NORTHROP
Level 1, 215 Pacific Highway
Charlestown NSW 2290
02 4943 1777
newcastle@northrop.com.au
ABN 81 094 433 100

16 June 2020

NL181251 [B]

Lyons
Hari Pliambas
Level 3, 246 Bourke Street
Melbourne VIC 3000

Dear Hari,

Re: University of Newcastle STEMM – Stormwater Management

Northrop Consulting Engineers have prepared Civil design and documentation for the University of Newcastle STEMM development. This letter summarises the proposed stormwater quantity and quality management strategy proposed for the site in order to respond to queries raised in the SSDA review.

We note that the current design has been refined from the originally submitted DA documentation, and this letter seeks to outline the revised onsite detention and water quality treatment philosophy whilst satisfying TCON's requirements as outlined in Section 7.06 of their Development Control Plan 2012 and Stormwater and Water Efficiency for Development Technical Manual.

Existing and Proposed Catchments

Due to the existing site topography, two distinct stormwater catchments have been identified for the existing McMullin buildings and surrounding landscape areas. Review of existing services data and subsequent site inspections indicates the northern portion of the site drains in a general north easterly direction to the existing drainage network which runs beneath the existing social sciences building, whilst the southern portion of the site drains in a southerly direction to the university Ring Road.

The stormwater philosophy for the proposed development generally maintains the existing drainage regime by discharging captured runoff to the existing drainage networks which exist to the northeast and south of the development area. The STEMM building roof catchment and the majority of the surrounding pavement areas discharge to the southern drainage network adjacent to Ring Road. This methodology decreases the catchment area discharging to the existing northeast drainage network to the north, and as such detention for the new northern catchment is not required. Detention is however required for the southern catchment due to the increased catchment and hardstand areas, the details of which are discussed further below.

Stormwater Quantity Management (Detention)

Due to the increased hardstand area associated with the proposed development, stormwater detention is required to reduce peak stormwater runoff to pre-development flows discharging from site. Stormwater infrastructure has been detailed in our drainage design to:

- Reduce the catchment draining to the northeast stormwater network by discharging the majority of site runoff to the south. This increases the redundant capacity within the existing network to the northeast of the site, thus reducing the risk of flooding in the event of partial downstream blockage. The reduced catchment size allows the peak runoff to be reduced compared to pre-developed flows and therefore no detention is required for this catchment.
- Provide a new OSD tank installed within the external landscape area of the site to detain peak flows in the southern catchment to that of pre-developed flows. The roof area of the STEMM building will be plumbed through the OSD tank. Part of the external area in the southern catchment will also be directed through the OSD tank. The remaining external areas in the southern catchment will bypass and do not need to be detained.

Hydrological modelling was undertaken to assess the peak flows for a range of storm durations and frequencies to determine the impact of the proposed development on the hydrologic regime. Detention measures were then designed to ensure no net increase in peak flows during storm events up to the 1% AEP. Modelling was undertaken using the computer software package DRAINS utilising the ILSAX hydrological method. Rainfall data for the model was obtained from the Bureau of Meteorology using ARR2019 procedures.

The catchment areas were defined in the model for both pre- and post-developed conditions. The pre-developed catchment areas, in which greenfield conditions have been adopted are indicated in Table 1 below.

Table 1 – Pre-Developed Catchment Areas

Catchment Type	Catchment Area (ha)	
	North	South
Pervious	0.66	0.87
Impervious	-	-

A breakdown of the post-developed catchment areas adopted for the modelling is below in Table 2.

Table 2 – Post-Developed Catchment Areas

Catchment Type	Catchment Area (ha)		
	Roof & External– To OSD	South - Bypassing OSD	North - Bypassing OSD
Pervious	0.0298	0.2988	0.1972
Impervious	0.7142	0.1472	0.1428

A single detention tank was considered appropriate given the building configuration, fractions impervious/ pervious, and site layout. Through runoff routing in DRAINS a volume of 230kL was determined to be required for the tank. The results from the DRAINS model for the peak storm events are summarised below in Table 3.

