Level 11, 345 George Street, Sydney NSW 2000
T (02) 9241 4188 F (02) 9241 4324
E sydney@northrop.com.au ABN 81 094 433 100

CIVIL STORMWATER AND FLOODING DUE DILIGENCE REPORT

Castle Ridge Retirement Village

350 Old Northern Road Castle Hill NSW 2154

PREPARED BY
Northrop Consulting Engineers
ACN 064 775 088
Level 11, 345 George Street,
SYDNEY NSW 2000

Tel: 02 9241 4188
Fax: 02 9241 4324

PREPARED FOR
Architectus
Level 18, MLC Centre
19 Martin Place
SYDNEY NSW 2000

Tel: (02) 8252 8400

Ref: S152307

Activity schedule

Date	Revision	Issue	Report by	Approved by
18.03.16	1	Preliminary Issue	CM	
18.03.16	2	Final Issue	CM	MB
13.12.18	3	Final Issue	MC	MB
19.12.18	4	Final Issue	MC	MB

INDEX

1. INTRODUCTION

Northrop Engineers have been engaged to provide high level due diligence reporting services for a proposed retirement village redevelopment located at 350 Old Northern Road, Castle Hill, NSW 2154.

This document provides a stormwater and flooding infrastructure assessment and analysis.

The purpose of this report is to:

- Provide high level advice regarding the stormwater infrastructure;
- Provide high level advice regarding flooding; and
- Provide a preliminary high level cost estimate for the development.

Limitations and Exclusions

The limitations and exclusions of this report are as follows:

- The following assessment is based upon a desktop site assessment and review of information provided by the client. Physical inspection of the site was undertaken only limited to those areas and sections of the site and council land reasonably accessible and visible to the inspector on the date of the inspection;
- Existing underground service routes have been determined with the use of information available from sources such as DBYD and council;
- This report is prepared based on current concept plans and documentation in the absence of detail design.

2. DUE DILIGENCE ASSESSMENT

2.1 Background

The site covers an approximate area of 3.92 Ha being Lot 503 in DP1048808. The site is bound by The Old Northern Road to the East and existing residential dwellings to the North, South and West. The site is located within The Hills Shire Council Local Government Area (LGA).

Refer to Figure 1 for the site locality.

