Dear Matt,

We have reviewed the agency submissions to the Concord Hospital Application Reference SSD9036 and provide the following responses:

<table>
<thead>
<tr>
<th>Agency and Issue Raised</th>
<th>TTW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS</td>
<td></td>
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<tr>
<td>The design of new roundabouts should be designed in accordance with Austroads Guide to Road Design Part 4B: Roundabouts Section 4.3.3 (2015), Roads and Maritime notes that the current design currently is inconsistent with the guide.</td>
<td>The SSDA concept design has been progressed since the time of submission. It is recommended that the final approval by the Roads Authority prior to construction (City of Canada Bay as required by Section 138 of the Roads Act) is placed as a condition of consent prior to construction. The design will show a mountable roundabout to direct cars and allow busses and trucks to mount the roundabout as required.</td>
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</tbody>
</table>

Swept path analysis, should be provided to illustrate the maximum size service vehicle and an articulated bus (19.0m) on Hospital Road. This is to ensure that these vehicles can operate on Hospital Road. | Note that detailed design of roundabout utilises turning paths for the design vehicles as one of the design inputs. Refer to swept paths shown on drawings 240298-00-SKT001 to SKT007. Recommend that this be placed as a condition of the consent for this to be completed with the 100% Detailed Design. |
**TFNSW**

**Architectural Plans** - The Stage 1 works include the construction of roundabouts to service the multi-storey car park and new at grade car park. The architectural plans provided in Appendix C of the Concept Proposal indicate a two-lane approach to a single circulating lane roundabout at the intersection of Hospital Road and within the car park. The proposed design is inconsistent with Austroads Guide to Road Design Part 4B: Roundabouts Section 4.3.3 (2015) which requires that the number of circulating lanes from any particular approach must be equal or greater than the number of entry lanes on that approach.

The design of the roundabouts should be revised accordingly.

| As per comments in RMS response above, detailed design approval of the roundabout to be conditioned in the approval at Detailed Design Stage, and prior to construction. Refer to drawing 171496-MSCP-CV-DRG-SKC110 which shows single lanes on all roundabout entries and exits. |

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**Council (Traffic)**

Inadequate detail is provided with regard to the proposed 'mini roundabout' and raised pedestrian crossing to its east. Of the details provided it is apparent that the proposed entry on the north side of Hospital Road is poorly aligned with the entry on the south side of the road.

It is also apparent that investigations are required for the continuity of the footpaths along the north and south sides of Hospital Road past the proposed roundabout. Negotiations over land ownership and maintenance obligations are also required noting that the proposed roundabout extends into the hospital propert. As the design of the roundabout is a critical element of the successful operation of the proposed development, its design should be further refined at this stage before the planning of the proposed development progresses further.

