NEPEAN RIVER FLOODPLAIN RISK MANAGEMENT STUDY & PLAN INCLUDING NARELLAN CREEK

APPENDIX F – OSD GUIDE

Final Report (13 November 2022)

NEPEAN RIVER URBAN STORMWATER DETENTION (USD) – A GUIDE FOR INITIAL SIZING

Urban Development changes the hydrologic behaviour of the land to which it applies and can follow onto imposing adverse impacts to existing flood behaviour. The study area is located along the Nepean River within the Camden Council LGA and changes in hydrology could lead to adverse flood impacts to downstream and adjacent properties. It is therefore important to carefully plan and design stormwater management systems, including On-Site Detention (OSD) systems, detention basins and regional storage to ensure that adequate storage and retardation of urban stormwater is provided to replicate, as far as possible, the existing hydrology. These guidelines have been provided as a general guide for urban development to assist in the preparation of Water Cycle Management plans and detention concept designs in the Nepean River catchment area within the Camden LGA.

Objectives of Guidelines

The overarching objectives of the guidelines are to:

> Encourage an integrated approach to water cycle management to replicate, as far as possible, existing hydrology so that there is minimal impact on flood behaviour and stability of waterways;
> Outline a set of parameters that guide urban development for an upper and lower limit so hydrology is replicated with reference to existing conditions (2017). The upper limit aims to mitigate the effect of urban development on flooding whilst the lower limit aims to mitigate waterway stability impacts;
> Replicate the hydrology through design of storage coupled with hydraulic controls to limit peak flows and overall discharge volume in the developed condition back to existing conditions; and
> Allow urban developments to fill and reconfigure existing farm dams and regional storages providing that the floodplain storage benefits of the reference condition be maintained.

Guiding Principles/Documents

Applicants are required to refer to the following documents when preparing Development or Project Applications:

> Camden Council Engineering Design Specification (2017);
> Camden Council DCP 2011 – Environmental Management;
> Camden Council's Building in Saline Prone Environments Policy (2004);
> Camden Council's Flood Risk Management Policy (2006);
> Nepean River Draft Floodplain Development Matrix (2020); and
> South West Growth Centres DCP (2012), applicable for land within the South West growth Area only.

USD Requirements

> The maximum post-development discharge from the site shall not exceed the pre-development flows for the 50% AEP (lower) and 1% AEP (upper) for the critical duration storm duration under the pre development condition. The critical duration is to be determined through an examination of a full range of design storms durations;
> The stormwater drainage system (including surface grades, gutters, pipes, surface drains and overland flowpaths) for the property must:

- Be able to collect and convey all site runoff to the USD system in a 1% AEP event in the post-development critical duration storm. This is the storm burst duration which gives the highest peak runoff under post-development conditions i.e., the drainage system needs to convey all flow to the USD system without any overflows.; and
- Ensure that the all runoff from any upstream properties bypasses the USD storage in all storms up to and including the 1% AEP event;

> The required USD storage can be achieved through either below ground or above ground storage or a combination of both and ideally should be integrated with other water sensitive urban design measures where possible. Any above ground storage is to be designed in such a manner that public safety and the integrity of property is not compromised, and it does not interfere with overland flowpaths or adversely affect flood behaviour; and

> The required upper and lower limits for sizing the USD shall be informed by the generic parameters provided in **Table 1. This can be used as a starting point and then modelling is required to confirm performance**.

Table 1: USD Site Storage Requirement (SSR) and Permissible Site Discharge (PSD) Sizing Limits

Land Use	50% AEP SSR (m^3/ha)	50% AEP PSD (l/s/ha)	1% AEP SSR (m^3/ha)	1% AEP PSD (l/s/ha)
Residential	**119**	**47**	**234**	**130**
Commercial/Industrial	**130**	**43**	**270**	**130**

RAFTS Models Utilised

The following methodology was used to derive OSD requirements.

Cardno have used the XP-RAFTS models prepared by Worley Parsons as part of their Nepean River flood study and by MHL as a part of Narellan Creek Floodplain Risk Management Study (upstream of subject study area) for the estimation of suitable USD parameters. These areas are considered representative of conditions across the study area and the investigations aimed at selecting two sub areas within the two precincts in order to increase confidence that the result would be applicable.