Table 3 - Peak Storm Event Site Discharge Flow Rates

AEP (%) STORM EVENT	Detention Tank 1 – Roof and Bypassing South Catchment		North Catchment Bypassing OSD	
	PRE DEV Flow (m^3/s)	POST DEV Flow (m^3/s)	PRE DEV Flow (m^3/s)	POST DEV Flow (m^3/s)
20	0.198	0.194	0.150	0.096
10	0.280	0.265	0.212	0.126
5	0.347	0.344	0.263	0.154
2	0.442	0.441	0.336	0.188
1	0.527	0.522	0.400	0.224

As summarised, the tank will attenuate runoff from the roof catchment and part of the external area up to the 1% AEP peak flow, compensating for runoff from the remaining south bypassing catchment. Further to this, the northern catchment has reduced in size between the pre-developed and post-developed scenarios, as a portion of the catchment forms part of the proposed roof. With this reduction, discharge from the post-developed northern bypassing catchment was observed to be less than the pre-developed for each simulated storm event without the need for additional detention storage. From these results, it is therefore considered that the proposed stormwater management strategy effectively mitigates the effects of the development on stormwater quantity in accordance with the intent of the Concept Design goals, and Councils DCP. The DRAINS model has been provided for review.

The DA design had detention storage located within the building footprint. Due to spatial constraints within the building realised as the design progressed, the detention tank was relocated into the southern landscape area. This relocation allowed the detention tank to capture a portion of the external southern catchment in addition to the roof area, where it previously did not in our original DA design. This change in catchment area has been accounted for in the updated DRAINS modelling as documented in Tables 2 and 3. Refer to the drawings in Attachment A for further information.

Stormwater Quality Management

Stormwater quality provisions have been nominated within the detailed design to satisfy the requirements of Newcastle Council DCP. The performance of the proposed stormwater management strategy was assessed against Council's targets using the conceptual software MUSIC (Version 6). The MUSIC model was developed using recommended parameters presented in the 2015 NSW MUSIC Guidelines and the TCoN's MUSIC LINK. A schematic of the MUSIC model is shown below in Figure 1.

