Appendix A

Infrastructure Assessment

Infrastructure Report

ROLLESTON INDUSTRIAL DEVELOPMENTS LTD

LINCOLN SOUTH PLAN CHANGE

PROJECT 14692

ISSUE 3 – 28 OCTOBER 2020

INOVO PROJECTS

Contents

QUALITY ASSURANCE

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1. Introduction

1.1. Purpose

Inovo Projects Ltd has been engaged by Rolleston Industrial Developments Ltd to complete an Infrastructure Assessment for a proposed residential development at 1491 Springs Road, south of the township of Lincoln, in support of a Plan Change application for development of approximately 2,000 residential lots at the site. The purpose of this report is to provide information on ;

- Existing infrastructure around the site
- Proposed infrastructure for the development
- Conformance to national standards, Selwyn District Council's (SDC) policies and best practices relating to subdivision development, in particular:
  - Waterways, Wetlands and Drainage Guide (Christchurch City Council)
  - Selwyn District Council's *Engineering Code of Practice* (SDC ECOP)
  - NZS4404:2010 Land Development and Subdivision Infrastructure

1.2. Limitations

This report may not be reproduced, in whole or in part, without our prior written approval. This report has been prepared for the purpose stated in the report and may be relied upon for that purpose only. Assumptions made in the preparation of the report are as expressly stated in the report or set out below.

Where information has been supplied to us for the purpose of the report by another party, this information is believed to be reliable but we can accept no responsibility if this should prove not to be so.

2. Site Overview

2.1. Site Description

The Lincoln South Plan Change site is an existing dairy farm of approximately 186 ha straddling either side of Springs Road located to the south of Lincoln township, adjacent to the Te Whāriki (Residential - Living Z) and Verdeco Park (Residential - Living 3 & Living Z and Business 2B) developments. The site extends south to Collins Road, east to Ararira/LII River , and west to an unnamed private drain along its western boundary.

The land is currently zoned Rural – Outer Plains. The current land use surrounding the site to the west, south and east is primarily rural. Lincoln University located 1 km to the north and the Lincoln township located approximately 2 km to the northeast of the site. Stage 4 of Te Whāriki subdivision, between Southfield Drive and the plan change site, is currently under construction and will contain approximately 360 lots typically ranging in size from 500-900m^2.

The site is typically gently sloping (1:180) to flat, sloping from Springs Road to the southeast towards Ararira/LII River and to the south / southwest to Collins Road and the unnamed private drain. Springs Creek traverses the eastern half of the site before combining with the Ararira/LII River. The site has been used for dairy farming purposes for the last 50 years and is currently covered in variety of irrigated pasture. The majority of the site comprises agricultural fields and pasture, with a cluster of farm building and diary-farm infrastructure situated near the centre. There are 5 existing houses on the subject site, including the historic 'Chudleigh' homestead on the south bank of the Springs Creek headwater springs. Shelter belts, including poplar and macrocarpa species, line Springs Road but otherwise the site is free of any significant vegetation with the exception of around the homestead and Springs Creek headwaters.

2.2. Drainage Features

Springs Creek is a spring fed tributary of the Ararira/LII River with headwater springs situated within the grounds of the historic 'Chudleigh' homestead. Springs Creek traverses the eastern half of the site before linking with the Ararira/LII River some 400m downstream of the confluence of the L1 River and Liffey Stream. The creek bed alignment has been modified over time to straighten the channel and improve its drainage function.

Lincoln Main Drain (LMD) is a spring-fed classified drainage channel that crosses the northeast portion of the site from northwest to southeast and serves as the main drain outlet for the Te Whāriki subdivision. The LMD is a formalised drainage channel some 1.5 to 2.5m deep with steep banks and discharges into the Ararira/LII River some 185m downstream of the confluence of the LI River and Liffey Stream.

Collins Road Drain is a classified drainage channel running alongside Collins Road on the south boundary of the site and discharging into the Ararira/LII River in the southeast corner of the site. There are 3 branch drains extending into the lowest parts of the site and connecting to numerous springs. Collins Road drain was formalised over 100 years ago to drain swampy land adjacent to the Ararira/LII River to increase agricultural production.

Baseflow in Springs Creek, Lincoln Main Drain, and Collins Drain is dominated by groundwater discharges from artesian springs.

There is an unnamed private drain (unclassified) on the western boundary of the site which discharge into the SDC classified drainage network in Collins Road. The SDC drain flows southwest along Collins Road then connects with a larger drain that follows Sergeants Road until it enters the Ararira/LII River approximately 3.4 km downstream from the site. The unnamed drain is believed to be a natural ephemeral watercourse that was formalised as a drain over 100 years ago. The tail end of the Paparua Stockwater Race network discharges into the northern end of this drain (this is formally the end of the stockwater race) and provides more regular flows (subject to water demand upstream). Stormwater runoff from the Verdeco Park development including any secondary overland flow is directed to this unnamed drain.

2.3. Ground Conditions

A geotechnical investigation and assessment of suitability for subdivision has been carried out by Coffey Services Ltd as described in their *Geotechnical Assessment Report* for 1491 Springs Road Lincoln (Ref. 773-CHCGE280252 dated October 2020).

The ground model for the site is described as interbedded alluvium consisting of soft to very stiff silts, sandy silts and silty sands to varying depth from 1 to 5.5m, overlying interbedded alluvium deposits typically consisting of sand and gravel deposits with some layers of silt, sandy silt and silty sand to greater than 20m depth (Springston Formation). The eastern edge of the site has potentially organic deposits in the low-lying areas (further investigation required to confirm).

Groundwater is shallower in the eastern portions of the site and gradually deepens to the west as ground levels rise to around 2 to 3m below ground level. Groundwater levels on the eastern edge of the site are dominated by the water level in the Ararira/LII River which is in turn affected by water levels in Te Waihora/Lake Ellesmere and regular maintenance of the drainage network to remove weeds and sediment. Small rainfall events mostly infiltrate into the soils, but more substantial rainfall events, particularly in winter, can produce overland runoff.

2.4. Groundwater & Springs

The Environment Canterbury (ECan) GIS database shows 12 wells within the plan change site. The wells are used for domestic supply (4), irrigation and/or stockwater (5), and groundwater quality and water level observations (3). The productive water supply wells range in depth from 19m to 28m. The highest measured depth to groundwater in shallow wells near the site varies between 0.2 and 0.42 m below ground level.

The groundwater table level will influence the depth of stormwater management systems, particularly on the lower lying land on the eastern portion of the site where groundwater levels are influenced by the water level in the Ararira/LII River.

There are a number of artesian springs and associated land drains located across the site that will be incorporated into the overall development plan.

2.5. Existing Infrastructure

There is no existing SDC infrastructure located within the site. Existing dwellings located within the site have on-site supply wells and wastewater systems, as well as private connections for power and telecommunications. Infrastructure to neighbouring residential subdivisions to the north can be extended to the proposed development.

Stormwater drains located on both the western and eastern boundaries of the site have the potential to be utilised as the stormwater discharge points for the proposed development. Both drains ultimately discharge to the Ararira/LII River . Further discussion of stormwater is found in Section 3.

An existing sewer rising main is located within Springs Road, immediately north of the proposed development site. This existing Ø140mm rising main originates from the wastewater pump station in Verdeco Park and discharges into the Springston/Prebbleton rising main at the intersection of Gerald Street / Springs Road, which then discharges to the Allendale Pump Station located immediately to the north of the development site. From the Allendale Pump station wastewater is pumped to 'The Pines' Wastewater Treatment Plant in Rolleston via the Selwyn Road Pump Station. Further discussion of sewer infrastructure is found in Section 4.

There is an existing Ø200mm uPVC water supply main located within Springs Road which extends to the Verdeco Park Business Zone immediately opposite the driveway to No. 1491 Springs Road. Further discussion of water supply is found in Section 5.

3. Stormwater

3.1. Eastern Catchment

The eastern catchment is bounded by Springs Road, Collins Road, Ararira/LII River and Te Whāriki Subdivision to the west, south, east and north respectively, and generally falls west to east towards the Ararira/LII River .

Springs Creek is a small spring-fed watercourse that bisects the eastern catchment and discharges into the Ararira/LII River . The Springs Creek alignment has been partially straightened to improve its drainage function and increase usable area for farming. There are also numerous land drains within the farm that typically originate at existing springs and provide land drainage to reduce waterlogging of the soil and increase productivity . There is a classified drain along the north side of Collins Road known as Collins Drain, with 3 branch drains extending into the site.

The proposed receiving environment for stormwater discharge from the eastern catchment is the Ararira/LII River which runs along the eastern boundary of the site. The Ararira/LII River is a spring fed river which begins at the confluence of the LI and Springs Creeks approximately 1 km south of the Lincoln township. The river flows into the northern end of Te Waihora / Lake Ellesmere some 10 km downstream. The full length of the river is characterised and influenced by land drainage and agricultural land use.

3.2. Western Catchment

The potential receiving environment for stormwater discharge from the western catchment is an existing private drain which runs along the western boundary of the site. The drain is classified as a private drain conveying overland flow including stormwater discharge from the Verdeco Park development. There are several options to convey the water currently carried by this drain including piping it or using an engineered channel. The expected peak flow through the current drain will need to be calculated in order to appropriately design the chosen conveyance method to ensure that flooding onsite of upstream properties does not occur.

Existing overland drainage from Verdeco Park subdivision to the north of the site has been modified and diverted westwards as part of the subdivision development. There is a formed swale along the common boundary that conveys overland runoff and excess stormwater from the Verdeco Park Stormwater Management Area (adjacent to Springs Road) to the unnamed drain to the west.

3.3. Stormwater Management

By developing the site to residential land use there will be an increase in the impervious areas and hence stormwater runoff. The additional runoff will be associated with rooves, driveways and hardstand surfaces which will require treatment and attenuation to manage quality and quantity before being discharged to the receiving environment.