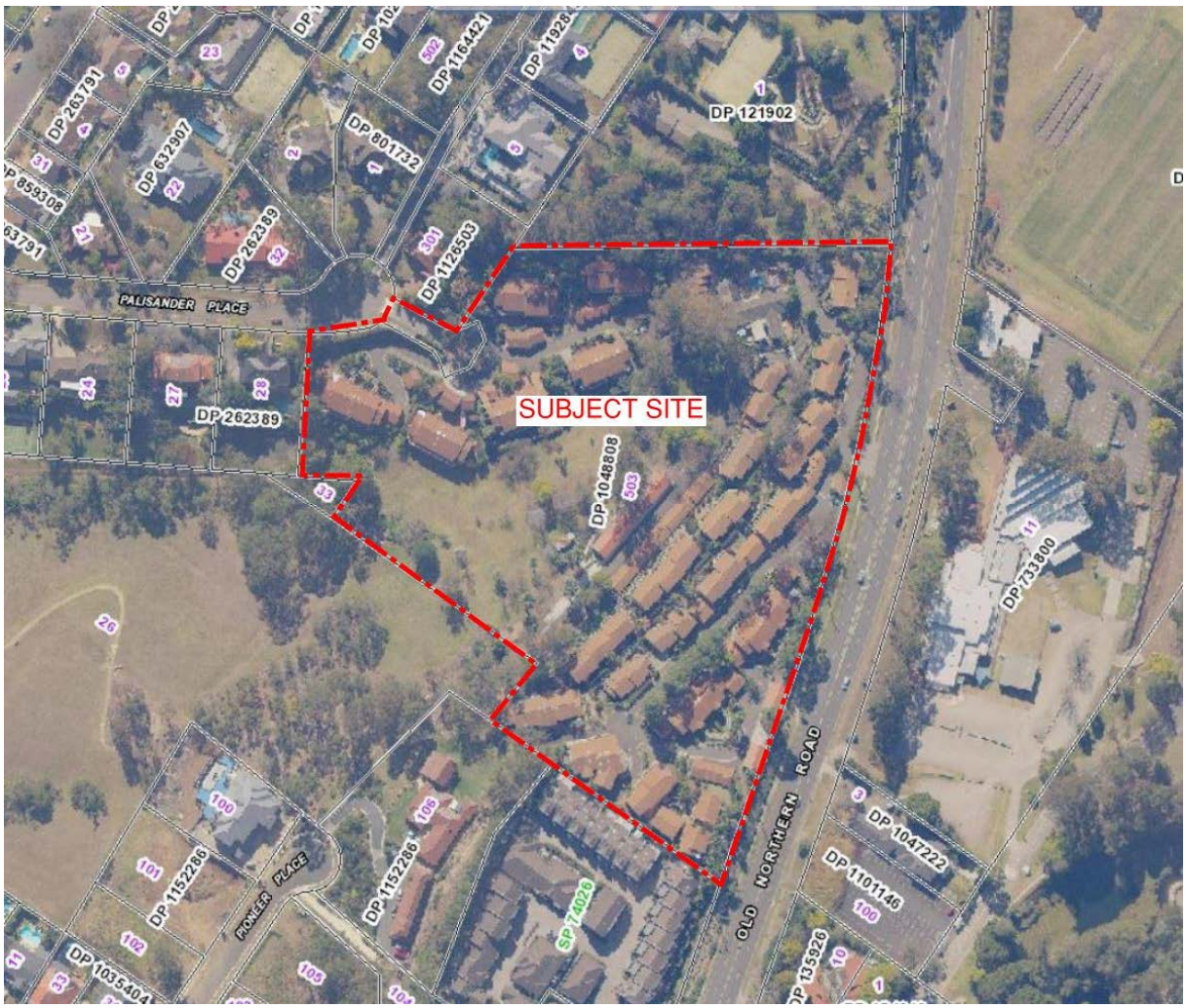


Figure 1 - Site Locality

3. STORMWATER INFRASTRUCTURE

3.1 Existing Infrastructure

The site has been assessed to be located at the top of the catchment. The existing topography of the land indicates resultant grades are in the order of approximately 10%. The natural slope of the land is down towards an existing watercourse located along the western boundary.

Surface runoff from majority of the existing site drains through a pit and pipe system towards the centre of the site, before entering a DN525 trunk drainage pipe. The pipe discharges directly to the existing watercourse through a headwall. Refer to Figure 1 below.

Figure 2 - Existing Headwall

Overland flow paths are located throughout the site as shown below in Figure 3, with swales forming majority of the overland flow path routes.

Figure 3 - Overland Flow Path

The watercourse exists directly downstream of the grassed area. The watercourse within the property extents is badly incised and requires rehabilitation. Refer Figure 4 and 5 below.

Figure 4 - Incised Watercourse - SE

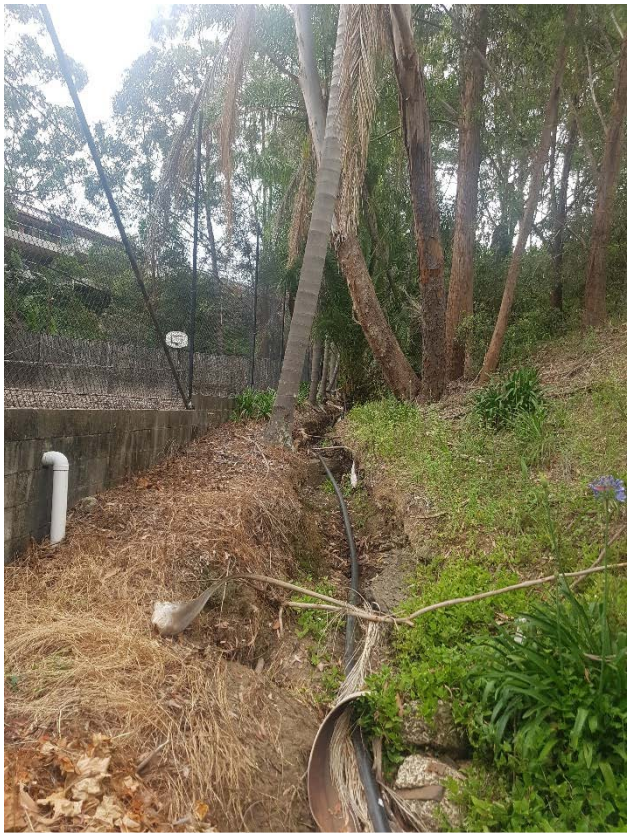


Figure 5 - Incised Watercourse - NW

Currently, the stormwater flows are attenuated by a number of above ground and below ground On-Site Detention (OSD) basins and tanks which are located throughout the site. Refer to **Appendix A**. They exist in the form of landscaped depressions (Figure 4) as well as below ground tanks.