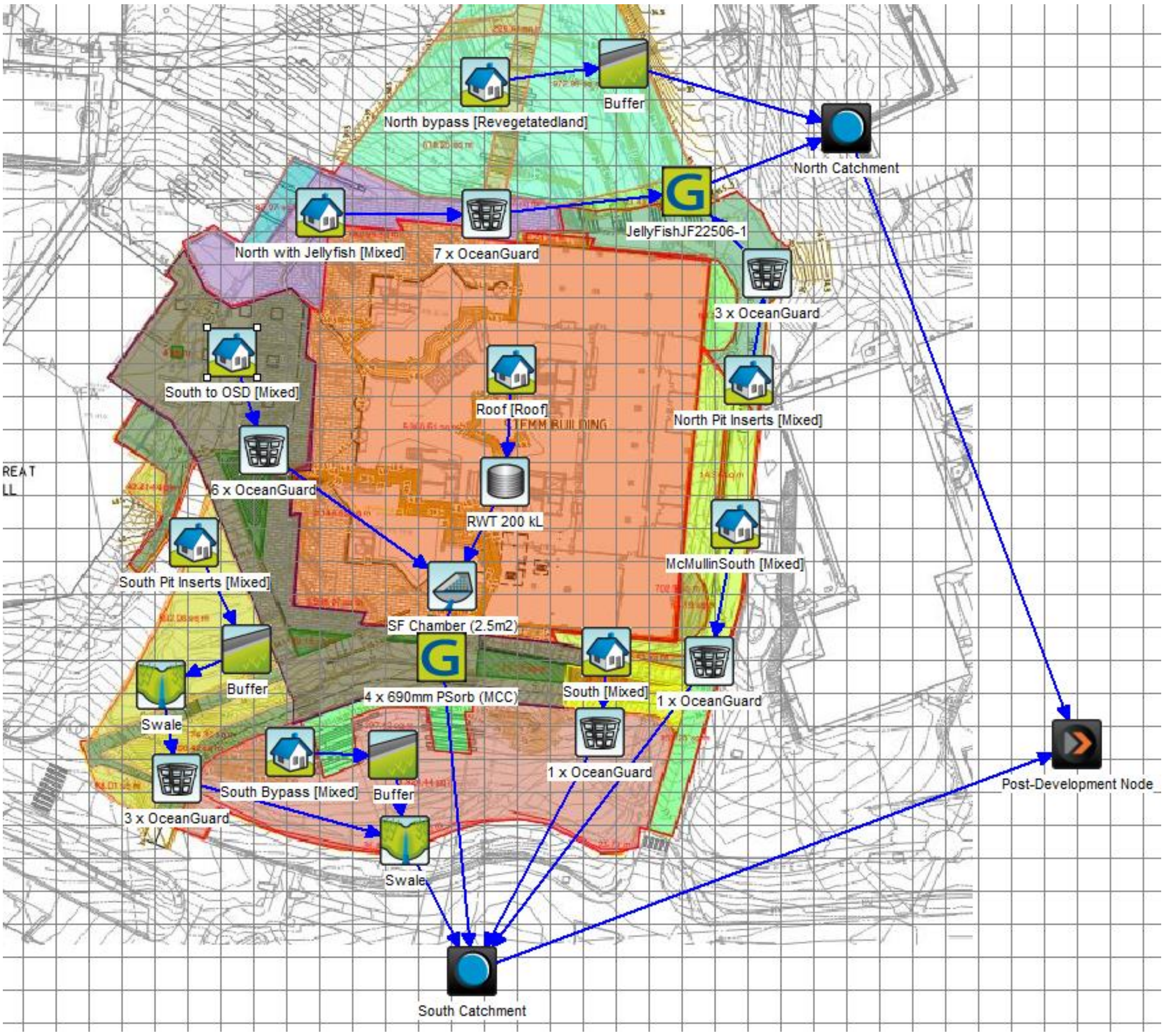


Figure 1 - MUSIC Model

The following is a summary of the water quality treatment devices that have been utilised within the design:

- **Rainwater reuse tank** – Runoff from the roof is to be directed to an individual reuse tank with downpipe fitted with propriety first flush devices. Runoff collected in the tanks is to be plumbed to all internal toilets and urinals for internal reuse. Reuse rates have been provided by the hydraulic engineer, these rates in conjunction with the roof catchment area were used to find the optimal storage capacity. A 71.7% demand efficiency is achieved with proposed reuse tank volume of 200kL, which has been modelled as a lump node in MUSIC. This meets the demand efficiency of 70% required by Council.

- **Pit filter baskets** – It is proposed that proprietary pit filter baskets, Ocean Guard or an approved equivalent product, will be fitted to all pits within site to aid in primary treatment in the removal of gross pollutants. The pit filters have been modelled as per treatable flowrate and performance recommended in the supplied node for the OceanGuard filters by Ocean Protect.

- **Proprietary filtration device** –Proprietary filtration devices have been proposed to provide secondary treatment to runoff from the roadways, roof and landscaped areas, to remove fine sediment and suspended nutrients prior to entry into the downstream stormwater network. One (1) Ocean Protect Jellyfish or approved equivalent has been proposed within the northern catchment with calculations confirming a single filter is adequate to treat runoff from the entire northern catchment. Four (4) Ocean Protect StormFilters or approved equivalent have been proposed in the southern catchment, to be located within a StormFilter chamber fit in the OSD tank footprint. The Jellyfish has been sized as a JF22506-1 in the model, reflected accordingly by the treatment flowrate capacity of that model in the MUSIC node. Treatment rates of the jellyfish in the model are as per the supplied node settings from proprietary device suppliers (Ocean Protect). Similarly, the StormFilter device has been modelled as per recommendations and supplied node by Ocean Protect.
- **Landscape Swales –** Landscape swales will be provided in appropriate landscape areas to further treat fine sediment and suspended nutrients in the runoff. Swales also benefit in reducing the length of pipework required.

In addition to the above measures, portions of the pervious landscaping will form part of the treatment train to aid in treatment of surface runoff throughout the site where practical. The existing McMullin Lane which is to remain in the site is going to be treated by water quality devices in this detailed design where it currently is not. As a result, an equivalent area in the northern bypass has not been considered in the water quality design.

The proposed treatment train resulted in the reduction percentages outlined in Table 4. The MUSIC model and MUSIC Link report with full result details has been provided.

Table 4 - MUSIC Modelling Results

Pollutant	Sources	Residual Load	% Reduction	TCON's Reduction Target %
Total Suspended Solids (kg/yr)	1250	135	89.2	85
Total Phosphorus (kg/yr)	3.18	1.08	66	65
Total Nitrogen (kg/yr)	29.6	13	56	45
Gross Pollutants (kg/yr)	312	0.467	99.9	90

As shown above the proposed stormwater quality management strategy will achieve the required load reduction targets and is therefore considered to adequately meet the design intent of Council's DCP.