Initial observations indicate that across most of the site ground conditions consist of poorly drained soils and relatively high groundwater levels that would suggest that stormwater generated from individual lots may not be able to be discharged to ground and therefore will need to be managed with surface facilities. For the higher parts of the western catchment (i.e., west of Springs Road) disposal to ground may be feasible (to be further investigated during subdivision design stage). For the purpose of this assessment it is assumed that all additional stormwater resulting from the development will be managed using constructed Stormwater Management Areas to treat and attenuate runoff before discharging to the receiving environment.

Stormwater Management Areas (SMA'S) are proposed at the downslope end of each catchment to provide stormwater treatment and attenuation following the principles of the *Wetlands and Waterways Design Guide* (WWGD) published by Christchurch City Council (CCC, 2012). The SMA'S will consist of ;

- a first flush basin to capture and remove total suspended solids in the runoff generated by the first 20 mm of rainfall on the catchment (primary treatment);

- a wetland to provide water quality polishing in rainfall events up to the first flush depth of 20 mm (secondary treatment), and provide live storage in large rainfall events exceeding the 20% AEP event; and
- a detention basin to provide water quantity attenuation in large rainfall events greater than the first flush event, but up to the 2% AEP.

Refer to Appendix A for the *Stormwater Concept Design Report* prepared by e2 Environmental which provides a high-level analysis undertaken for the concept design of the required stormwater management areas. The report demonstrates how the proposed stormwater management meets legislative requirements and documents the methodology behind the calculations.

From a stormwater perspective, the plan change can be supported with areas set-aside for stormwater treatment and attenuation as outlined above.

3.4. Diversion of Drains

Existing drains within the site may be diverted to maximise the opportunity for developable land, improve the amenity value by naturalisation of formal land drains, provide compensatory flood storage volume, and to achieve stormwater quality objectives.

The Lincoln Main Drain is to be diverted to the northern boundary of the site. This presents the opportunity to naturalise and enhance the amenity values of this drain. This will not affect its primary function as main drain outlet to the Te Whāriki subdivision.

Branch drains connecting to the Collins Drain will be diverted around proposed Stormwater Management Areas to avoid mixing of clean spring waters and untreated stormwater runoff. Where appropriate (and feasible) spring flows will be used to maintain baseflow through wetland treatment areas.

There are a number of smaller springs and associated land drains located across the site that will be incorporated into the development at the subdivision design stage.

3.5. Flood Management

The lower parts of the site next to the Arariri/LII River are susceptible to surface water ponding and flooding in high rainfall and flood events, including overtopping of the Arariri/LII River and tributaries in extreme events. Detailed model results showing the extent and flood depth are available to view on the SDC's website and are presented in the *Stormwater Concept Design Report* in Appendix A. Options for flood management are also presented.

Flood modelling for the 0.2% AEP indicates flooding of the Arariri/LII River floodplain next to the Arariri/LII River to a maximum level of approximately RL 4m (New Zealand Vertical Datum 2016). Parts of the site above RL 4m are not subject to inundation and can be safety developed. Areas of the site below the RL 4m contour line can potentially be developed as larger residential lots subject to setting minimum building platform levels and allowing part of these lots to flood in extreme events.

In general, ground levels for residential lots will be set above internal road levels so the roads act as secondary flow paths to safely convey floodwaters towards the Stormwater Management Areas. Flood levels will be controlled by the stormwater basin/wetland outlet structures. Compensatory storage may be required to offset embankments and structures constructed for the stormwater management areas in the Arariri/LII river floodplain.

A flood risk assessment will be carried out at subdivision consent application stage as required by Section 106 of the Resource Management Act. Overland flow from upstream catchments shown in the flood models, and in particular Te Whāriki subdivision, have been modified and mitigated by subdivision development upslope and the flood models will need to be updated. It is considered that any adverse stormwater effects can be appropriately mitigated through stormwater management areas in the ODP and minimum floor level rules at the time of subdivision and / or residential development.

4. Wastewater

4.1. Reticulation

The majority of new lots can be serviced by gravity sewer network discharging to new pump stations located at the west and east ends of the site (lowest elevation). Lots that cannot be serviced by gravity sewer will utilise local pressure sewer to discharge into the gravity network.

The final number and locations of sewer pump stations will be determined during subdivision design in consultation with SDC. It is envisaged there will be at least two pump stations located to the west and east margins of the site (lowest elevation).

The pump station servicing the area east of Springs Road will discharge via a new rising main laid directly across to the SDC Allendale Pump Station some 900m to the northeast. This avoids adding any extra load to the existing local sewer infrastructure to the north of the site.

If developed first, the pump station servicing the area to the west of Springs Road can initially discharge into the existing Ø140mm sewer rising main Springs Road, and then be modified to discharge to the gravity network draining to the eastern pump station once this is developed to avoid adding additional load to the existing Springston/Prebbleton rising main.

A third pump station may be required to service the north-eastern portion of the site north of Springs Creek to avoid a siphon or deep sewer crossing under the creek bed. This pump station would pump into the same rising main to the Allendale Pump Station. An alternative solution is to service this area with local pressure sewer.

4.2. Network Capacity

Refer to the Wastewater Network Capacity Assessment prepared by WSP attached as Appendix B for an assessment of the capacity of the Allendale Pump Station and rising main network to Rolleston. In their assessment WSP concluded that the addition of the proposed wastewater flows from the plan change area does not cause any significant problems at Allendale Pump Station and Selwyn Road pump stations during dry weather. During wet weather the peak flow to Allendale Pump Station is greater than its capacity and overflow to the emergency storage facility at Allendale is predicted. Allendale Pump Station has sufficient emergency storage to act as a buffer for the additional flows entering the system from the ODP area.

The capacity of the existing Ø140mm sewer rising main in Springs Road and the Springston/Prebbleton rising main discharging to the Allendale Pump Station has not been assessed. However, increased demand on this pipeline due to population growth in Springston and Prebbleton can be expected. A new rising main from the proposed eastern pump station directly to the Allendale Pump Station avoids any local network constraints.

From a wastewater perspective, the plan change can be supported with new infrastructure servicing the plan change area as outlined above.

5. Potable Water

5.1. Reticulation

The Lincoln township reticulated supply extends along Springs Road to the Verdeco Park Business Zone, opposite the plan change site. As reported by WSP in their memo in Appendix C, upgrades of existing pipes in Springs Road may be required to ensure adequate water supply.

Additional connections to other parts of the Lincoln township reticulation network to the northeast such as Te Raki Drive (via the Allendale pump station site) and Liffey Springs Drive to increase network connectivity and resilience will be determined at the subdivision design stage.

The internal pipework within the development will be designed to accommodate peak demand including provision for fire-fighting demand in accordance with SDC's *Engineering Code of Practice* and SNZ/PAS 4509:2008 *Fire Service Code of Practice*.

5.2. Network Capacity

Refer to the Water Supply Network Capacity Assessment prepared by WSP attached as Appendix C for an assessment of the upgrades required to the SDC water supply network to service the plan change area. Two upgrade options were considered in their assessment including upgrading the existing SDC bore facility at Vernon Drive and water supply mains to the site, and development of a new supply bore in the proposed development area. WSP concluded there are there are no water supply issues which would impede rezoning of this land for residential use.

From a water supply perspective, the plan change can be supported with upgrades and extension of existing infrastructure to service the plan change area as outlined above.

6. Power / Telecommunications

6.1. Power

There is existing 11kV and 33kV electricity network bordering the site which can be extended to provide sufficient power to the development. Full appraisal of the network extension requirements will be carried out by the network provider once the Plan Change approval has been obtained.

Power will be provided to all allotments to utility company and industry standards. All network and reticulation cabling will be installed underground. Transformer kiosk sites will be located on separate lots at locations approved by the utility company and SDC.

6.2. Telecommunications

Telecommunications will be provided to all sites in the form of fibre optic network installed to utility company and industry standards. The existing fibre network in Springs Road can be extended from the Verdeco Boulevard intersection to the site and distributed to individual allotments. All network and reticulation cabling will be installed underground.

7. Roading

7.1. Road Layout

The proposed primary roading layout is shown on the ODP plans attached to the planning application. There are several proposed connections onto Springs Road and Collins Road. A connection onto Moirs Lane has been proposed to provide a link to Ellesmere Road.

The proposed secondary roading patterns have been indicatively shown on the ODP plans attached to the planning application. Tertiary roads to further subdivide the main roading patterns will be determined during the subdivision design stage in consultation with SDC.

All road corridors will have 13m-23m legal width. Rights of way will be between 3.5m and 6.5m, dependant on the number of users and length of ROW.

7.2. Road Cross Section

Standard "SDC Low Profile" kerb and channel will be used in all roads in the subdivision, with cutdowns where appropriate for pedestrian crossings and ROW's.

Concrete footpaths with broom or exposed aggregate finish are proposed in the roading network in accordance with SDC Engineering Code of Practice and in keeping with other recent subdivisions in Lincoln. Footpath layout and links to green spaces will be discussed further with SDC at the engineering approval stage.

7.3. Road Stormwater Drainage

Stormwater runoff within road corridors will be conveyed via kerb and channel into appropriately spaced sumps or roadside swales. All sumps will have trapped and/or inverted outlets, and connected to the piped stormwater network or conveyance swales. The road corridor will be used as overland flow paths to direct stormwater runoff when the drainage network is at full capacity.

8. Earthworks

8.1. Bulk Earthworks

The topography of the existing site is generally sloping either northeast to southwest (western catchment) towards the drain on the western boundary or west to east towards the Ararira/LII River (eastern catchment), at an average gradient of 1:180 and with height difference of approximately 8 metres total elevation change from the Ararira/LII River (RL 3m) to the highest point west of Springs Road (RL 12m in terms of New Zealand Vertical Datum 2016).

Bulk earthwork design will be determined by providing overland flow paths along roads and achieving 1:500 (absolute minimum) grade from the top of kerb to the rear of the sections fronting the road. The design philosophy for the setting of earthwork levels will be determined by the following criteria:

1. Road gradients not to exceed 1 in 20, not to be less than 1:450 where possible
2. Cut/fill balance where applicable
3. Overland flow paths for the subdivision are to follow the road layout, with the overall site overland flows not being different to the current situation.

