

NL150017\_B01 [C]

21<sup>st</sup> January 2016

#### AVEO

C/- PEP Consulting Shay Riley-Lewis 1/29 McCann Court Carrington NSW 2294

Dear Shay,

#### Re: Shortland Waters Seniors Living – Stormwater Management Masterplan Strategy

Northrop Consulting Engineers have been engaged by AVEO to provide civil design services for the proposed seniors living development encompassed within the existing Shortland Water Golf Course, herein known as 'the site'. This letter intends to discuss stormwater management strategies relating to the ultimate and entire development site at a level appropriate for master planning and should be read in conjunction with the attached sketch plans NL150017/SM-01.

This letter does not attempt to provide detailed design solutions to all issues; rather it will establish the key elements of stormwater management at a conceptual level to achieve the requirements of governing Authorities. The master plan contained herein is an evolving long term planning document that shall provide guidance to the implementation of stormwater management measures for subsequent DA approvals.

A schematic of the proposed site is shown below in Figure 1.



Figure 1 – Site Schematic

Prepared	AK	21/01/2016
Reviewed	AB	21/01/2016



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#### 1. Proposed Stormwater Management Strategy

The proposed stormwater management strategy for the 11ha development site can be summarised as follows;

- Runoff from the proposed access road from the Vale Street Bridge will be collected via a series of pits and pipes at the upper reach of the access road. Captured runoff shall be discharge to the existing stormwater network which is currently piped and discharged to the adjacent drainage gully to the west.
- Runoff from the lower reach of the access road will sheet directly off the pavement across the existing grass towards the adjoining golf course, imitating the natural runoff regime and maintaining dispersed flow.
- Runoff from the new Independent Living Unit (ILU) roof areas will be collected and diverted to above ground harvesting tanks. The harvesting tanks will provide a minimum volume of 2.5kL which will be reticulated internally for toilet flushing and laundry use. In accordance with Table 4.1 of Newcastle City Councils 'Stormwater and Water Efficiency for Development', the volume that can be disposed of by a 2 bedroom dwelling via toilet and laundry re-use is 1.9kL. Overflow from the harvesting tanks will be directed to the underground pipe network for the site;
- Runoff from the community facility roof area will be diverted to a 10kL reuse tank which will be reticulated for toilet flushing. Overflow from the harvesting tanks will be directed to the underground pipe network for the site;
- Runoff from the internal access road and driveways will be collected via surface inlet pits and conveyed to the stormwater quantity and quality treatment devices for the site via the underground pipe network;
- Stormwater quantity targets will be achieved by providing a total of approximately 2200m<sup>3</sup> of On Site Detention which will be typically located under the driveway pavement. A number of detention devices have been included in the strategy to mimic the anticipated staging of the development. Please refer to section 2. Stormwater quantity assessment below for further details;
- Stormwater quality targets will be achieved through the implementation of a number of Water Sensitive Urban Design (WSUD) features including; biofiltration swales, raingardens, GPT devices and rainwater reuse. Similarly to detention, the biofiltration swales have been located to suit the anticipated staging of the development. The biofiltration swales will be located within the 10m landscape zone around the perimeter of the site. A typical crosssection of the biofiltration swales is shown overleaf in Figure 2. Please refer to section 3. Stormwater quality assessment below for further details;
- Discharge from the proposed stormwater quality and quantity controls will ultimately be conveyed across the adjoining golf course. The discharge shall be in the form of dispersed sheet flow to prevent erosion of the downstream golf course. Please refer to section *4. Discharge of Stormwater Runoff* below for further details.



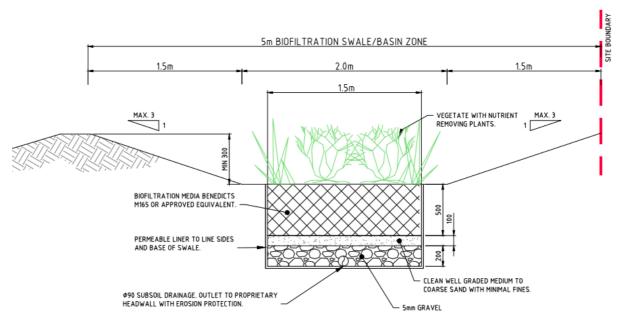


Figure 2 – Typical Biofiltration Swale Section

#### 2. Stormwater Quantity Assessment

In order to minimise the impact of the development on the wider catchment runoff regime, hydrological and hydraulic modelling has been undertaken using the software package DRAINS. In particular, the modelling was undertaken to achieve the objectives outlined in NCC DCP 7.06 and in accordance with the Concept Approval for the senior's housing development. A schematic of the DRAINS model is shown below in Figure 3.