The following updates to the design were made whilst retaining the water quality philosophy from the DA design:

- Source nodes were split into smaller more detailed catchment areas, as the design was refined.
- Additional reuse volume has been provided as requested by the hydraulic engineer to supply the water coolant system, based off detailed reuse demand provided.
- OceanGuard pit filter numbers has been updated for detailed pit locations.

- Proprietary Jellyfish in southern catchment changed to proprietary filter cartridges located in separate chamber in the detention tank, as the detention tank was moved into the location of the Jellyfish in the DA design and this was an opportunity to combine treatment and detention spatially.
- Swales are now provided for stormwater conveyance and treatment in catchment areas that otherwise bypass the proprietary treatment devices due to detailed surface level design.

Conclusion

The development requires stormwater detention facilities in the southern catchment to mitigate post-developed stormwater runoff from the additional impervious areas. Stormwater treatment devices are proposed to treat runoff from the additional impervious areas of the developed site. Requirements of the detailed design have resulted in updated stormwater quality and treatment device measures, however the intent of the DA design and the requirements of TCON’s DCP are considered to be satisfied in the detailed design.

Yours sincerely,

Rachel Stevenson
Civil Engineer
BEng (Civil) | BEng (Environmental)

MUSIC-*link* Report

Project Details

Project:	STEMM UON
Report Export Date:	1/04/2020
Catchment Name:	200331 - STEMM CC Cartridge option
Catchment Area:	1.493ha
Impervious Area*:	67.20%
Rainfall Station:	61078 WILLIAMTOWN
Modelling Time-step:	6 Minutes
Modelling Period:	1/01/1995 - 31/12/2008 11:54:00 PM
Mean Annual Rainfall:	1125mm
Evapotranspiration:	1735mm
MUSIC Version:	6.3.0
MUSIC-link data Version:	6.33
Study Area:	Newcastle
Scenario:	Newcastle

Company Details

Company:	Northrop Consulting Engineers
Contact:	Rachel Stevenson
Address:	Level 1, Pacific Highway Charlestown NSW
Phone:	(02) 49431777
Email:	RStevenson@northrop.com.au

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Post-Development Node	Reduction
Flow	26.9%
TSS	89.2%
TP	66%
TN	56%
GP	99.9%

Treatment Nodes

Node Type	Number
Rain Water Tank Node	1
Buffer Node	3
Bio Retention Node	1
Swale Node	2
Sedimentation Basin Node	1
GPT Node	6
Generic Node	2

Source Nodes

Node Type	Number
Urban Source Node	9

Comments

StormFilter Chamber has recommended settings from the proprietary device supplier.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention	Hi-flow bypass rate (cum/sec)	None	None	100
Bio	Bioretention	PET Scaling Factor	2.1	2.1	2.1
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.3
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.57
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.8
GPT	1 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.02
GPT	1 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.02
GPT	3 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.06
GPT	3 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.06
GPT	6 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.12
GPT	7 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	None	0.14
Post	Post-Development Node	% Load Reduction	None	None	26.9
Post	Post-Development Node	GP % Load Reduction	90	None	99.9
Post	Post-Development Node	TN % Load Reduction	45	None	56
Post	Post-Development Node	TP % Load Reduction	65	None	66
Post	Post-Development Node	TSS % Load Reduction	85	None	89.2
Rain	RWT 200 kL	% Reuse Demand Met	70	None	71.7291
Sedimentation	SF Chamber (2.5m2)	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber (2.5m2)	Hi-flow bypass rate (cum/sec)	None	None	100
Sedimentation	SF Chamber (2.5m2)	High Flow Bypass Out (ML/yr)	None	None	0
Swale	Swale	Bed slope	0.01	0.04	0.0125
Swale	Swale	Bed slope	0.01	0.04	0.0125
Urban	McMullinSouth	Area Impervious (ha)	None	None	0.059
Urban	McMullinSouth	Area Pervious (ha)	None	None	0.010
Urban	McMullinSouth	Total Area (ha)	None	None	0.07
Urban	North bypass	Area Impervious (ha)	None	None	0.002
Urban	North bypass	Area Pervious (ha)	None	None	0.147
Urban	North bypass	Total Area (ha)	None	None	0.15
Urban	North Pit Inserts	Area Impervious (ha)	None	None	0.055
Urban	North Pit Inserts	Area Pervious (ha)	None	None	0.017
Urban	North Pit Inserts	Total Area (ha)	None	None	0.073
Urban	North with Jellyfish	Area Impervious (ha)	None	None	0.071
Urban	North with Jellyfish	Area Pervious (ha)	None	None	0.010
Urban	North with Jellyfish	Total Area (ha)	None	None	0.082
Urban	Roof	Area Impervious (ha)	None	None	0.53
Urban	Roof	Area Pervious (ha)	None	None	0
Urban	Roof	Total Area (ha)	None	None	0.53
Urban	South	Area Impervious (ha)	None	None	0.018
Urban	South	Area Pervious (ha)	None	None	0.003
Urban	South	Total Area (ha)	None	None	0.022