To avoid carting material off-site earthworks will be designed to achieve a cut/fill balance across the site. Any filling operations exceeding 300mm depth will be carried out in accordance with NZS4431:1989 *Code of Practice for Earthfill for Residential Development*. It is envisaged that material won from site, will be sufficient to use as structural engineered fill.

A former borrow pit located to the northwest of Springs Road and Collins Road intersection has been identified, and it is understood environmental investigation and reporting has been carried out previously. Options for remediation for residential land use or setting aside for alternative land use such as reserve area will be investigated during the subdivision design stage.

All earthworks on residential lots and roads will be carried out in accordance with principles outlined on the Environment Canterbury's *Erosion Sediment Control Toolbox* to minimising the adverse effects of erosion and sedimentation during construction.

9. Summary & Conclusion

Stormwater runoff from the majority of the site will be conveyed by a network of swales and pipes to two proposed Stormwater Management Areas for treatment and attenuation before being discharged into the Ararira/LII River to the east and an existing private drain to the west of the site. Detailed design of the SMA's will be determined by the developer in collaboration with SDC at the subdivision stage and in accordance with Environment Canterbury requirements.

The majority of new sites can be serviced by gravity sewer network discharging to new pump station(s) located to the west of Springs Road and at the east end of the site (lowest elevation). Sites that cannot be serviced by gravity sewer will utilise Local Pressure Sewer to discharge into the gravity network. The eastern pump station will discharge via a new pumping rising main directly across to the SDC operated Allendale Pump Station some 900m to the northeast of the site. The Allendale Pump Station has sufficient emergency storage to act as a buffer for additional flows entering the system from the plan change area.

The water reticulation will be an extension of the existing water reticulation network bordering the site. Upgrades of existing pipes in Springs Road may be required to ensure adequate water supply. Additional connections to other parts of the SDC network to the northeast will be determined at the subdivision stage to increase network connectivity and resilience.

Existing electricity and fibre broadband networks in the surrounding developments to the north can be extended to service the proposed plan change area.

From an infrastructure perspective, the plan change can be supported by extension of infrastructure servicing neighbouring developments and provision of stormwater management areas within the development.

APPENDIX A | STORMWATER CONCEPT DESIGN REPORT

CARTER GROUP

22 October 2020

LINCOLN SOUTH PLAN CHANGE

Stormwater Concept Design Report

Carter Group

22 October 2020

Lincoln South Plan Change

Stormwater Concept Design Report

Quality Control			
Author	*Daniel McMullan*	Client	*Carter Group*
Reviewed by	*Andrew Tisch*	Date Issued	*22 October 2020*
Approved by	*Andrew Tisch*	Revision No.	*2*
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1 Introduction

This report focusses on the following:

- **Treatment of stormwater in the first flush event;**
- **Attenuation of stormwater in large rainfall events; and**
- **Management of overland flow paths and ponded water in large flood events.**

1.1 Background

This report supports an application for a private plan change to the Selwyn District Council (SDC) on a block of land south of the Lincoln township, just north of Collins Road and west of the Ararira/LII river (see Figure 1). e2Environmental Ltd (e2) has been engaged to provide technical advice regarding the management of stormwater from both a water quality and a water quantity perspective.

1.2 Report Purpose

The purpose of this report is to document the high-level analysis undertaken by e2 for the concept design of stormwater management areas. The report demonstrates how the proposed stormwater management meets legislative requirements and documents the methodology behind the calculations.

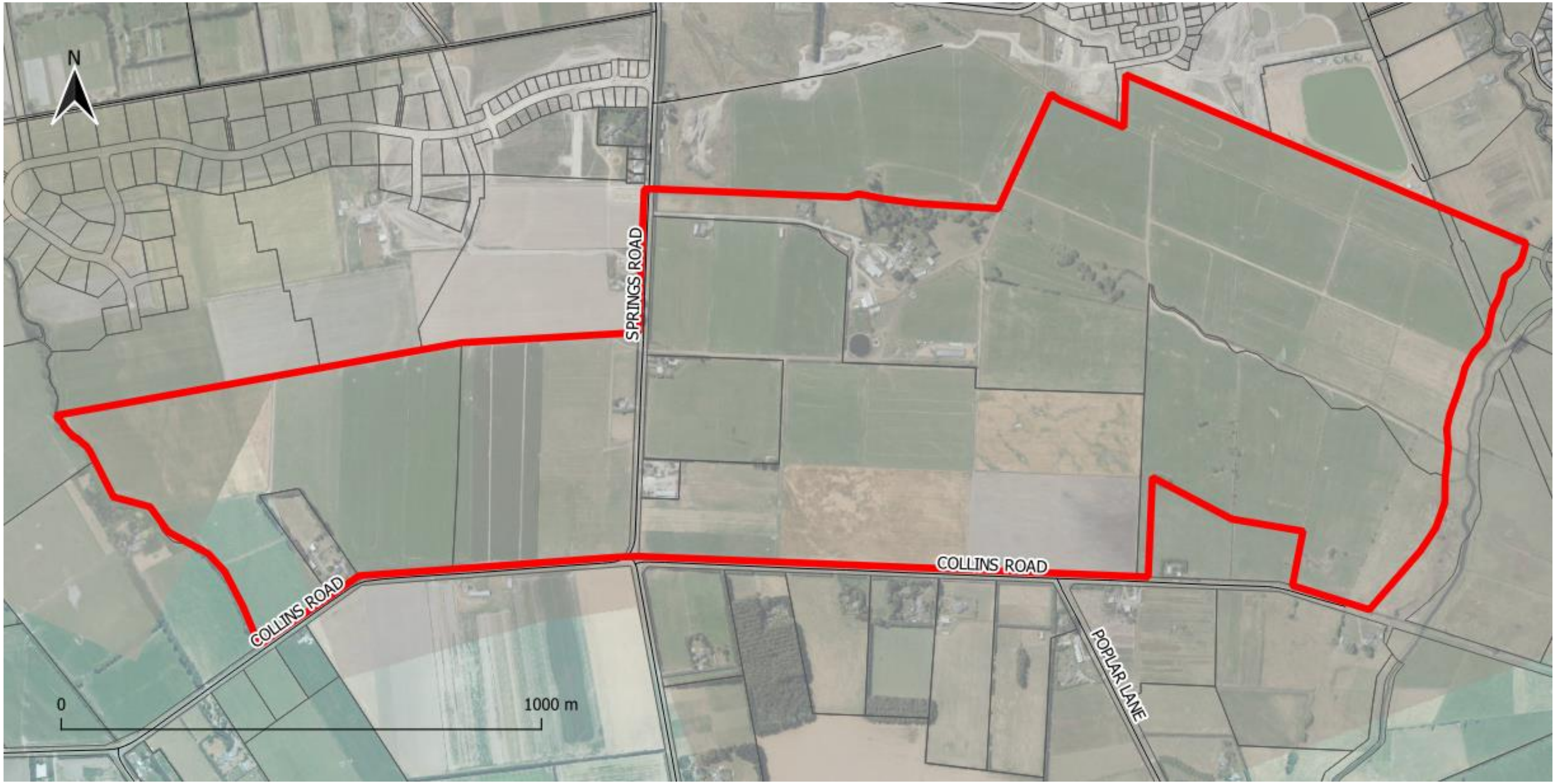


Figure 1 *Site area (highlighted by red outline)*

2 Design Specifics

2.1 Legislative Requirements Specific to the Design

Stormwater discharge in Lincoln needs to be authorised by one of the approval options outlined below:

1. A rule in the Environmental Canterbury (Ecan) Land and Water Regional Plan (LWRP). *This activity will not meet the relevant rule(s) in the LWRP*.
2. An existing global stormwater consent held by SDC. *The global consent CRC184822 covers an area north of the site and therefore cannot be used*.
3. A site-specific discharge consent from Ecan. *This is the only approval route available for the proposed site discharges.*

As much of the site is near the south boundary of the SDC global consent area we have assumed that the stormwater treatment and attenuation conditions in the consent will be appropriate for the site. This is based on geotechnical findings to date that show that soil and hydrogeological conditions are sufficiently similar to the area covered by the consent; and that SDC will have similar development drivers for new developments in Lincoln.

Relevant design requirements from the global consent include:

- The stormwater drainage network to have capacity to convey stormwater from the contributing catchment from events up to and including a 10% AEP;
- Provide overland flow paths for secondary flows in excess of a 10% AEP event away from buildings and private property;
- Provide peak flow attenuation for events up to a 2% AEP for storm durations up to the critical duration of the waterway into which it discharges for discharges into surface water. Detention basins will, either alone or in combination with other devices, attenuate flows so that the post-development flows do not exceed the pre-development flows for events up to a 2% AEP event of any duration;
- Provide retention for all events up to a 2% AEP for discharges to land.
- Provide primary and secondary treatment in series (a treatment train), to remove at least 75 percent of total suspended solids from the discharge on a long-term average basis.
- Design of all devices to allow for climate change in scenario RCP8.5 out to the years 2081 to 2100.
- The 'first flush' rainfall depth for water quality treatment of 20 mm; and
- Treatment wetlands will, either alone or in combination with other devices, attenuate flows so that the post-development flows do not exceed the pre-development discharge rate for the 50%, 10% and 2% AEP design storm events for durations up to and including 12 hours.

Additional design performance requirements have been specified based on Christchurch City Council's (CCC) Waterways, Wetlands, and Drainage Guide (WWDG).

2.2 Catchments

The site for proposed development has been split into three catchments identified as the western catchment, an eastern catchment, and a north-eastern catchment. The western and eastern catchment boundary has been defined based on a natural ridge approximately 175 m west of Springs Road. The eastern and north-eastern catchment boundary has been defined based on location of Springs Creek. Additionally, we understand that overland flow from land to the north of the western catchment has been effectively cut off (T. McLeod, personal communication, October 21, 2020). Refer to Figure 2 for a plan showing the catchment extents, and Table 1 which provides assorted catchment details.

