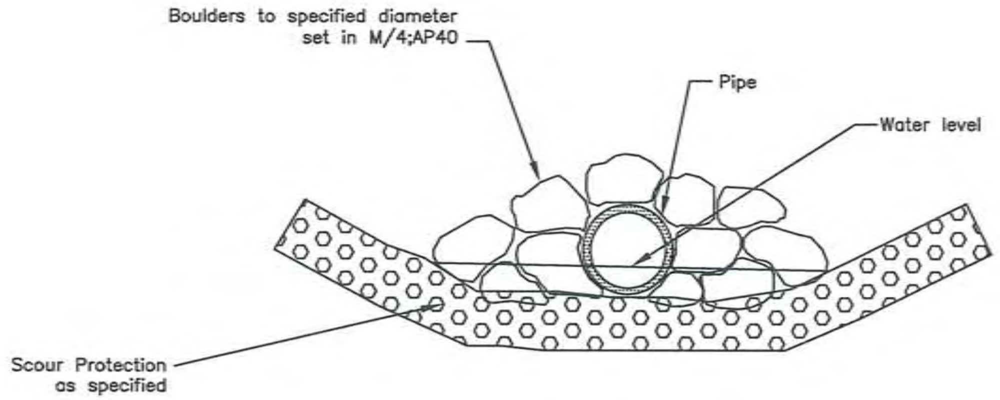


OUTFALL DETAILS
(PIPE <750)
Scale: NTS



OUTFALL END VIEW
Scale: NTS

AMENDMENT	APP'D	DATE
Minor improvements for consent application	TC	2/08

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APPROVED	A.J.COULMAN		2/08

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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

Typical Details
Outfall Details

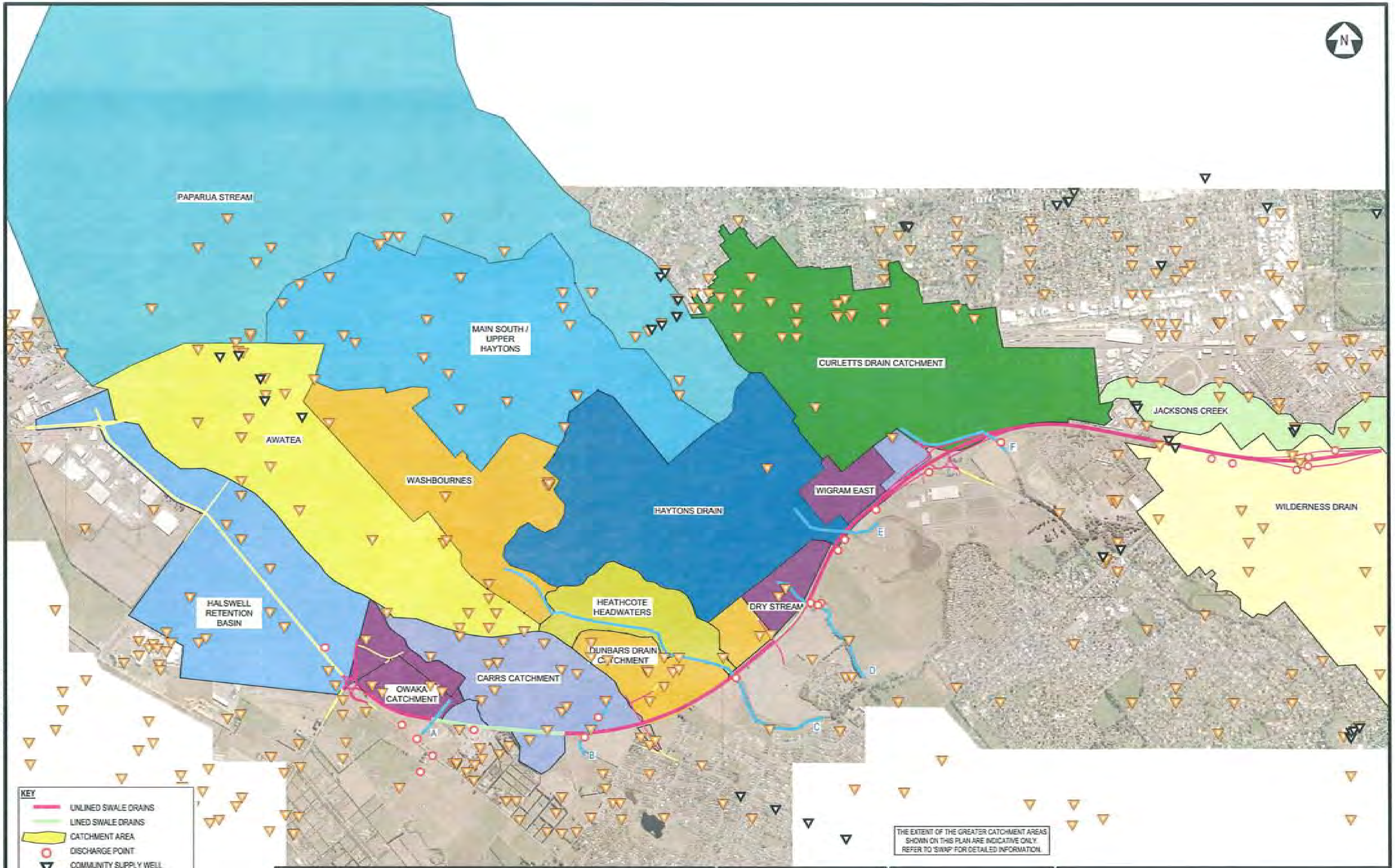
STATUS	FILE			
SPECIMEN DESIGN	5C1124.00			

SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
AS SHOWN	Feb 08	6/208/6	7504	SD22	R1

GRAPHIC SCALES

p:\projects\5c1124.00 christchurch southern motorway tnz61704\Drawings\Specimen Design\Stormwater ORIGINAL SHEET SIZE A3 [420x297]

Appendix C
Stormwater Management – Upper Catchment Areas



	BY	CHECKED	DATE
DESIGN	M.ENGLAND	P.MITCHELL	5/08
DRAWN	I.TAYLOR	P.MITCHELL	5/08
APPROVED			

AMENDMENT | APP'D | DATE

TRANSIT NEW ZEALAND

OPUS
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TITLE S.H.73 R.11 R.S.0
CHRISTCHURCH SOUTHERN MOTORWAY DUPLICATION & EXTENSION

STORMWATER CONCEPT
OVERVIEW PLAN

STATUS	SPECIMAN DESIGN	FILE	5C1124.00		
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
1:12000(A1), 1:24000(A3)	23/05/08 @ 07:38	6/208/6	7504	SD25	R0

GRAPHIC SCALES 1:12000(A1) 0 200 400 600 800 1000 1200 m

p:\projects\5c1124.00 christchurch southern motorway tnz61704\drawings\specimen design\stormwater\6_208_6_7504_sdxx.dwg ORIGINAL SHEET SIZE A1 [840x594]