The following models were used to undertake the assessment:

> Narellan Creek flood study model: Narellan_2015-05-01_Design_Storms 10 errors fixed.xp
> Nepean River flood study model: Nepean_15_100y9h_Ext.xp

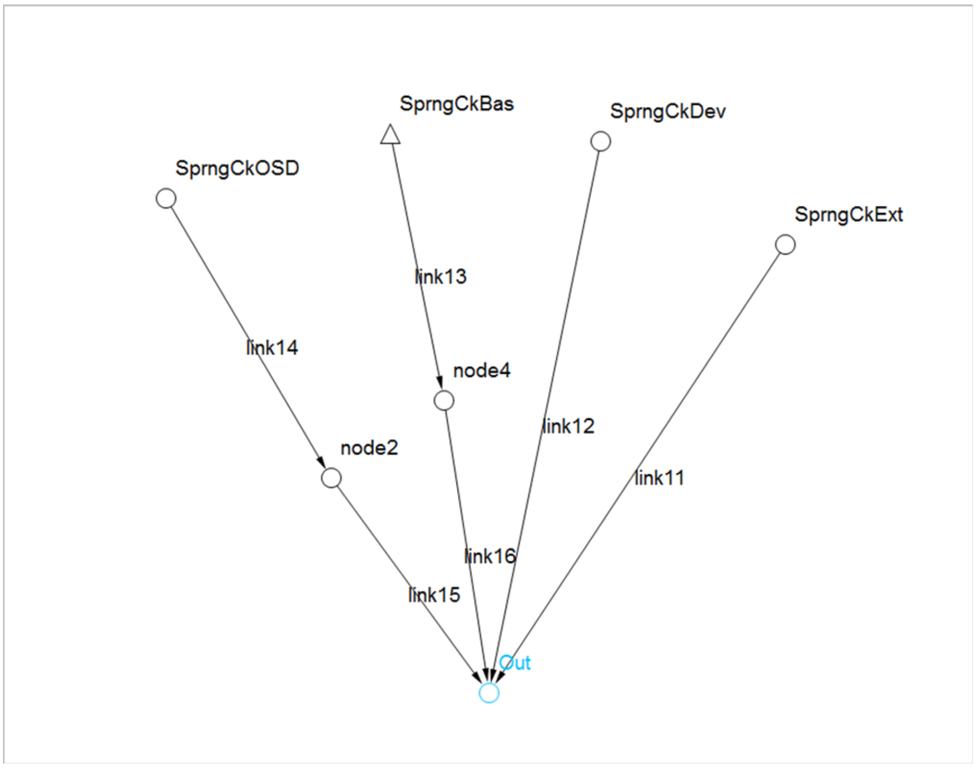
Catchment Selection

The Narellan Creek model included retarding basins for replication of pre-development hydrology. The basins performed sufficiently to satisfy the requirement to reduce post development flow to pre development levels. Therefore, it is considered that the RAFTS models are a sound basis for estimation of site storage requirements (SSR) and permissible site discharge (PSD) for the Neapean River sub catchments.