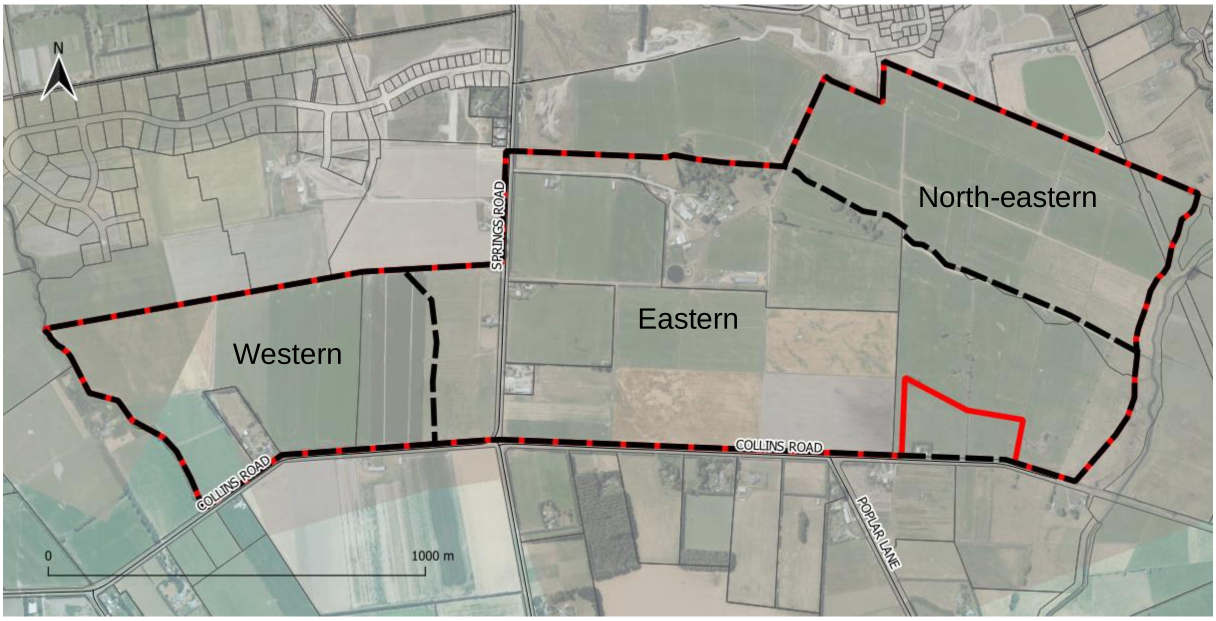


Figure 2 Site catchments (defined by black dashed line)

Table 1 Catchment details

Catchment:	Western Catchment	Eastern Catchment	North-Eastern Catchment	Source
Area:	39.5 ha	114.0 ha	40.7 ha	GIS / 2016 LiDAR
Assumed drainage:	Moderate	Poor	Poor	On-site geotechnical investigations of soils
Estimated time of concentration (approximate):	1 hour	2 hours	1 hour	Calculations based on WWDG

2.3 Design Philosophy

The design of the stormwater management area (SMA) has followed the process laid out in the WWDG (CCC, 2012). The SMA will consist of:

- A first flush basin to capture and remove total suspended solids in the runoff generated by the first 20 mm of rainfall on the catchment (primary treatment);
- A wetland to provide water quality polishing in rainfall events up to the first flush depth of 20 mm (secondary treatment), and provide live storage in large rainfall events exceeding the 20% AEP event; and
- A detention basin to provide water quantity attenuation in large rainfall events greater than the first flush event, but up to the 2% AEP.

This is presented in a conceptual diagram in Figure 13. Attenuation will be provided by controlled outlets with the provision of storage.

A SMA is proposed for each of the three catchments.

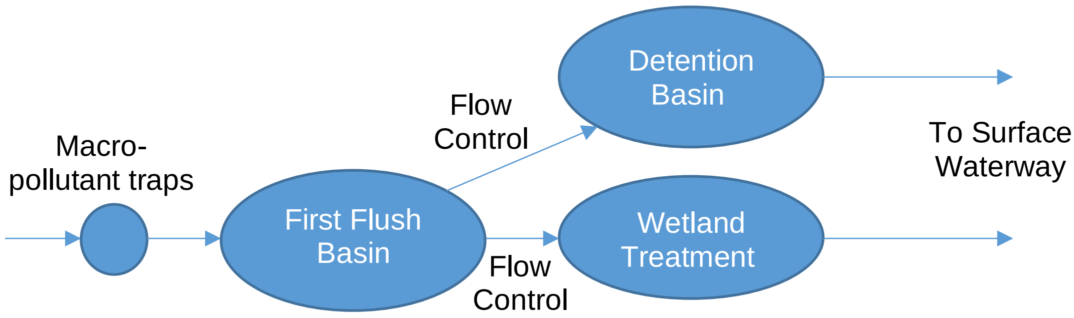


Figure 3 Approximate conceptual stormwater management area

2.4 Stormwater Management Areas

The required volumes and areas for each catchment's SMA has been estimated using a high-level rational method calculation (refer to Table 2). Due to the high-level approach, there is some inherent uncertainty for the stormwater runoff volumes; however, the approach taken is expected to be conservative and suitable for the requirements of this report. Further analysis will be required for the detailed design of these SMAs. Additional storage volume is available if required for the east and north-eastern catchments within flood zone #1 (detailed in Section 2.5).

Table 2 Stormwater management area details

	Western Catchment		Eastern Catchment		North-Eastern Catchment	
	Volume	**Area**	**Volume**	**Area**	**Volume**	**Area**
First Flush Basin	4,980 m³	1.0 ha	14,360 m³	2.9 ha	5,120 m³	1.0 ha
Detention Basin	3,200 m³	0.5 ha	2,500 m³	0.4 ha	900 m³	0.15 ha
Wetland	6,640 m³	1.3 ha	19,150 m³	3.8 ha	6,830 m³	1.4 ha

The following assumptions have been made:

- First flush basins have been assumed to have an average depth of 0.5 m of live storage due to the likely available depth for a small embankment to contain floodwaters on the natural slope of the land;
- Detention basins have been assumed to have an average depth of 0.6 m of storage due to the likely available depth for a small embankment to contain floodwaters on the natural slope of the land;
- Wetlands have been assumed to have an average depth of 0.5 m of live storage above their live operating water level. This is a typical depth of live storage recommended by CCC in the WWDG;
- Wetlands have an average operating water depth of 0.25 m, a vegetation porosity of 0.75, and a hydraulic residence time (HRT) of two days. Note that the SDC global consent may allow for an HRT of at least 24 hrs, which would reduce wetland area. However, as the SMA is likely to be smaller than the flood management area, a 2 day HRT could be accommodated within the area.

- That water can be conveyed to each of these stormwater management areas from their contributing catchments;
- That the proposed development will have a density approximately equivalent to the Residential New Neighbourhood in CCC's district plan and outlined in the WWDG (CCC, 2020);
- That the stormwater management areas can also be utilised for flood storage in the 0.5% and 0.2% AEP flood events;
- That the Ararira/LII River has a time of concentration of less than 12 hours, and that the 12 hour rainfall event is the critical duration for volume in the SMA. Further analysis during future design will confirm the critical storm events for the SMA;
- That no soakage to ground will be possible; and
- That design rainfall depths and intensities are consistent across the development.

2.5 Qualitative Flood Management

Flood management is required to ensure that floodwaters in the 0.5% AEP and 0.2% AEP flood events are safely managed away from people and property. These events have been modelled by SDC in a large catchment-wide two-dimensional hydraulic model which represents the floodplain by a 10 m coarse rectangular grid[1]. Detailed model results showing extent and flood depth are available to view on SDC's website, and is shown below in Figure 4. The broad flood extents have been approximately digitised and are presented in Appendix A.

In general, ground levels on lots will be set above road levels so that in large flood events the roads act as secondary flow paths. These secondary flow paths will need to safely convey floodwaters to their existing flow path location at the boundary of the proposed development (i.e. the management of secondary flow paths should maintain the site's hydraulic neutrality). There are eight key areas which require varying levels of engineering design (conceptually at this stage) to ensure the overland flow paths and flooded areas are safely managed. The following options are proposed in Table 3 (the areas these number relate to are presented in Figure A1 in Appendix A by the numbers with the yellow buffer).

[1] The model simplifies the topography of the land into a grid with cells that are 10m wide by 10m long, where each cell has an average elevation of the true topography in the extent of the cell. This means that small drains common on farms are not as well represented.