Only certain parameters are reported when they pass validation

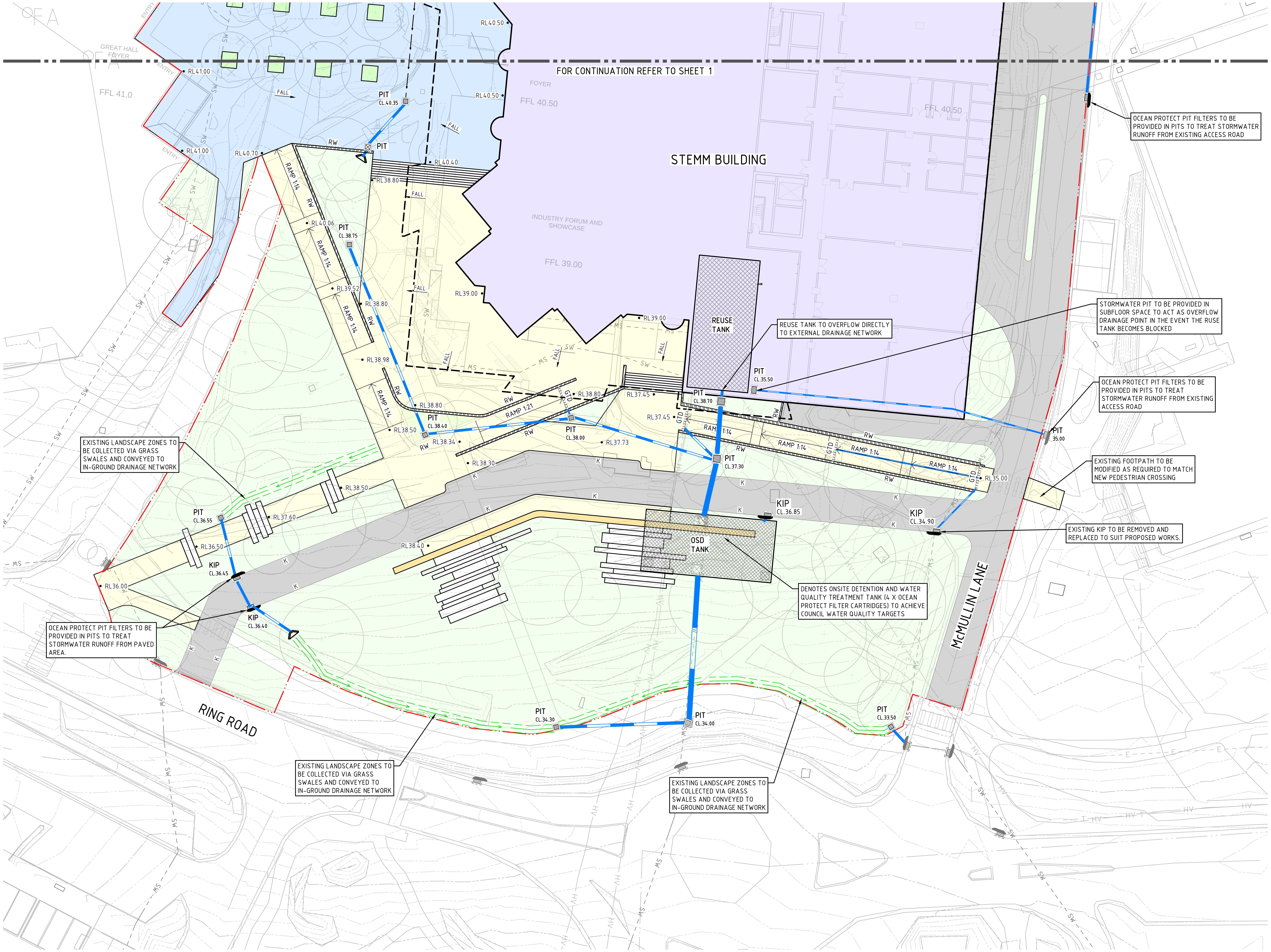
Node Type	Node Name	Parameter	Min	Max	Actual
Urban	South Bypass	Area Impervious (ha)	None	None	0.035
Urban	South Bypass	Area Pervious (ha)	None	None	0.182
Urban	South Bypass	Total Area (ha)	None	None	0.218
Urban	South Pit Inserts	Area Impervious (ha)	None	None	0.046
Urban	South Pit Inserts	Area Pervious (ha)	None	None	0.087
Urban	South Pit Inserts	Total Area (ha)	None	None	0.134
Urban	South to OSD	Area Impervious (ha)	None	None	0.183
Urban	South to OSD	Area Pervious (ha)	None	None	0.030
Urban	South to OSD	Total Area (ha)	None	None	0.214