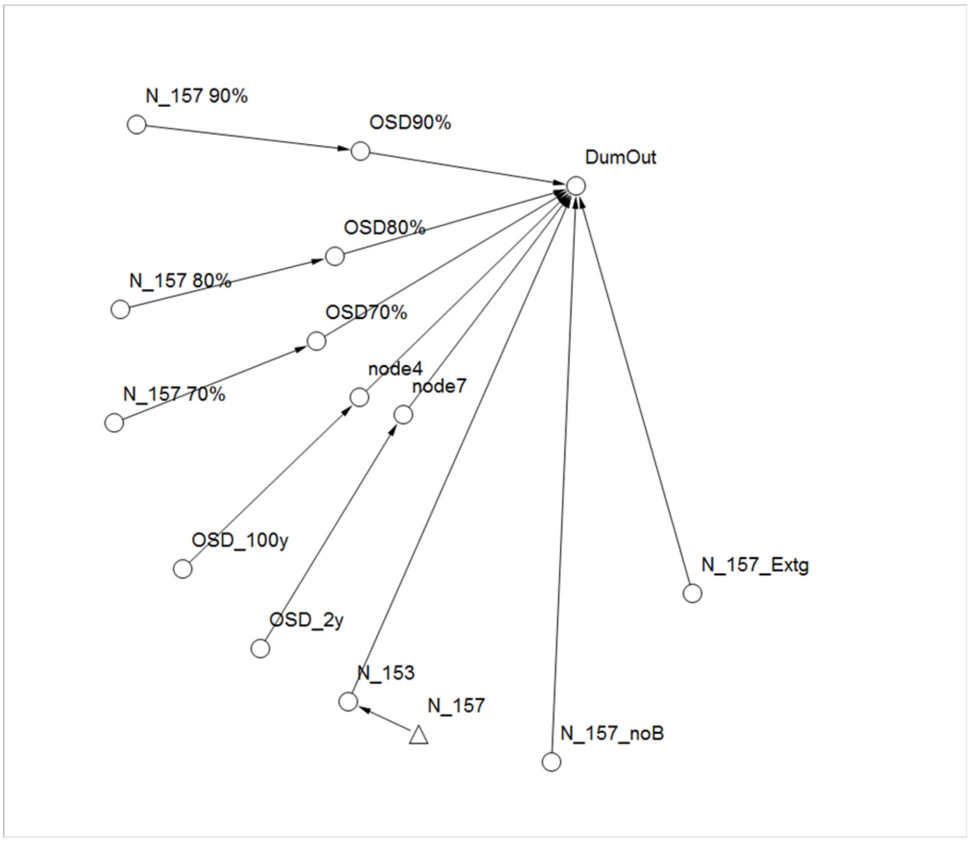
The general approach used was to initially add up the average storage and discharge control requirements of the retarding basins included in the Narellan Creek flood study model. Thereafter a basis for application of generic OSD parameters could be applied by the OSD tool within the RAFTS software. The OSD tool allows the user to rapidly assess a post development scenario through inclusion of primary and secondary SSR and PSD parameters without the need to explicitly size and configure a basin. Two locations where chosen for the modelling and are described in **Table 2**.

Table 2: Sub catchments selected for assessment

Location	Catchment Area (ha)	Description
1	438.5	The eastern segment of the Spring Creek Precinct that drains to Nepean River was chosen from *Nepean River flood study model* to get an understanding of the performance of the OSD tool on a precinct scale.
2	22	This location represents sub-catchment N_157 of *Narellan Creek flood study model* and includes an offline retarding basin. A number of different impervious percentages were trialled for this area to gain an understanding of sensitivity for the SSR and PSD values estimated.



Location 1: Spring Creek Precinct (Eastern)



Location 2: Subcatchment N_157 of Narellan Creek flood study model with numerous impervious fractions

The Narellan Creek RAFTS models included retarding basins having a SSR for a retarding basin. Commonly a lower level culvert outlet and vertical slot spillway were included as the discharge controls. No stage discharge relationships were used. As a first pass of the modelling the Narellan Creek RAFTS models were run and the results for the total storage volume and peak discharge were recorded. The total storage and peak discharge were then converted into preliminary SSR and PSD values with reference to the catchment area. Then the OSD tool of the RAFTS model was used with the preliminary SSR and PSD values. Usually the results showed that the post development flow was lower than the predevelopment peak and the SSR values needed to be decreased. In general, it was the SSR that the results were most sensitive too, however in some cases manipulating the PSD assisted in replication of the pre development flow rates.

Results

The results for each case are shown in **Table 3**. It is generally the case that the modelling of retarding basins requires slightly higher SSR and PSD parameters than in the case of the OSD tool. This is a result of the default assumption of the OSD tool where 80% of the catchment is assumed to be captured by the storage, whilst the remaining 20% is routed elsewhere. This is not the case for the Narellan Creek RAFTS models that include retarding basins that accepts 100% of the catchment.

The parameters estimated through this methodology are intended for use in the Nepean River study area and would eventually be applied on both a small and large scale. Hence it is prudent to adopt parameters that would achieve a reasonable outcome considering the variety of catchments that would be planned in future. This leads to the selection of the parameters for Case 1 as having a higher importance than other cases due to its size. Adequately retarding development flows back to pre-development levels would be of more importance to resulting flood behaviour than for smaller catchments such as cases 2 to 4.