<p>| As per comments in RMS response above, detailed design approval of the roundabout to be conditioned in the approval prior at Detailed Design Stage, and prior to construction. The design is currently under review by the traffic engineers. |</p>
<table>
<thead>
<tr>
<th>Council (Stormwater)</th>
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<tbody>
<tr>
<td>It is noted that the flood study has been carried out based on existing structures and the Stage 1 proposal. The Flood study/analysis should be based on entire proposed development to include all stages of the redevelopment.</td>
<td>The flood study is undertaken on the known inputs at the time of assessment. The final details and layout of future stages of the development may yet alter during the design development of those stages, and there it will still be a requirement to assess the impacts of that section of the development when the layout is finalised. The following is noted for the current Flood Study for clarification: New buildings will predominantly replace existing, or existing hardstand. The hospital is at the crest of the development, and flooding is limited to minor ponding around buildings and overland flows, and not mainstream flooding. Stormwater designs and pavement levels for current stage take into account overland flows. Refer to drawings SKC104 to SKC109 for stormwater and pavement levels. Stormwater designs for future stages will take into account these minor overland flows.</td>
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<td>Stormwater from the catchments which will be discharged to Council's drainage system along Hospital Road will require an On Site Detention (OSD) system to be in place for the stormwater management.</td>
<td>Stormwater drainage for the Temporary On Grade Carpark has been amended in design to discharge to the south, away from Hospital road, to negate the need for detention storage in this location. Refer to drawing 171496-NEWB-CV-DRG-SKC174.</td>
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<td>It is noted that the proposed Multi Storey Car Park (MSCP) will discharge to the north &amp; further investigation is required to determine the size and location of the existing stormwater infrastructure. The outcome of these investigations should be included in the final report and should also be incorporated into any redesign on the Civil Plans.</td>
<td>The proposed Multi Storey Car Park (MSCP) will discharge to the north. An investigation into existing stormwater infrastructure to the north shows limited formal drainage. Existing sheet flow from the carpark discharges into the bushland to the north at this proposed location. The proposed stormwater system for the MSCP includes a dispersion trench to provide some stormwater infiltration and mimic the existing situation. The dispersion trench reduces the risk of erosion in the bushland by spreading the stormwater out rather than installing a concentrated stormwater outlet. (refer to drawing 171496-MSCP-CV-DRG-SKC111) Prior to entering the dispersion trench, stormwater is treated to remove gross pollutants, sediment and nutrients (nitrogen and phosphorus) to meet the requirements of the DCP. Prior to completion of the Detailed Design for these works, a detailed survey of the proposed location is required, and the location of the dispersion trench will need to be agreed upon with Ecologist/Arborist and Canada Bay Council to ensure no impact on the adjacent bushland/EEC and existing path network. This requirement should be conditioned on the approval.</td>
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<td>It is noted that the Civil Report prepared by TTW does mention the provision for water quality systems but there are no detailed drawings or MUSIC model results provided to support the stormwater quality targets as outlined in Council’s DCP.</td>
<td>Soil and Water Report nominates the stormwater treatment devices (GPT and Stormwater360 “Stormfilter” units). The plans show that the current Water Quality Devices are to be upgraded (171496-NEWB-CV-DRG-SKC107). Final configuration of these devices will be shown on the detailed design drawings, and this requirement should be conditioned on the approval.</td>
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</tbody>
</table>
The design of internal drainage system must take into consideration all surface runoff/overland flows from adjoining sites. The design of the internal drainage system will require the submission of longitudinal sections. All trunk drainage long-sections will need to include invert levels, finished ground/grate levels, design flowrates, pipe sizes and class, service crossings and a hydraulic grade line. The design documentation should include Stormwater concept design and reports, sub catchment plans, Stormwater calculations, Overland flow analysis, Water quality plans etc.

The plans as submitted for the SSDA application have the level of detail regarding catchments, network layout and pipe sizing is as required for planning assessment (171496-NEWB-CV-DRG-SKC107). The level of detail requested by Council is that as normally required for the 100% Detailed Design stage, not at the SSDA/planning approval stage. The provision of this level of stormwater details (inverts, grades, flow rates, etc) will be part of the 100% Detailed Design Stage. The provision of this information should be placed as a Condition of Consent prior to construction.

A formal overland flow path must be provided to ensure that, should the underground drainage system become blocked or if the design storm is exceeded, a safe overflow route for stormwater is available for which runoff can be safely conveyed to the Yaralla Bay. Drawings should be included to show the proposed formal overland flow routes.

1. Overland flow routes for Stage 1 will not impact on other properties, and are shown on the current drawings discharging over the existing and proposed access roads towards Yaralla Bay. Refer to drawings SKC104 to SKC109 for stormwater and pavement levels.
2. For the car park north of Hospital Road, the existing overland flow paths to are maintained towards the waterways.

**Council (Civil)**

Civil works within road reserves require approval under Section 138 of the Roads Act 1993 from Council. A separate set of civil plans will need to be submitted to Council and an approval shall be obtained prior to the commencement of any works.

Approval of Civil Plans for Roadworks should be placed as a condition on the approval, prior to construction. The works need to be confirmed by the traffic engineers on the project before the civil design is finalised.

It is noted that a roundabout/intersection and footpath works has been proposed at Hospital Road. Detailed designs including footpath connection details at the Roundabout/intersection will need to be provided to Council. Plans will need to include long sections and cross sections.

Approval of Civil Plans for Roadworks should be placed as a condition on the approval, prior to construction.

**OEH (Environment)**

A similar SSD for the Prince of Wales Hospital redevelopment included a hydrocarbons trap or separator to treat runoff generated. The nominated proprietary product will be specifically designed to provide high removal efficiencies of suspended solids and their associated pollutants, oil, and floatables over a wide range of flow rates. OEH recommends a similar approach for the redevelopment of Concord Hospital.