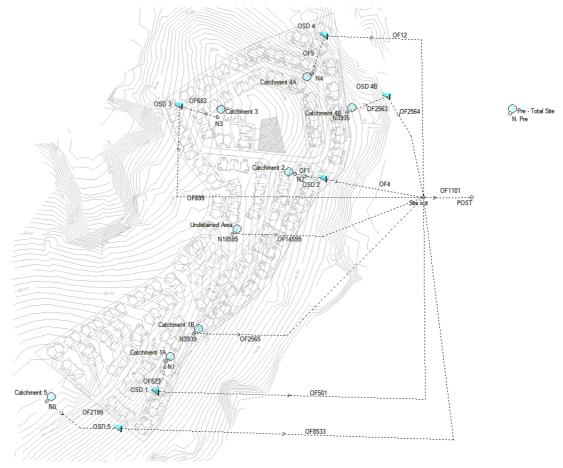


Figure 3 – DRAINS Schematic



The target objectives can be achieved for the development by implementing a total of approximately 2200m<sup>3</sup> of detention storage.

The results of the DRAINS analyses are summarised below in Table 1. The respective Permissible Site Discharge and Site Storage Requirements (SSR) are also denoted for specification in subsequent DA's for each stage.

Storm Event	Peak Pre-developed Runoff	Peak Post-developed Runoff	Detention Volume Required	PSD	SSR
20% AEP	2.03 m³/s	1.98 m³/s	1450m <sup>3</sup>	180 L/s/ha	130 m³/ha
10% AEP	2.36 m³/s	2.24 m³/s	1600m <sup>3</sup>	200 L/s/ha	145 m³/ha
5% AEP	2.79 m³/s	2.59 m³/s	1850m <sup>3</sup>	235 L/s/ha	170 m³/ha
1% AEP	3.6 m³/s	3.41 m³/s	2200m <sup>3</sup>	310 L/s/ha	200 m <sup>3</sup> /ha

Table 1 – Estimated Peak Runoff

It is anticipated the detention volume can be achieved using a number of below ground solutions, including but not limited to;

- Gravel trenches;
- · Atlantis cells or equivalent proprietary products;
- · Tunnel trenches; or
- Blockwork detention tanks.

The preferred On Site Detention solution will be investigated at the timing of subsequent DA's for each stage, with due consideration given to spatial requirements, maintenance access and cost.

#### 3. Stormwater Quality Assessment

In order to minimise the developments adverse impacts upon the ecology of the downstream watercourses a number of stormwater treatment devices have been incorporated into the stormwater design. The stormwater quality treatment strategy has been assessed against two performance indicators identified in NCC DCP 7.06; those being 'Pollutant Load Reduction' and 'Stream Erosion Index' as detailed below.

#### Pollutant Load Reduction

NCC DCP 7.06 [2012] identifies the level of stormwater quality treatment to be provided for the proposed development, as seen below in Table 2.

Pollutant	% post development average annual load reduction
Total Suspended Solids (TSS)	85 %
Total Phosphorous (TP)	65 %
Total Nitrogen (TN)	45 %
Gross Pollutants	90 %

Table 2 – NCC Water Quality Targets

The performance of the proposed stormwater management strategy was assessed against these targets using the conceptual software MUSIC (Version 6). The MUSIC model was developed in accordance with the 'Draft NSW Music Modelling Guidelines.' A schematic of the MUSIC model is shown below in Figure 3.





Figure 3 – MUSIC Schematic

	Source Load (kg/yr)	Residual Loads (kg/yr)	Percentage Reduction	Target Objectives
Total Suspended Solids (TSS)	9720	1440	85.2 %	85 %
Total Phosphorous (TP)	20.9	6.06	71 %	65 %
Total Nitrogen (TN)	150	78.1	47.9 %	45 %
Gross Pollutants	1760	73.3	95.8 %	90 %

The results from the investigation can be seen below in Table 3.

Table 3 – MUSIC Results

Table 3 above shows the proposed stormwater management strategy is predicted to achieve the load reduction targets, as estimated by MUSIC. As such, it is estimated a total biofiltration area of approximately 850m<sup>2</sup> will be required to achieve the pollutant reduction targets sitewide. Averaging across the development site, approximately 80m<sup>2</sup> of biofiltration swale per hectare will be required for subsequent DA's to comply with the requirements of the masterplan stormwater strategy.