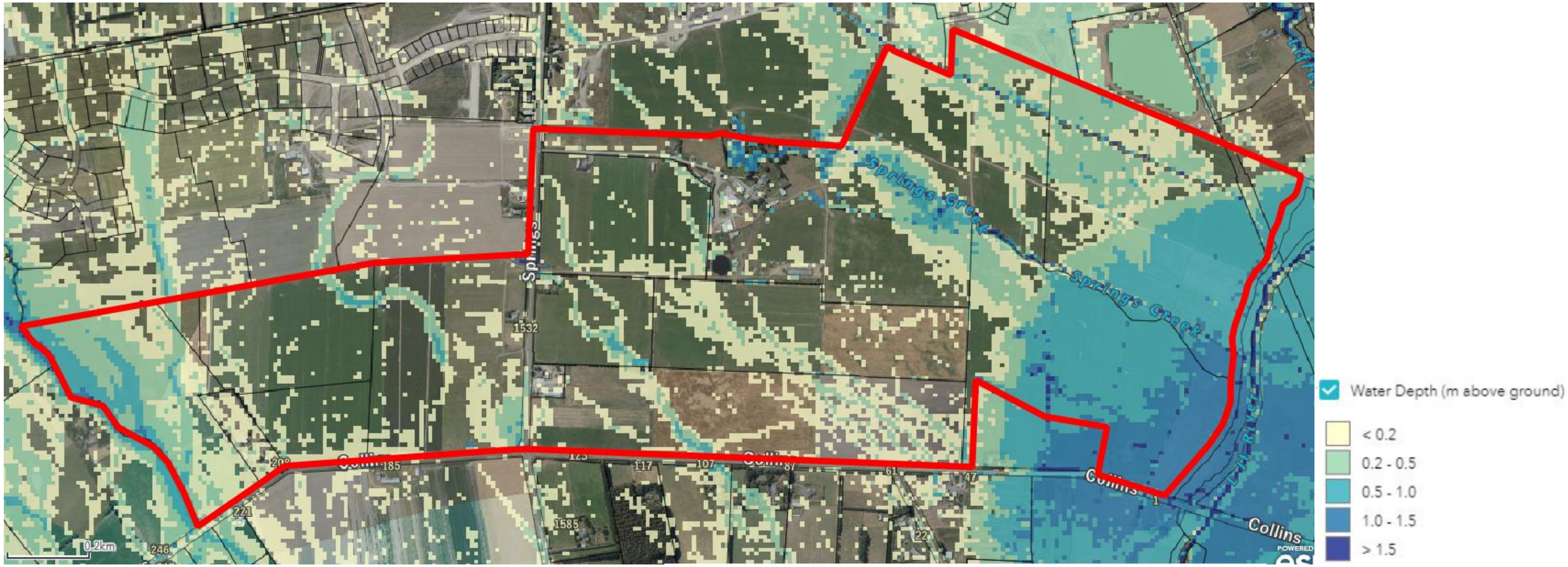


Figure 4 *Screenshot of SDC's flood modelling results in a 0.2% AEP flood event* [2]

[2] Selwyn District Council, 2019, *Selwyn's flooding and coastal hazards*. Retrieved October 12, 2020 from https://apps.canterburymaps.govt.nz/SelwynNaturalHazards/

Table 3 Flood management areas

Flood Zone # (see Figure A1)	Flood zone description	Option for flood management
1	Deep ponded water (Ararira/ LII floodplain)	Exclude deeper areas from development. Option for development of shallower areas or raising of ground level will require compensatory storage elsewhere. Utilise land for SMA.
2	Overland flow path (from Te Whariki)	Collect run-on floodwaters from upstream of site and contain overland flow path within designated flow path. Note that the model results are pre-Te Whariki development. SMA, roads and naturalised drains will change this overland flow path. It is expected flooding can be contained.
3	Overland flow path	Contain overland flow path within 80 m wide zone around Springs Creek.
4	Overland flow path	Existing overland flow path from rainfall onto site area. Manage overland flow path with on-site drainage infrastructure. Lot re-grading and road construction would modify drainage paths and direct overland flow eastwards to SMA.
5	Overland flow path	Existing overland flow path from rainfall onto site area. Manage overland flow path with on-site drainage infrastructure. Lot re-grading and road construction would modify drainage paths and direct overland flow eastwards to SMA.
6	Ponded water	If the current representation of flooding by the model is accurate, the storage provided by this area will need to be maintained, or compensatory storage would need to be provided elsewhere in the same catchment to provide similar flow characteristics, such as within flood zone #1. Further detailed investigations may indicate that the SDC model is overly conservative due to the coarseness of the model and so flood extents may be reduced if demonstrated by future investigations (i.e. culverts and/or drains not represented in the model may have created the ponding area due to the lack of an outlet for the depression area). Additionally, we understand that ground levels since the time that the LiDAR was flown have been modified by filling (T. McLeod, personal communication, October 21, 2020).
7	Overland flow path	Flow at time of model development now cut off by Verdeco Park swale along boundary. Flow path from on-site rainfall to be managed by on-site drainage infrastructure. Lot re-grading and road construction would modify drainage paths and direct overland flow eastwards to SMA.
8	Overland flow path from channel breakout	Seek to optimise the flow conveyance of the floodplain to the east of the drain in order to reduce the flood extents, and allow a greater area of development. Compensatory storage may be required. Detailed analysis would be required as part of this.

A Section 106 assessment (based on the Resource Management Act) is required where land proposed for development may be at significant risk from natural hazards. In general, the Section 106 assessment should include:

- a combined assessment of the likelihood of the natural hazards occurring;
- the material damage that would result from natural hazards to the development site, other land or structures;
- any likely subsequent use of the land that would accelerate or worsen the damage predicted from a natural hazard; and
- Proposed finished floor levels.

2.6 Contaminant Removal Rates

Contaminant removal rates have been calculated based on Table 6-6 of the WWDG for a combination of a first flush basin and wetland in each SMA, with inflow contaminant concentrations based on Table 6-3 of the WWDG (see Table 4 below).

Table 4 Average contaminant loads into the first flush basin and out of the wetland

Pollutant	*Inflow flow-weighted mean concentration (mg/m^3)*	*Estimated removal rates*	*Outflow flow-weighted mean concentration (mg/m^3)*
Total suspended solids (TSS)	33,000 – 200,000	84% - 96%	1,320 – 32,000
Total Phosphorus (TP)	260	64% - 96%	10.4 – 93.6
Total Nitrogen (TN)	2,500	52% - 84%	400 – 1,200
Chemical Oxygen Demand (COD)	35,600	*Not given in WWDG*	-
Biological Oxygen Demand (BOD)	7,000	36% - 76%	1,680 – 4,480
Zinc	400	64% - 96%	16 – 144
Copper	50	64% - 96%	2 – 18
Lead	75	64% - 96%	3 - 27
Hydrocarbons	500	*Not given in WWDG*	-

2.7 Additional Information

Table 5 below details the rainfall depths sourced from HIRDS V4 that have been used in this report’s analysis.

Table 5 HIRDS V4 rainfall depths (mm) – RCP8.5 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h
2	**50%**	6.08	8.06	9.66	13.5	18.9	31.4	42.4
5	**20%**	8.98	11.8	14.1	19.4	26.9	44.3	59.2
10	**10%**	11.4	14.9	17.7	24.2	33.4	54.4	72.3
50	**2%**	18.2	23.4	27.6	37.3	50.8	81.1	106

3 Quality Control

The design of this development complies with the following documents:

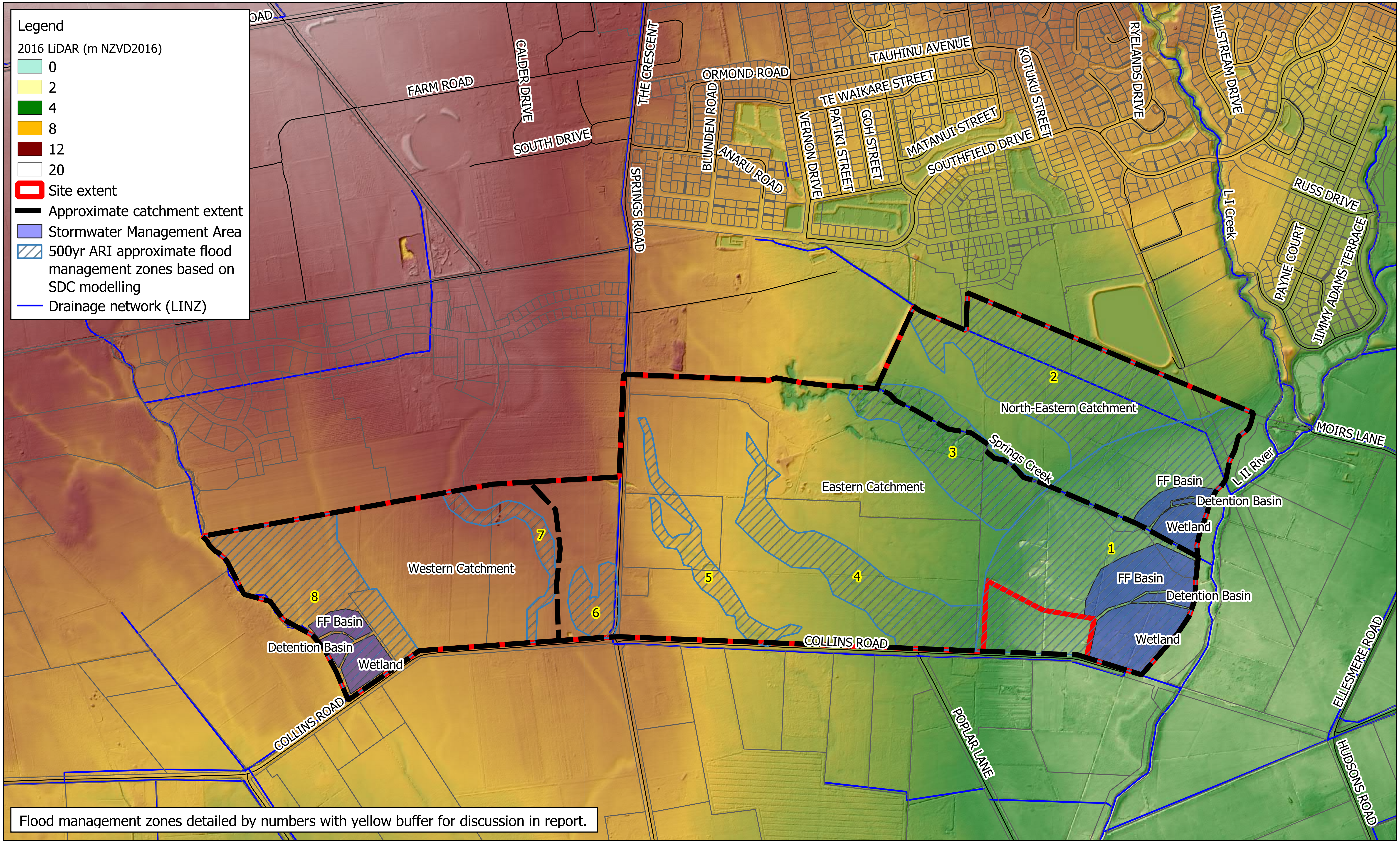
- CCC Waterways and Wetlands Design Guide
- New Zealand Building Code Clause E1

4 Design Report Approvals

This report has been:

Task	Initial	Signature	Date
Prepared by:	Daniel McMullan, e2		October 22, 2020
Reviewed by:	Andrew Tisch, e2		October 22, 2020
Approved by:	Andrew Tisch, e2		October 22, 2020

Appendix A – Concept Plans



Paper Size A3

100 0 100 200 300 400 m

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Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

e2 environmental CONSULTING CIVIL ENGINEERS

Lincoln South Plan Change

Figure A1: Initial Stormwater Management Areas

Job Number	20055
Revision	4
Date	2020/10/22

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APPENDIX B | WASTEWATER CAPACITY ASSESSMENT

Memorandum

To	Tim Carter, Bruce Van Duyn
Copy	Sue Harrison, Murray England
From	Lyndsey Foster, Charlotte Mills
Office	Christchurch
Date	21 October 2020
File/Ref	3-C2210.00
Subject	Lincoln South Plan Change Wastewater Capacity Assessment

1 Summary

WSP was engaged by Rolleston Industrial Developments Ltd. to complete a wastewater network capacity assessment for a proposed development at 1491 Springs Road, Lincoln. The development will be of approximately 160 ha, with 2,000 lots proposed.