The above mitigation measures are required to ensure the proposal is consistent with the E2 PoW report includes for an Oily Water Separator for carpark and loading dock areas prior to discharge. This is typically required where there is a high concentration of hydrocarbons or the risk of a spill. The water quality treatment train proposed for this site includes a GPT and a Proprietary Stormwater360 "Stormfilter" units. The Stormfilter units were selected as it will remove oily water at the levels anticipated on a carpark such that proposed on this development. (product brochure attached to this letter) The treatment train is designed to meet the requirements of the DCP through the removal
### Objectives of the zone, and the following policies: REFER SUBMISSION

- gross pollutants, sediment and nutrients (nitrogen and phosphorus), plus oils as per the above. This is the same level of treatment as the POW proposed system in principle.

If you have any further queries, please do not hesitate to contact the undersigned.

Yours faithfully

TAYLOR THOMSON WHITTING (NSW) PTY LTD

[Signature]

**STEPHEN BRAIN**

Technical Director
Removing the most challenging target pollutants

The Stormwater Management StormFilter is a best management practice (BMP) designed to meet stringent regulatory requirements. It removes the most challenging target pollutants – including fine solids, soluble heavy metals, oil, and total nutrients (inc. soluble) – using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and through product enhancements the design continues to be refined for ease of use.

Why StormFilter is the best filter available

**Superior hydraulics**
- External bypass – protects treatment chamber from high flows and ensures captured pollutants are not lost during low frequency, high intensity storm events
- Multiple cartridge heights – minimises head loss to fit within the hydraulic grade line and shrink system size, reducing installation costs
- Multiple StormFilter configurations in use across the country

**Reliable longevity**
- One-of-a-kind self-cleaning hood – prevents surface blinding, ensures use of all media, and prolongs cartridge life
- Customised maintenance cycles – fewer maintenance events compared to similar products, which reduces costs over the lifetime of the system
- 12 years of maintenance experience – predictable long-term performance comes standard

**Proven performance**
- Only filter on the Australian market tested within Australia achieving best practice guidelines, for TSS, TP and TN
- Qualifies for a minimum 2 EMI 5 Green star credits
- Achieve water quality goals with confidence – easy approval speeds development assessment process
- 8th generation product – design refined and perfected over two decades of research and experience

**Maximising your land use and development profitability**

StormFilter systems are utilised in below ground systems. The advantages this offers over above ground systems includes:
- Land space saving that enable an increase in development density and reduce sprawl
- The potential to add car parking, increase building size, and develop out parcels

In addition, StormFilter’s compact design reduces construction and installation costs by limiting excavation.
Media options
Our filtration products can be customised using different filter media to target site-specific pollutants. A combination of media is often recommended to maximise pollutant removal effectiveness.

**PhosphoSorb™** is a lightweight media built from a Perlite-base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously.

**Perlite** is naturally occurring puffed volcanic ash. Effective for removing TSS, oil and grease.

**Zeolite** is a naturally occurring mineral used to remove soluble metals, ammonium and some organics.

**GAC (Granular Activated Carbon)** has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

Cartridge options
With multiple cartridge heights available, you now have a choice when fitting a StormFilter system onto your site.

The 69cm cartridge provides 50% more treatment than the previously standard 46cm cartridge, which enables you to meet the same treatment standards with fewer cartridges, and via a smaller system.

If you are limited by hydraulic constraints, the low drop cartridge provides filtration treatment with only 0.55m of headloss.

Cartridge flow rates

<table>
<thead>
<tr>
<th>Cartridge Type</th>
<th>Hydraulic Drop</th>
<th>Treatment Capacity (l/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.7 l/s/m²</td>
<td>1.4 l/s/m²</td>
</tr>
<tr>
<td>StormFilter 69cm</td>
<td>0.93 m</td>
<td>0.71</td>
</tr>
<tr>
<td>StormFilter 46cm</td>
<td>0.70 m</td>
<td>0.47</td>
</tr>
<tr>
<td>StormFilter Low Drop</td>
<td>0.55 m</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Selecting cartridge height

Note: Indicated media are most effective for associated pollutant type. Other media may treat pollutants, but to a lesser degree.