The recommended SSR and PSD parameters for Nepean River Study Area are the weighted values. These results are in the ball park of values estimated by the UPRCT OSD guideline for sub catchments having a size of 100-200ha according to the sliding scale for catchment size.

Table 3: Results of SSR & PSD Assessment

	Catchment Area (ha)	Imp (%)	Parameters	Lower (OSD)	Lower (Basin)	Upper (OSD)	Upper (Basin)	Weighting
Case 1	438.5	70	SSR (m³/ha)	120	160	230	285	0.7
			PSD (l/s/ha)	45	18	130	117	0.7
Case 2	22	70	SSR (m³/ha)	100	111	210	258	0.1
			PSD (l/s/ha)	50	43	130	136	0.1
Case 3	22	80	SSR (m³/ha)	115	134	245	302	0.1
			PSD (l/s/ha)	50	43	130	136	0.1
Case 4	22	90	SSR (m³/ha)	130	156	270	344	0.1
			PSD (l/s/ha)	50	43	130	136	0.1
Average			SSR (m³/ha)	116	140	239	297	
			PSD (l/s/ha)	49	36	130	131	
Weighted			**SSR (m³/ha)**	**119**	**152**	**234**	**290**	
			PSD (l/s/ha)	**47**	**25**	**130**	**123**	
UPRCT	100-200	100	SSR (m³/ha)	210		360		
			PSD (l/s/ha)	40		150		

(Basin) = modelling results using retarding basins
(OSD) = modelling results using the OSD tool of XP-RAFTS

The peak flows from the sub catchments under existing, developed (no SSR) and developed (with basin and SSR) are shown in **Table 4**.

Table 4: Resulting Flows from Sub catchments after SSR Applied

	ARI	Existing Flow	Developed Flow	Developed with Basin	Developed with OSD
Case 1	2yr 9hr	18.1	24.3	17.4	15.9
	100yr 2hr	51.4	117.3	50.4	51.4
Case 2	2yr 9hr	0.9	1.3	0.8	0.9
	100yr 2hr	3.0	7.8	3.0	3.0
Case 3	2yr 9hr	0.9	1.3	0.8	0.9
	100yr 2hr	3.0	8.8	3.0	3.0
Case 4	2yr 9hr	0.9	1.4	0/.8	0.9
	100yr 2hr	3.0	9.8	3.0	3.0

OSD Tool Description

A basic explanation of the modelling approach with the OSD tool in included below:

> For larger catchments >50ha it is assumed that the retarding basins would be offline and as such the riparian area of the precinct would not be collected by drainage to the basin. For catchments <50ha the pervious area capture was assumed to be 80%;

> The break down of the roof, road and paved surfaces is consistent with default values and doesn't make much difference when it is assumed that there is 100% capture of these surfaces (refer **Figure 3**);

> No allowance has been made for use of air space in a rainwater tank for OSD;

> The developed area assumption stems from the case where only 80% of a precinct is developable due to constraints such as flooding/riparian/significant vegetation/utility easements; and

> The primary outlet was initially sized using the 50% AEP design storm. The seconday outlet discharge was then sized using the 1% AEP design storm. The primary outlet is located at the base of the OSD, the sencandary outlet is located 1m above the OSD base. No spillway is allowed in determining the storage requirement. Discharge from the storage is to be fully managed by the secondary outlet in events up to the 1% AEP (refer **Figure 4**).