Figure 6 - Existing OSD Basin - SW

Figure 7 - Existing OSD Basin

The site is prone to erosion and slope stability issues. At the time of the initial site visit, works were underway to re-align pipes along the eastern section of the grassed area. The completed drainage works have not been evaluated as part of this assessment.

4. PROPOSED DEVELOPMENT

Based on the Urban Design Report provided, the proposed redevelopment incorporates a footprint similar to the layout of the existing buildings. The redevelopment is proposed to incorporate 298 independent living units as represented on the Masterplan.

Several parts of the stormwater infrastructure has the potential to be retained. This includes OSD tanks and existing in-ground drainage pits and pipes. To optimise costs, it is recommended that the proposed design incorporate as many of the existing OSD tanks and drainage features as possible. Revised OSD calculations will be required to ensure each system has sufficient capacity. If capacity is deemed insufficient, augmentation of the existing system and/or network may be required.

In order to manage stormwater effectively in the proposed development, it is anticipated that one of the existing above-ground OSD basins in the western portion and an underground OSD tank in the eastern portion of the site will have to be reconfigured to avoid the proposed building's footprint. Within the current design there are possible locations available for the placement of additional OSD tanks in the centre, west and south of the site.

A portion of the trunk drainage and drainage easement will need to be diverted as shown in Figure 8. The drainage will also need to be redesigned and reconfigured to suit the proposed site arrangement.

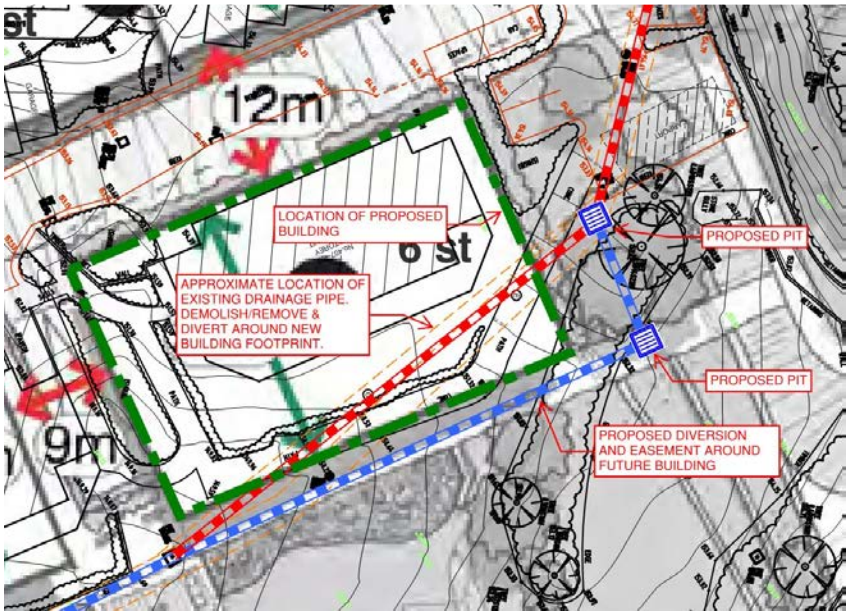


Figure 8 - Proposed Trunk Drainage Diversion

As the site is prone to erosion and slope stability issues, drainage and stormwater treatment measures will need to be appropriately sealed to avoid seepage and infiltration into surrounding soils. Local overland flow paths, drainage and culvert connections should be designed to prevent erosion in the grassed area.

The existing watercourse within the site boundary will also require rehabilitation and landscaping. This may include measures like rock lining at stormwater outlets and bank stabilisation with vegetation.

Overall, the redevelopment envisaged by the master plan is supportable from a drainage and flooding perspective.

Refer to **Appendix B** for recommendations for the stormwater network.

The redevelopment envisaged by the masterplan is supportable from a drainage and flooding perspective.