#### Stream Erosion Index

The Stream Erosion Index (SEI) has been determined for the development based on the guidelines laid out under Section 4.15 of the NCC Technical Manual. The pre developed and developed scenarios were modelled in MUSIC. The recommended pervious area parameters for a silty clay, as laid out in the 'Draft NSW MUSIC Modelling Guidelines' (WBM, 2010), were utilised for both the pre developed and developed scenarios.

The stream forming flow was taken as half of the 2 year ARI predevelopment flow. Based on the 5 years of rainfall data within the MUSIC model (Williamtown 2002 – 2006), the 2 year ARI was determined to be  $0.18m^3/s$  (third largest peak flow). Hence the stream forming flow for the development is  $0.09m^3/s$ .

Using the generic node in MUSIC the SEI was calculated to be 1.38 which is below the required 2 as stated in the NCC DCP. The reduction of post developed flows has been achieved by the proposed re-use tanks and the extended detention volume above the biofiltration swales.



A summary of the results is provided in Table 4 below.

Scenario	Pre Developed	Developed	SEI	Target SEI
Mean annual flow	18.8 ML/Year	67 ML/Year	-	-
Mean annual flows above stream forming flow	15.9 ML/Year	21.9 ML/Year	1.38	2

Table 4 – Stream Erosion Index

As seen above in Table 4, the proposed stormwater treatment train for the ultimate development will mitigate developed flows to an acceptable level in accordance with NCC's stream erosion index.

MUSIC data files can be provided upon request.

#### 4. Discharge of Stormwater Runoff

Due to the natural lay of the land, it is anticipated the development precinct will have seven (7) locations of discharge. At each discharge location, flow velocities will be limited for the major storm event to prevent the erosion of the downstream golf course through flow spreading and disposal of concentrated flows. In accordance with Table 5.2 of Landcoms '*Managing Urban Stormwater – Soils and Construction*' (the Blue Book), the critical velocity for erosion of Couch grass is 1.8m/s (for storm events less than 6hrs). Applying the principles of weir flow, the estimate discharge velocity for each runoff location is shown overleaf in Table 5. Refer to the attached concept plan for discharge locations.

Discharge Location	Estimate 1% AEP Peak Discharge	Approximate Weir Length	Approximate Depth of Flow	Estimated Discharge Velocity
А	415 L/s	30	50mm	0.3m/s
В	445 L/s	30	50mm	0.3m/s
С	440 L/s	30	50mm	0.3m/s
D-E	800 L/s	50	50mm	0.3m/s
F-E	550 L/s	40	50mm	0.3m/s
G	555 L/s	40	50mm	0.3m/s
Н	400 L/s	30	50mm	0.3m/s

Table 5 – Estimate Site Discharge Velocities

As seen above in Table 5, it is estimated that sufficient provisions are available to reduce discharge velocities such that the site runoff is in a controlled manner which will maintain the integrity of the downstream environment (i.e. discharge velocity is less than 1.8 m/s).

In short, concentrated flow is proposed to be spread at each of the discharge points using level spreaders/contour mounds/swales etc. Subsequent DA's for each stage shall apply the minimum specified weir length at the outlet for each catchment.

#### 5. Conclusions

Given the results of the above investigations, it is reasoned the development meets NCCs requirements and has appropriate stormwater management for the downstream environment. In particular:



• The attenuation of stormwater runoff to match the pre developed scenario has been achieved via the use of On Site Detention. The detention shall be apportioned across the future development stages as per Table 6 below;

Storm Event	Permissible Site Discharge	Site Storage Requirement
20% AEP	180 L/s/ha	130 m³/ha
10% AEP	200 L/s/ha	145 m³/ha
5% AEP	235 L/s/ha	170 m³/ha
1% AEP	310 L/s/ha	200 m³/ha

Table 6 – On-Site Detention Requirements

- The treatment of stormwater runoff for waterborne pollutants is achieved through the proposed treatment train. This includes the use of rainwater harvesting tanks, on site detention, biofiltration swales and raingardens. The biofiltration swales shall be apportioned across the future development stages at a rate of 85m<sup>2</sup> per ha; and
- Adequate provisions are available to ensure stormwater runoff from the site is discharged in a controlled manner which will maintain the integrity of the downstream environment.

We reiterate the master plan detailed above is an evolving long term planning document that shall provide guidance to the implementation of stormwater management measures for subsequent DA approvals.

I trust the above meets your requirements; however, if you would like to discuss the development further, then please do not hesitate to contact the undersigned on 4943 1777.