**ZPG™** media, a proprietary blend of zeolite, perlite, and GAC.
Configurations and applications

The StormFilter technology can be configured to meet your unique site requirements. Here are a few of the most common configurations, however many other configurations are available. A Stormwater360 engineer can assist you evaluate the best options for your site or you can find out more by downloading the StormFilter Configuration Guide from www.stormwater360.com.au

Upstream treatment configurations

The following suite of StormFilter configurations are easily incorporated on sites where WSUD is recommended. These low-cost, low-drop, point-of-entry systems also work well when you have a compact drainage area.

GullyPit StormFilter

Combines a gullypit, a high flow bypass device, and a StormFilter cartridge in one shallow structure.

- Treats sheet flow
- Uses drop from the inlet grate to the conveyance pipe to drive the passive filtration cartridge
- No confined space required for maintenance

Gully inlet

- Accommodates kerb inlet openings from 900 to 3000mm long
- Uses drop from the kerb inlet to the conveyance pipe to drive the passive filtration cartridges

Linear grate

- Can be designed to meet volume based sizing requirements
- Can be installed in place of and similar to a typical gullypit
- No confined space entry required for maintenance
- Accommodates up to 29 StormFilter cartridges

Infiltration/retrofit configuration

infiltration

- Provides treatment and infiltration in one structure
- Available for new construction and retrofit applications
- Easy to install
- Re-charge groundwater and reduces run-off
Roof runoff treatment configuration

Down pipe
- Easily integrated into existing gutter systems to treat pollution from rooftop runoff
- Fits most downpipe configurations and sizes; single or dual-cartridge models available
- Treats up to 1300m² of rooftop area per dual-cartridge system

Downstream treatment configurations

Conventional stormwater treatment involves collecting, conveying and treating stormwater runoff with an end-of-pipe treatment system before discharging off-site. StormFilter configurations suitable for these applications are listed below and can be engineered to treat a wide range of flows.

Peak diversion
- Provides off-line bypass and treatment in one structure
- Eliminates material and installation cost of additional structures to bypass peak flows
- Reduces the overall footprint of the treatment system, avoiding utility and right-of-way conflicts
- Internal weir allows high peak flows with low hydraulic head losses
- Accommodates large inlet and outlet pipes (up to 900mm) for high flow applications

Vault / manhole
- Treats small to medium sized sites
- Simple installation – arrives on-site fully assembled
- May require off-line bypass structure

High flow
- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Configurations available, include, Panel Vault and Cast-In-Place

Volume
- Meets volume-based stormwater treatment regulations
- Captures and treats specific water quality volume (WQv)
- Provides treatment and controls the discharge rate
- Can be designed to capture all, or a portion, of the WQv
Filtration for low drop sites

Designing for limited drop

In some cases, site constraints limit the hydraulic drop that is available to drive the passive filtration cartridges. Following are a variety of solutions to either create the required drop or work around the limited drop without impacting the performance of the system.

<table>
<thead>
<tr>
<th>Solutions for Low Drop Sites</th>
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<tbody>
<tr>
<td><strong>Site modifications</strong></td>
</tr>
<tr>
<td>Reduce pipe slope</td>
</tr>
<tr>
<td>Use an alternate pipe material with a lower Manning’s n value for a portion of the site and reduce the pipe slope.</td>
</tr>
<tr>
<td>Reduce pipe cover</td>
</tr>
<tr>
<td>Use controlled density fill (CDF) at the front-end of the conveyance system to minimise pipe cover and raise the conveyance system. CDF, a method of pouring concrete with fine aggregate (sand vs. gravel) around pipe, allows the use of most pipe materials with limited cover.</td>
</tr>
<tr>
<td>Drain inlet treatment</td>
</tr>
<tr>
<td>Substitute several shallow inlet configurations for the single end-of-pipe system. Shallow options include the Catchpit/Gullypit StormFilter, CurbInlet StormFilter, Manhole StormFilter and the Linear StormFilter. These systems still require the normal drop (0.7m for 46cm cartridges) but utilise the drop into the conveyance system to drive the cartridges.</td>
</tr>
<tr>
<td>Provide pumping system</td>
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<tr>
<td>Stormwater360 offers the Integrated Pumping System (IPS), which can be designed in tandem with filtration system sizing.</td>
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</table>