5. FLOODING

At this point in time, the subject site has not been determined to be affected by flooding. Hill's Shire Council have not released any flood studies or flood maps relating to the subject site. A flood information application shall be submitted to Council to obtain site specific flood information.

6. COST ESTIMATE

High Level Cost Estimate

Castle Ridge Retirement Resort		
Stormwater/Drainage Item	**Comment**	**Cost estimate**
Reconfigure existing above-ground OSD basin (western side)	Incorporate WSUD landscaping	$15,000
Proposed above-ground OSD (western side)	Combine with water quality treatment (WSUD)	$60,000
Proposed above-ground OSD (centre of site)	Combine with water quality treatment (WSUD)	$60,000
Demolish/remove OSD tank in south of site		$15,000
OSD tank (southern end)	Construct new OSD tank and incorporate water quality components (WSUD) if required	$80,000
Re-align trunk drainage in north of site		$40,000
Watercourse rehabilitation works	Natural channel with vegetation	$60,000
	Total	$330,000

The above estimates are based on the Urban Design Report provided by Architectus. They are high level cost estimates that Northrop expects to be incurred for the nominated works. Clarification shall be sought with a quantity surveyor for expected costs for the works.

The pricing excludes design cost, which are typically estimated at 20%.

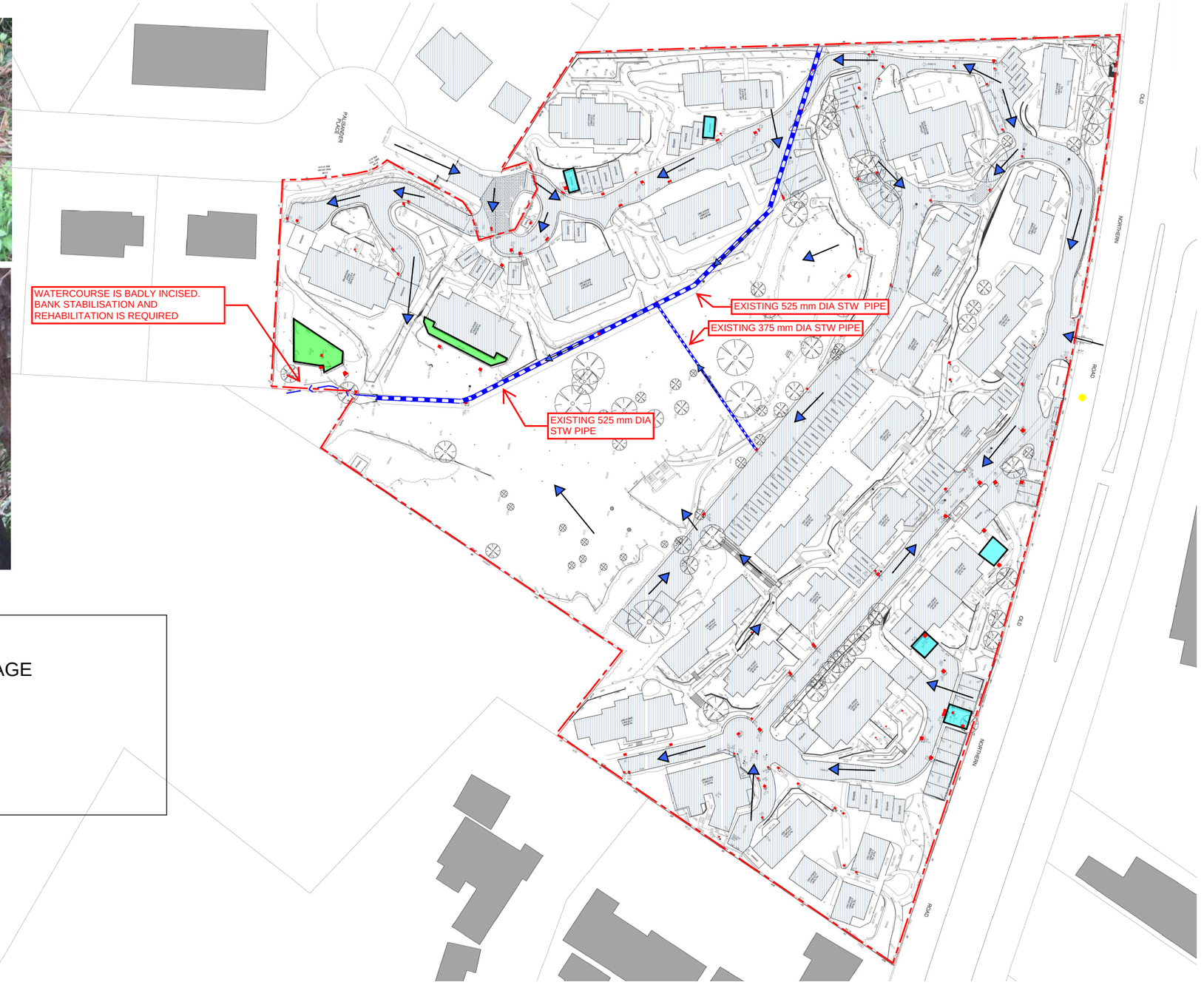
APPENDIX A – EXISTING INFRASTRUCTURE

VERIFIER:

JOB MANAGER:

DESIGNED:

DRAWN:



LEGEND

- ABOVE GROUND ON SITE STORAGE
- UNDERGROUND OSD TANKS
- PITS
- PIPES
- STREAM
- DIRECTION OF FLOW
- SITE BOUNDARY

NOTE:
1. EXISTING DRAINAGE NETWORK (SIZES, LEVELS ETC.) SHALL BE CONFIRMED THROUGH SURVEY.

NOT FOR CONSTRUCTION

REV	DESCRIPTION	ISSUED	VER'D	APP'D	DATE