Yours sincerely,

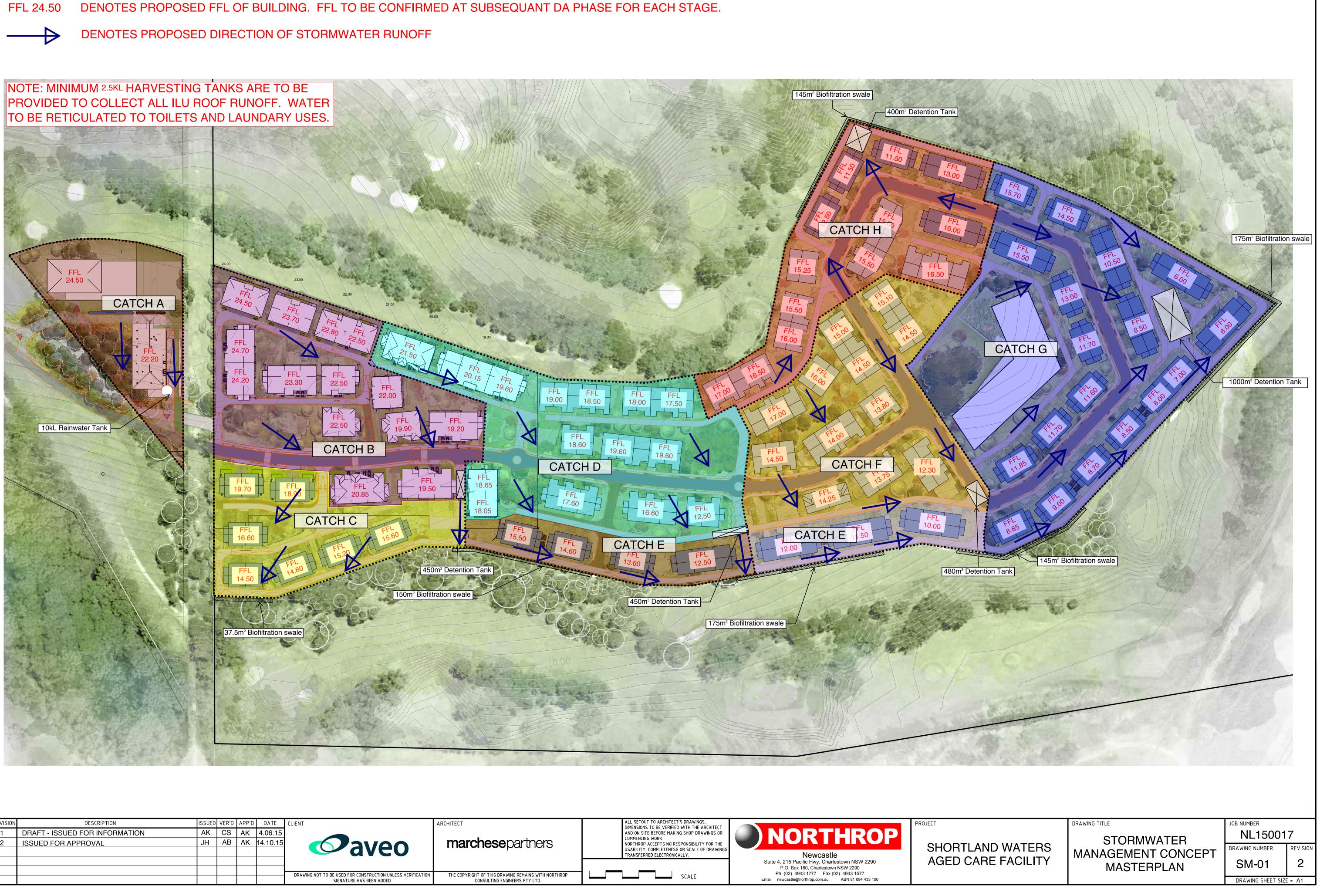
Aaron Knight <u>Civil Engineer</u> BE (Civil) Hons1



## ATTACHMENTS

# LEGEND





REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT	ARCHITECT
1	DRAFT - ISSUED FOR INFORMATION	AK	CS	AK	4.06.15		
2	ISSUED FOR APPROVAL	JH	AB	AK	14.10.15		l march
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NL150017\_B16

3<sup>rd</sup> February 2017

#### AVEO

C/- PEP Consulting Shay Riley-Lewis 1/29 McCann Court Carrington NSW 2294

Dear Shay,

### Re: Shortland Waters Seniors Living – Precinct 2 Stormwater Management Strategy

Northrop Consulting Engineers have been engaged by AVEO to provide civil design services for the proposed seniors living development encompassed within the existing Shortland Waters Golf Course, herein known as 'the site'. This letter intends to discuss stormwater management strategies relating to Precinct 2 of the development at a level appropriate for DA assessment and should be read in conjunction with;

- the overarching Concept Stormwater Management Masterplan report (ref# NL150017\_B01 [C]); and
- the engineering plans NL150017/C20DA-C25DA.