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Sedimentation	SF Chamber (2.5m2)	Notional Detention Time (hrs)	8	12	0.0852
Sedimentation	SF Chamber (2.5m2)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (2.5m2)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (2.5m2)	Total Suspended Solids - k (m/yr)	8000	8000	1

Only certain parameters are reported when they pass validation



LEGEND

- PROPOSED LIMIT OF WORKS
- PROPOSED BUILDING OVERHEAD. REFER TO ARCHITECTS DRAWINGS FOR DETAILS.
- STORMWATER PIPE
- EXISTING STORMWATER PIPE
- GRATED INLET PIT (NEW / EXISTING)
- JUNCTION PIT (NEW / EXISTING)
- KERB INLET PIT (NEW / EXISTING)
- OSD — ON-SITE DETENTION TANK
- GTD — GRATED TRENCH DRAIN
- CONCRETE HEADWALL
- EXISTING CONTOURS
- RL40.00 — PROPOSED SPOT HEIGHT
- 1.0% — DIRECTION OF GRADE IN FINISHED SURFACE
- RW — RETAINING WALL. DETAILS TO BE PROVIDED AT CC STAGE.
- SANDSTONE WALL. REFER TO ARCHIECTS DRAWINGS FOR DETAILS.
- TREE PLANTER. REFER TO ARCHITECTS DRAWINGS FOR DETAILS.
- K — KERB. DETAILS TO BE PROVIDED AT CC STAGE.
- EXPOSED AGGREGATE CONCRETE FOOTPATH PAVEMENT
- SANDSTONE PAVING
- AC ROAD PAVEMENT
- LANDSCAPING. REFER TO LANDSCAPE ARCHITECTS DRAWINGS FOR DETAILS
- PROPOSED BUILDING. REFER TO ARCHITECTS DRAWINGS FOR DETAILS.

VERIFIER:
JOB MANAGER: C.SMITH
DESIGNED: C.SMITH
DRAWN: W.CRITTENDEN

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REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR INFORMATION	WC		CS	26.07.19
2	ISSUED FOR APPROVAL	WC		CS	31.07.19
3	DRAINAGE DETAILS AMENDED	WC		CS	08.05.20

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NORTHROP
Newcastle
Suite 4, 215 Pacific Hwy, Charlestown NSW 2290
P.O. Box 180, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
Email newcastle@northrop.com.au ABN 81 094 433 100