The assessment has focused on the capacity of the trunk system (i.e. Allendale and Selwyn Road pump stations) and has directly connected the development flows to Allendale pump station in Lincoln. Options to look at whether there is capacity in the local reticulation for the development flows should be looked at once detailed layout of the development is determined.

During dry weather flow the proposed flows can be catered for with the duty pumps at the two pump stations. During wet weather the peak flow to Allendale PS is greater than its capacity and overflow to the emergency storage facility is predicted. The predicted overflow volume takes up 2% of the total storage available.

It should be noted that in the wet weather assessment that flow from the development is loaded to the model as a constant peak design value and therefore conservatively represents the volume of wastewater loaded to the network. Because of this, the predicted overflow volume is conservative. Therefore, in our professional opinion, the wastewater network has capacity to receive the residential re-zoning of this land for the plan change application.

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2 Assumptions

2.1 General

- The existing 2019 wastewater model was used, which was modelled in InfoWorks ICM v6.0.9 (WSP model reference: *chpc044:40000/SDC Wastewater Models*). This is the most up-to-date version of the model, used for Resilience Master Planning project completed for SDC in 2019. During the Resilience Study bulk population updates were applied so model matched SDC's 2019 population estimates, and the new Prebbleton pump station was added to the model, which diverts Prebbleton flows away from Lincoln directly to the Selwyn Road pump station. An overview of the system is presented in Figure 1.

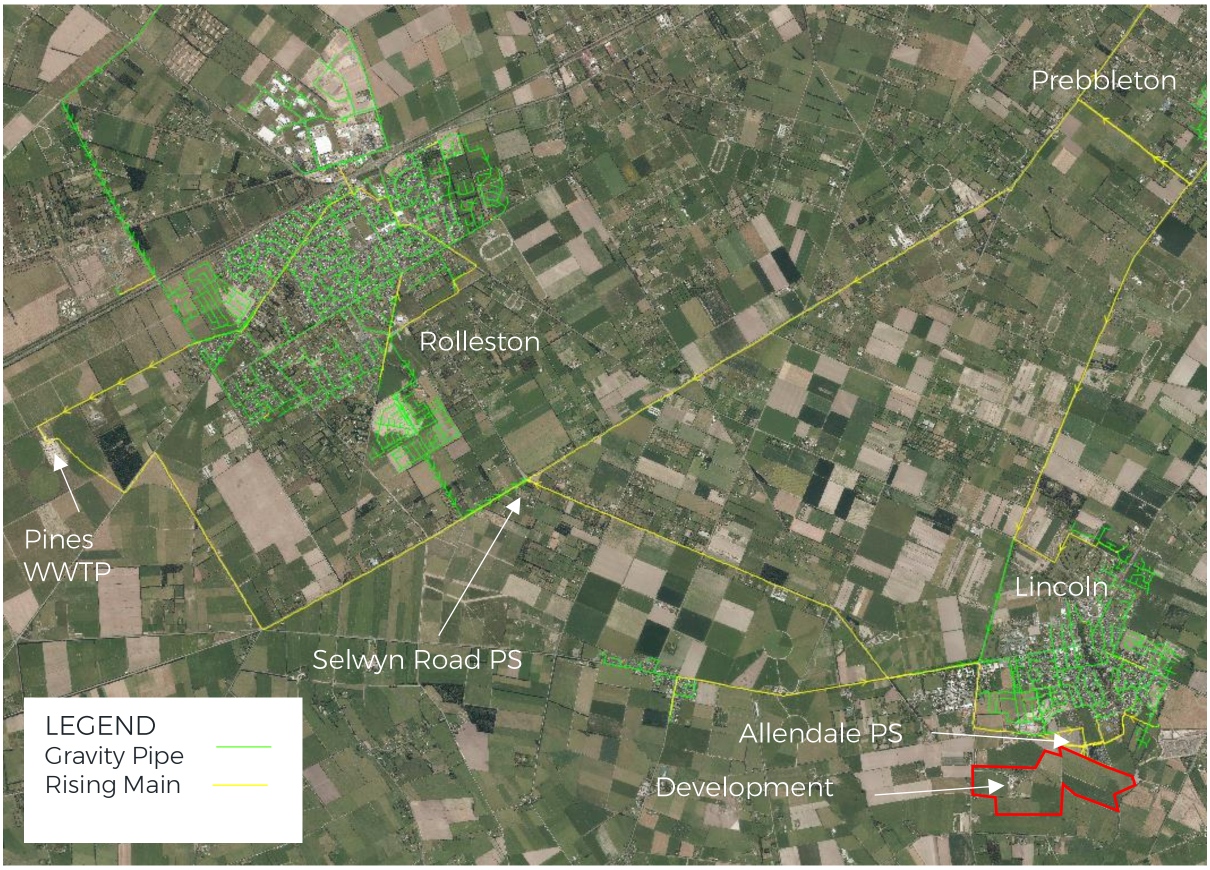

Figure 1: Wastewater System Overview

- Apart from the updates discussed above, the model asset data has not had an extensive update since the model was first built in 2016, as such it does not include infrastructure for recent subdivisions within the Lincoln, Prebbleton and Rolleston townships. However, as this assessment will focus on the trunk infrastructure capacity this does not impact the confidence in the model results for this assessment.

- To conservatively represent flow conditions the highest observed rate of groundwater ingress to the wastewater collection system was assumed. This high groundwater was observed in June 2014, affecting the communities of Prebbleton, Lincoln and Springston and was applied in the model as a constant baseflow.

- The model has been run with 1 in 5-year ARI 12-hour design event to replicate wet weather flow (WWF), as this was previously determined to be the critical storm duration for the ESSS system. To truly understand the impact of rainfall, a variety of rainfall events would need to be considered. However, there are many variables to consider, including but not limited to, the annual exceedance probability (AEP), intensity, duration and timing of the event (in relation to flows in the wastewater system). Comprehensive modelling of a variety of design rainfall events has not been conducted as part of this query.

2.2 Scenario Specific

- It has been assumed that the development connects directly to Allendale Pump Station;
- Flows from the plan change area were calculated using the following assumptions:
  - 2000 lots will be developed (email from Bruce Van Duyn on 13 October 2020);
  - Population per lot is 2.7 (SDC's Engineering Code of Practice);
  - Consumption rate is 220 l/h/d (SDC's Engineering Code of Practice);
  - The peak to average flow rate for wet weather is 2.5 (SDC's Engineering Code of Practice);
  - The peaking factor for wet weather is 2 (SDC's Engineering Code of Practice).

Table 2-1 below summarises the potential flows from the developed plan change area.

Table 2-1: Calculated Flows for the Developed Plan Change Area

Plan Change Area	Proposed No. of Lots	Population	Calculated ADWF (L/s)	Calculated PWWF (L/s)
1491 Springs Rd	2000	5400	13.75	68.75

3 Modelling Methodology

The following methodology was undertaken:

1 The existing 2019 model, with no amendments was used as the Base scenario.
2 Two new scenarios were created, for both dry weather and wet weather flow comparisons, and a new sub-catchment representing the development was included in both.
3 The dry weather scenario was updated to include the assumed for the development population to allow the impact of the diurnal flow from the development to be assessed.
4 The wet weather scenario was run the with the maximum flow applied as a constant flow. No contributing area or population for the plan change area was added as these are accounted for in the flow applied.
5 Simulations were run to assess the impact of the development on the existing network during dry and wet weather.

4 Modelling Results

To assess the potential impact of the plan change in the wastewater network, the operation of two pump stations was analysed – Allendale PS, and Selwyn Road PS. Allendale PS pumps through to Selwyn Road PS, which then pumps to the Pines WWTP.

4.1 Dry Weather

4.1.1 Allendale PS

Allendale PS has three pumps, operating under a duty/assist/assist regime. During the dry weather simulation, only the duty pump is predicted to operate. The addition of the proposed flows from the plan change, does not cause either of the assist pumps to operate.

4.1.2 Selwyn Road PS

Selwyn Road PS has four pumps, operating under a duty/assist/assist/assist regime. During the dry weather simulation, only the duty pump is predicted to operate. The addition of the proposed flows from the plan change, does not cause any of the standby pumps to operate.

4.2 Wet Weather

4.2.1 Allendale PS

During the wet weather simulation, all three pumps are predicted to operate in the Base scenario to cater for the predicted peak flow. With the addition of the proposed flows from the plan change the predicted peak flow exceeds the pump station capacity for a longer period. The volume of the operational storage is exceeded and 700 m^3 is predicted to overflow to the emergency storage facility beside the pump station (the old Lincoln WWTP SBR tanks pond). However, there is plenty of capacity in the emergency storage, as there is close to 600 m^3 of storage in the SBR tanks and the pond provides approximately 30,000 m^3 of storage.