NORTHROP
Sydney
Level 11, 345 George St, Sydney NSW 2000
T (02) 9241 4188
sydney@northrop.com.au ABN 81 094 433 100

CLIENT
ARCHITECTUS

PROJECT
CASTLE RIDGE RETIREMENT RESORT

DRAWING TITLE
EXISTING DRAINAGE NETWORK ANALYSIS

JOB NUMBER
S152307

DRAWING NUMBER
SK1

REVISION
2

DRAWING SHEET SIZE = A3

APPENDIX B – RECOMMENDATIONS FOR PROPOSED DESIGN

GENERAL NOTES:

1. EXISTING SITE MAY BE PRONE TO EROSION AND SLOPE STABILITY ISSUES.

2. EXISTING SITE DRAINAGE (I.E. PITS AND PIPES) TO BE RETAINED WHERE POSSIBLE.

3. OVERLAND FLOW PATHS TO BE REVIEWED AND RECONFIGURED TO SUIT NEW SITE ARRANGEMENT.

4. WATER QUALITY/QUANTITY TARGETS IN ACCORDANCE WITH HILLS SHIRE COUNCIL REQUIREMENTS (TBC). NO OSD SIZING OR WSUD ANALYSIS HAS BEEN UNDERTAKEN AS PART OF THIS ASSESSMENT.

5. RAINWATER TANKS FOR LANDSCAPE IRRIGATION ONLY.

LEGEND

- EXISTING ABOVE GROUND OSD
- EXISTING UNDERGROUND OSD TANKS
- PITS
- PIPES
- WATERCOURSE
- DIRECTION OF FLOW

VERIFIER:

JOB MANAGER:

DESIGNED:

DRAWN: MC

NOT FOR CONSTRUCTION

REV	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
2	ISSUED FOR INFORMATION	MC		MB	13.12.18

CLIENT: **STOCKLAND**

DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

ARCHITECT: **ARCHITECTUS**

THE COPYRIGHT OF THIS DRAWING REMAINS WITH NORTHROP CONSULTING ENGINEERS PTY LTD

ALL SETOUT TO ARCHITECT'S DRAWINGS. DIMENSIONS TO BE VERIFIED WITH ARCHITECT AND BUILDER BEFORE COMMENCING SHOP DRAWINGS OR SITE WORK. NORTHROP ACCEPTS NO RESPONSIBILITY FOR THE USABILITY, COMPLETENESS OR SCALE OF DRAWINGS TRANSFERRED ELECTRONICALLY.

NORTHROP
Sydney

PROJECT: **CASTLE HILL RETIREMENT RESORT**

DRAWING TITLE: **PROPOSED INFRASTRUCTURE**

JOB NUMBER: **152307**

DRAWING NUMBER: **SK02**

REVISION: **2**

DRAWING SHEET SIZE = A1