PROJECT: UNIVERSITY OF NEWCASTLE STEMM BUILDING

DRAWING TITLE: CIVIL ENGINEERING PACKAGE

CONCEPT STORMWATER MANAGEMENT AND LEVELS PLAN - SHEET 2

JOB NUMBER: NL181251

DRAWING NUMBER: DA-C03.02

REVISION: 3

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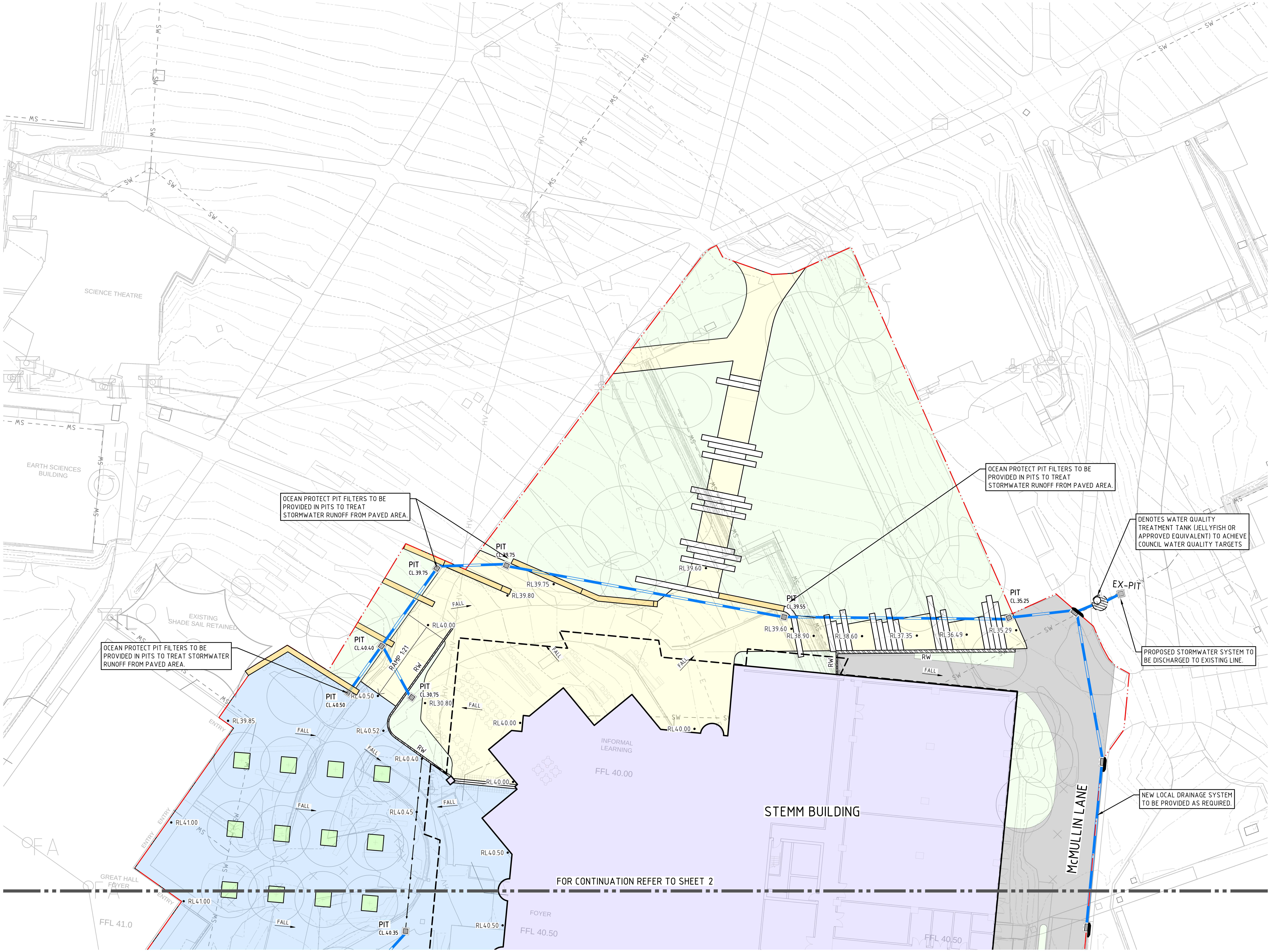

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DRAWN: W.CRITTENDEN DESIGNED: C.SMITH JOB MANAGER: C.SMITH VERIFIER:

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REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR INFORMATION	WC		CS	26.07.19
2	ISSUED FOR APPROVAL	WC		CS	31.07.19
3	DRAINAGE DETAILS AMENDED	WC		CS	08.05.20

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Newcastle
Suite 4, 215 Pacific Hwy, Charlestown NSW 2290
P.O. Box 180, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
Email newcastle@northrop.com.au ABN 81 094 433 100

PROJECT: UNIVERSITY OF NEWCASTLE STEMM BUILDING

DRAWING TITLE: CIVIL ENGINEERING PACKAGE — CONCEPT STORMWATER MANAGEMENT AND LEVELS PLAN - SHEET 1

JOB NUMBER: NL181251

DRAWING NUMBER: DA-C03.01 REVISION: 3

DRAWING SHEET SIZE = A1