4.2.2 Selwyn Road PS

During the wet weather simulation, all four pumps are predicted to operate in the base scenario. The peak flow to the station does not increase with the addition of the development flows, as Allendale is already predicted to run at full capacity in the Base scenario. The peak flow to Selwyn Road pump station does last for a longer period.

5 Conclusions

The addition of the proposed wastewater flows from the plan change area do not cause any significant problems at Allendale and Selwyn Road pump stations during dry weather.

During wet weather the peak flow to Allendale PS is greater than its capacity and overflow to the emergency storage facility is predicted. The predicted overflow volume only takes up 2% of the total storage available. In addition, it should be noted that in the wet weather assessment that flow from the development is loaded to the model as a constant peak design value and therefore conservatively represents the volume of wastewater loaded to the network. Because of this, the overflow volume presented in the above results is conservative.

Should spill to the storage tanks and WWTP pond be unacceptable to SDC during wet weather then Allendale and Selwyn Road pump station will require upgrade to cater for the predicted peak wet weather flows.

6 Limitations

- This assessment has not considered whether there are options for the development to connect to the local network. This should be considered when the model is updated with the local network data and further details of the layout of the development are known.
- This assessment has not considered whether the Pines WWTP has capacity to accept flow from the development

Prepared by:	Reviewed by:	Approved for Release by:
		
Lyndsey Foster	**Charlotte Mills**	**Sue Harrison**
Wastewater Modeller	Principal Environmental Engineer	Project Director

APPENDIX C | WATER SUPPLY CAPACITY ASSESSMENT

Memorandum

To	Tim Carter, Bruce Van Duyn
Copy	Sue Harrison, Murray England
From	Dan Edwards
Office	Christchurch
Date	21 October 2020
File/Ref	3-C2210.00
Subject	Lincoln South Plan Change Water Supply

1 Summary

WSP was engaged by Rolleston Industrial Developments Ltd to complete a water supply network capacity assessment at the proposed development at 1491 Springs Road, Lincoln, to assess the suitability of rezoning the site for residential use. This assessment has aligned with the Selwyn District Council (Council) objectives as part of their Master Planning when proposing upgrades to the network.

There are two options considered in this assessment for supplying water to the proposed development:

- Upgrade existing well site at Vernon Drive and upgrade the Water Supply mains servicing the proposed development area.
- Develop new well site(s) in the proposed development area in south Lincoln.

Subject to the recommendations in this memorandum, there are no water supply issues which would impede rezoning of this land for residential use.

2 Assumptions

2.1 Demand at 1491 Springs Road Development

The demand at 1491 Springs Road Development was added to the demand in the 2020 peak day model. The demand assumptions are as follows:

- 2000 lots will be developed (email from Bruce Van Duyn on 13/10/2020)
- Lincoln domestic peak day water demand is 2135 L/property/day (WSP 2020 model update)
- Lincoln domestic peak factor is 2.2. (WSP 2017 model verification). This was applied to the water demand only, not the leakage.

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- Lincoln leakage is 73 L/property/day (Thomas Consultants Water Balance 2019 Water Balance Report). This is applied on a flat profile (peak factor = 1).

Table 1 below summarises the Water Supply demand at the proposed development:

Table 1. Water Supply Demand at the Proposed Development

Area	Properties	Demand (L/prop/day)	Peak Factor	Leakage (L/prop/day)	Average Demand (L/s)	Peak Demand (L/s)
1491 Springs Rd	2000	2135	2.2	73	51.1	110.4

3 Water Supply Infrastructure Recommendations

3.1 Option 1: Upgrade Vernon Dr Well

3.1.1 Summary

This option involves supplying water from the Vernon Dr well to the proposed site. Council have expressed they would install additional well capacity at Vernon Drive as the priority if required, to accommodate future demand.

3.1.2 Methodology

The Vernon Dr well was not in the latest model update. It was included in this model assuming a fixed head, with a delivery pressure of 40m. The delivery pressure was estimated based on the delivery pressure from the other wells throughout Lincoln.

The proposed development was modelled with two connections to the existing network: one into the new DN 200 uPVC main on Springs Road, and the other into the DN 200 uPVC main at the south end of Vernon Drive (see Figure 1).

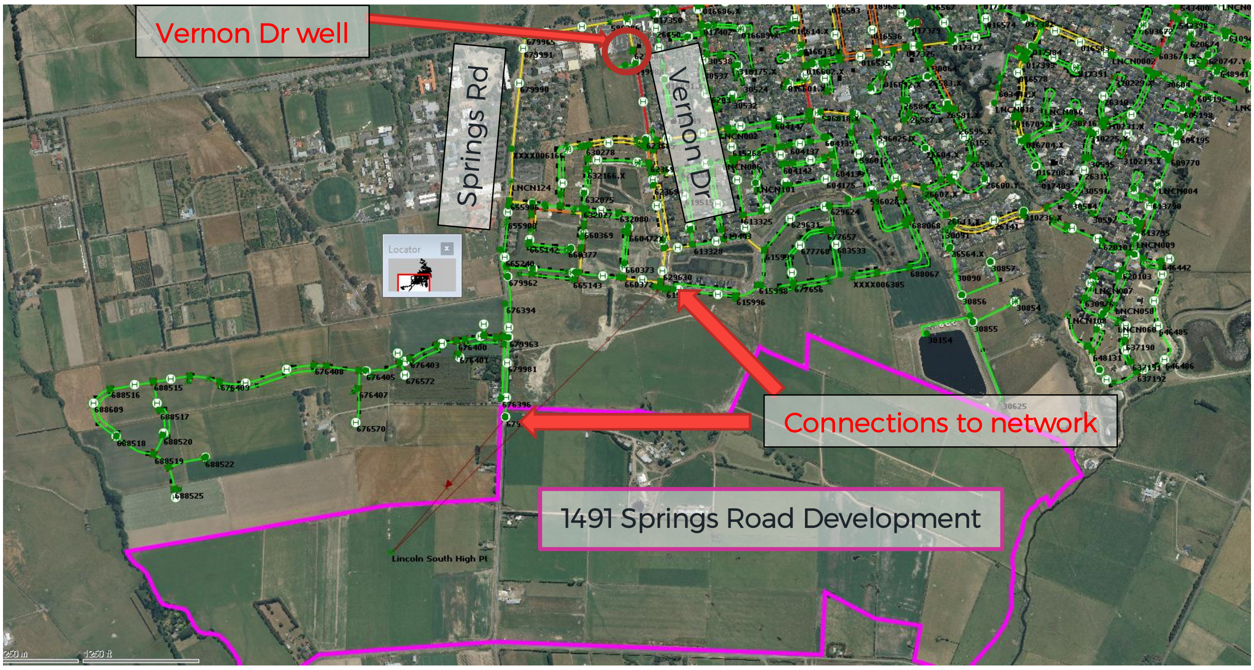

Figure 1. The proposed development site, water supply infrastructure and connections in South Lincoln.

3.1.3 Results + Recommendations

The existing network could not deliver Level of Service pressure to the proposed development. There were low pressures throughout the model, especially in Northern and South-Western Lincoln (see Figure 2). This is because the existing pipes are required to deliver higher flow than designed for, resulting in high headlosses.

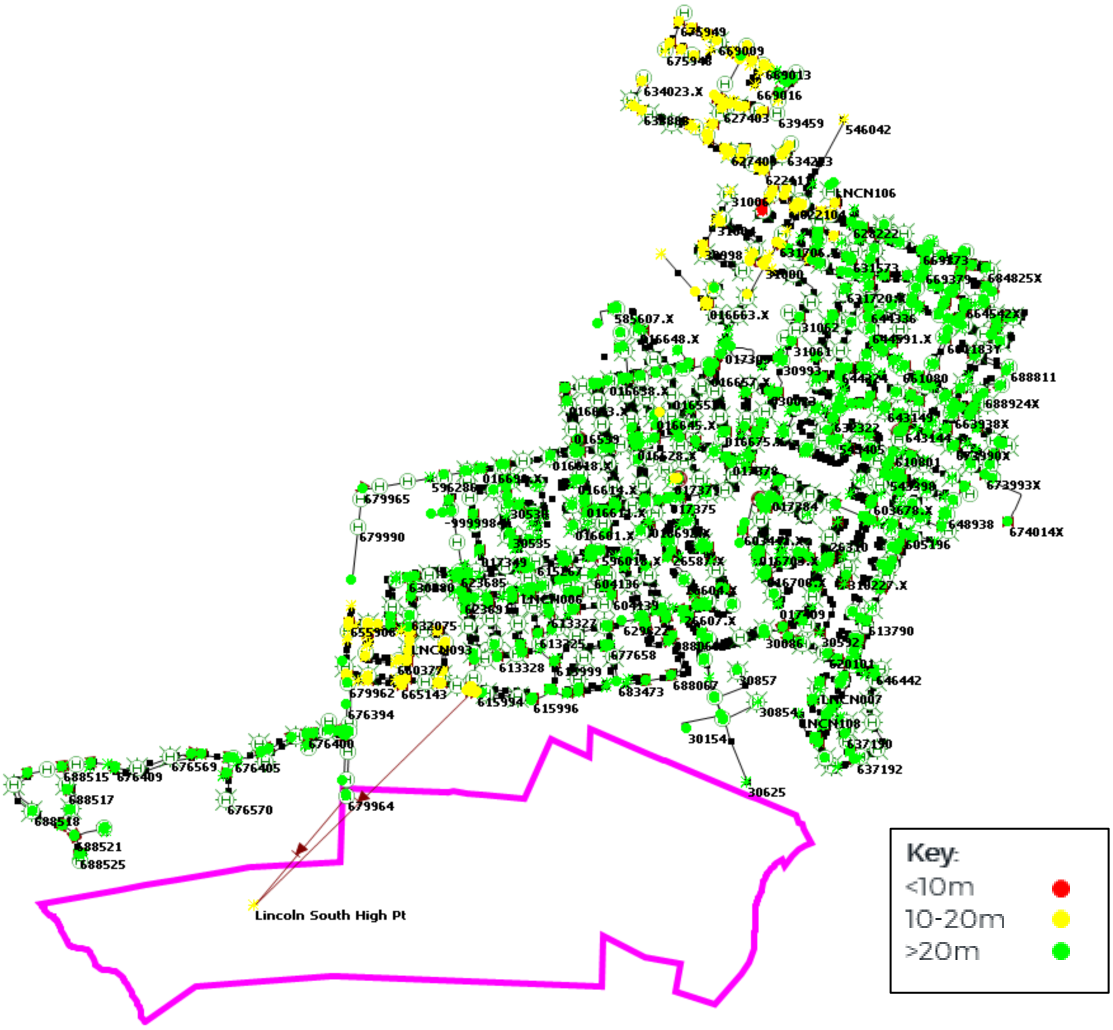

Figure 2. The network pressure with the proposed development demand and existing network.