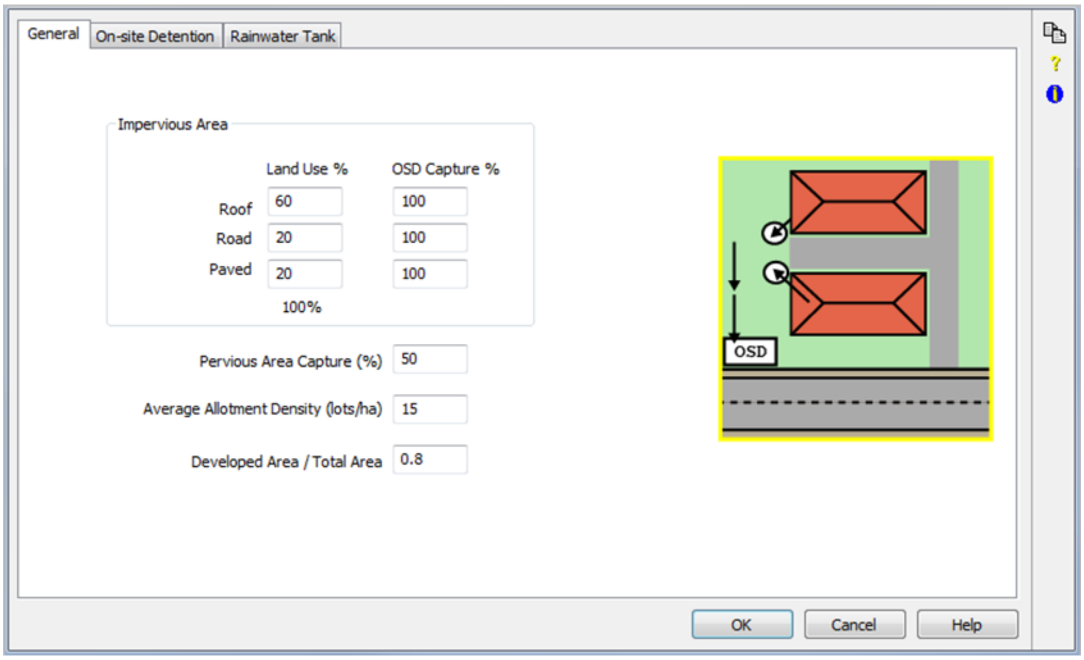


Figure 3: Contribution of Flows to OSD

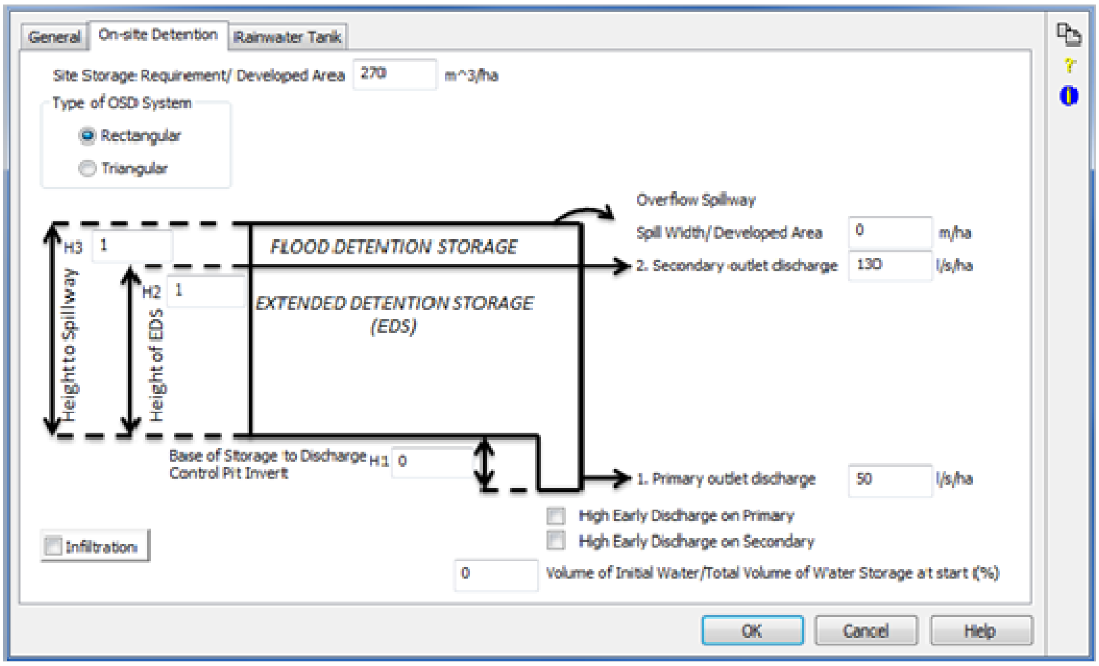


Figure 4: Typical OSD Setup in RAFTS Tool