This letter does not attempt to provide detailed design solutions to all issues; rather it will establish the key elements of stormwater management at a conceptual level in accordance with the masterplan to achieve the requirements of governing Authorities. The outcomes of this investigation will be developed further at Construction Certificate phase of the project.

A schematic of the proposed site with the Precinct 2 extent overlaid is shown below in Figure 1.

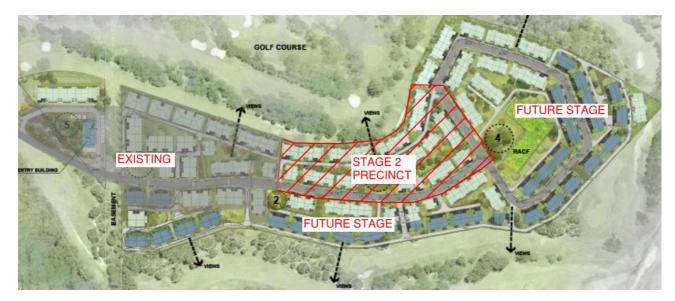


Figure 1 – Site Schematic of Precinct 2

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Prepared	AK	01/02/2016
Reviewed	AB	01/02/2016



#### Proposed Stormwater Management Strategy

The proposed stormwater management strategy for the Precinct 2 Independent Living Units (ILUs) shall be in line with the overarching approved Concept Stormwater Management Masterplan. The masterplan catchments for the Precinct 2 development footprint are shown below in Figure 2.

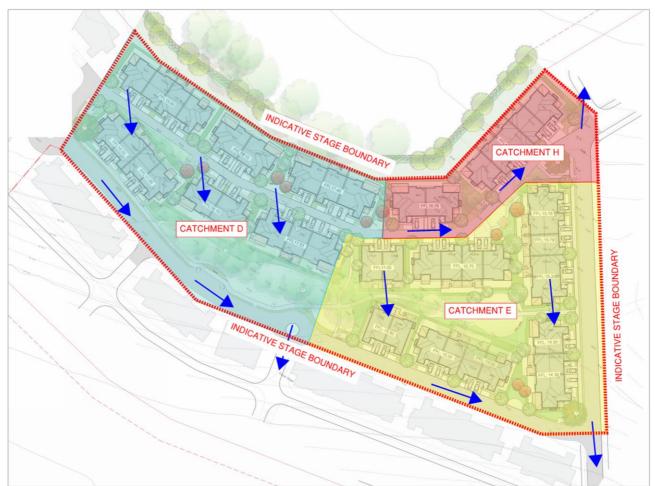


Figure 2 – Precinct 2 Stormwater Catchments Schematic

As seen above in Figure 2, the Precinct 2 footprint does not include the construction of any end of line detention or water quality treatment infrastructure. In accordance with the masterplan, these devices will be implement in the future stages of the development.

As such, it is proposed to install temporary discharge measures as denoted on Drawing NL150017/C22DA until such time that the future stage is constructed. The temporary measures shall reduce flow discharge velocities to below 1.8m/s for the major storm event to reduce the risk of eroding the downstream golf course as per the approved Concept Stormwater Management Masterplan. Details shall be provided at detailed design stage.

Notwithstanding the above, it is noted that at source controls will be implemented during Stage 2 (i.e. 2.5kL rainwater reuse tanks per villa). Furthermore, additional treatment such as filtration over grass buffer strips shall also be employed during the Precinct 2 works. For example; in the open space parklands; private courtyards; and adjacent to the temporary earth bunds.



#### Conclusions

Given the results of the above investigations, it is reasoned the development meets NCCs requirements in line with the overarching approved Concept Stormwater Management Masterplan. In particular; adequate provisions have been made to ensure stormwater runoff from the proposed works is discharged in a controlled manner which will maintain the integrity of the downstream environment.

I trust the above meets your requirements; however, if you would like to discuss the development further, then please do not hesitate to contact the undersigned on 4943 1777.

Yours sincerely,

this

Aaron Knight ´ <u>Civil Engineer</u> BE (Civil Hons1)