It is noted that there is a gap in the ring-main to the south-west of Lincoln in the current peak day model. However, a model was run connecting this with a DN 200 main which is Council's intention. The Level of Service pressure in the network was still inadequate, so upgrades are proposed.

The pipes servicing the proposed development from the Vernon Dr well site need to be up-sized to support the future demand from the proposed development (see Figure 3). It is recommended that the ring main around the SW edge of Lincoln is upsized to DN 300 uPVC, and the ring-main is fully connected. This pipe size is appropriate, as it achieves maximum headlosses on the peak day less than the design constraint of 3m/km. It also ensures that Level of Service pressure throughout the network is adequate in South Lincoln.

There are a few locations in central and northern Lincoln with pressures slightly below 20m in this scenario (see yellow nodes in Figure 3). The minimum pressure is 15.1m at one isolated node. The current network also experiences some pressure issues in central and northern Lincoln, so the proposed development with the upgraded ring-main does not worsen the Level of Service pressure throughout the network in central and northern Lincoln.

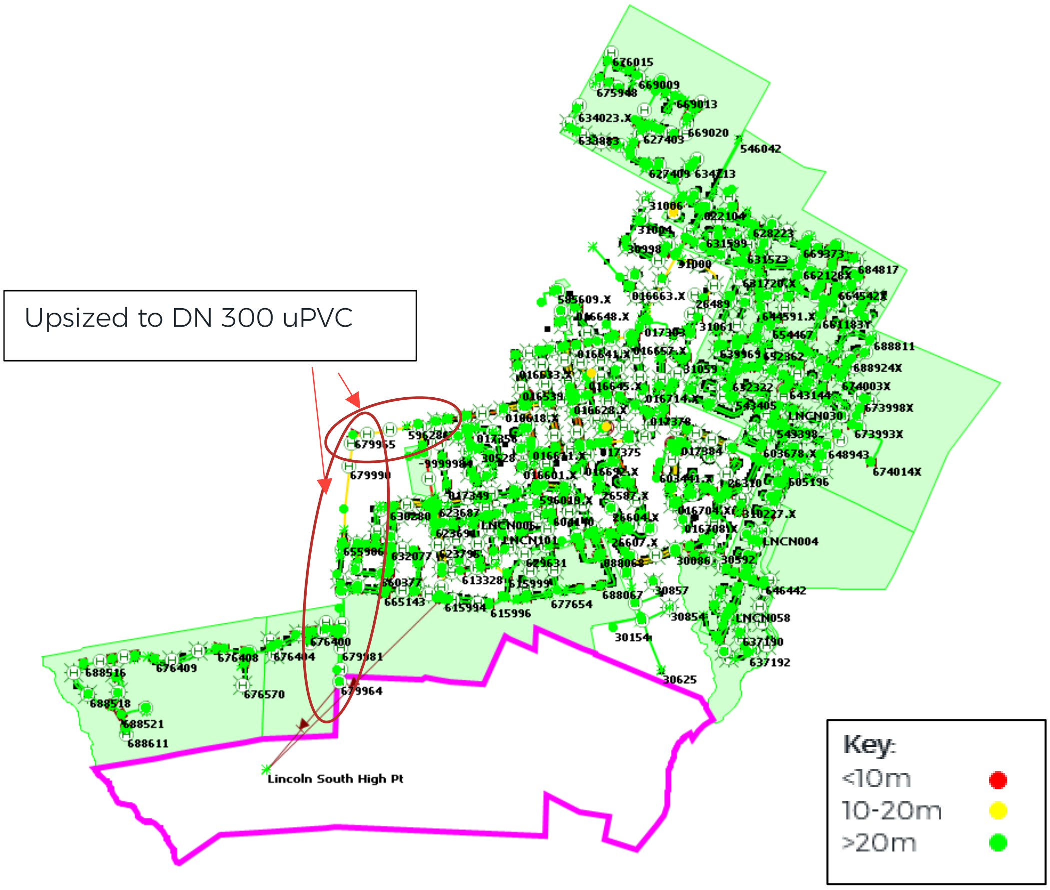

Figure 3. The network pressure with the proposed development demand and upgrades to the ring-main.

Under this scenario, there are relatively high headlosses in the trunk main on Vernon Drive (see Figure 4). The maximum headloss is 13.9m/km on the peak day. This does not affect the Level of Service in South-West Lincoln. However, this trunk main may require an upgrade to improve its resilience, by reducing its rate of failure.

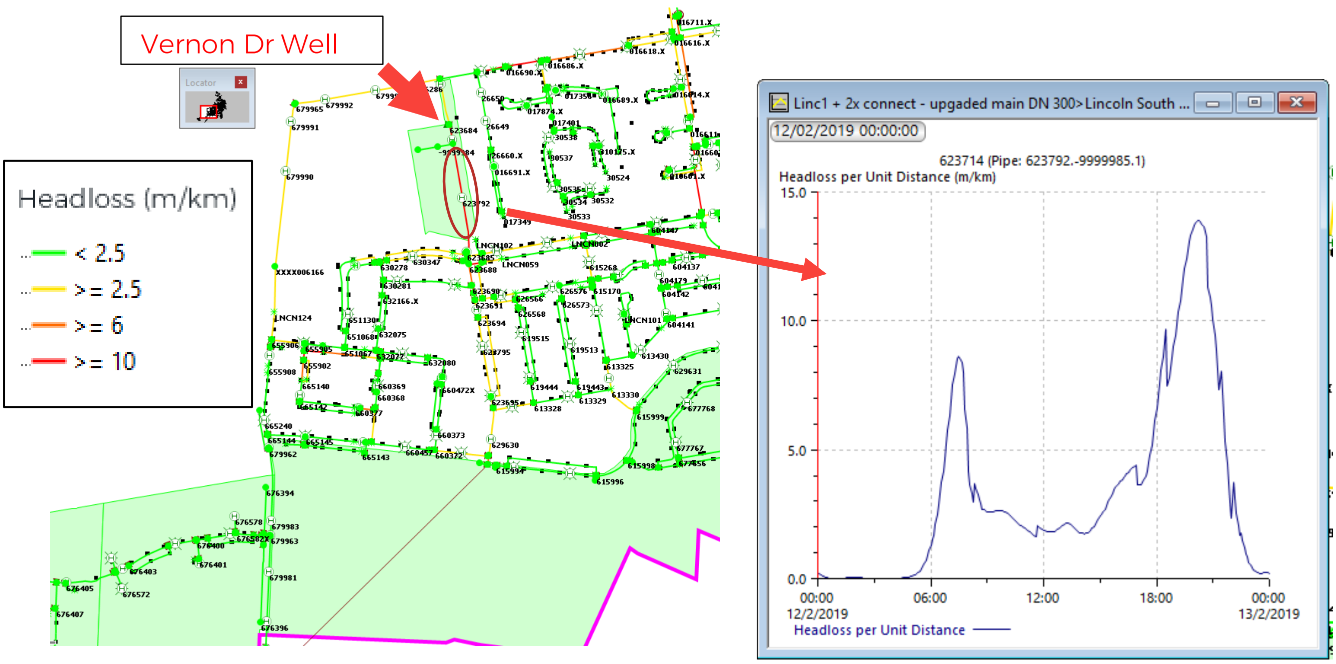

Figure 4. Headlosses (m/km) in South-Western Lincoln.

The Vernon Dr well is required to provide up to 150L/s during the peak day with the proposed development connected. The WSP 2017 Master Planning project recommended installing a well providing up to 100L/s. This well site could be further developed in line with Council's long-term planning.

3.2 Option 2: Install New Well in South Lincoln

WSP understands that there are multiple existing wells on the proposed development site (Canterbury Maps) (see Figure 5). One of these wells has been tested up to 45 L/s specific yield. In general, Lincoln has accessible groundwater aquifers for drinking water abstraction. There is potential for a new well site to be developed to the south of Lincoln by converting the existing dairy wells or drilling a new site.

Figure 5. Image of Wells in South Lincoln (Canterbury Maps). Note that this information has not been confirmed by WSP.

This option is subject to groundwater abstraction constraints. It is unknown whether the groundwater is suitable for municipal drinking water. The potential source will require treatment to ensure it complies with DWSNZ.

Subject to Council's intentions, this option may either supplement water from the existing network, or it may be used to supply the wider Lincoln township.

4 Limitations

- This assessment has only considered the existing water supply network operation with the additional demand from the proposed development. It does not account for any future neighbouring developments, such as those in ODP1, and their impact on the water supply network.
- This assessment has not considered any Fire Flow requirements.
- This assessment has not considered the localised pipework within the development. The internal development pipework will need to be designed accordingly to accommodate peak day / hour demand.

Prepared by:

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Graduate Engineer - Water

Reviewed by:

Estelle Boivin

Principal Hydraulic Modeller - Water

Approved for Release by:

Sue Harrison

Project Director