Analyte	Units	Sample ID						Average across site
		DS_01	DS_02	DS_03	DS_04	DS_05	DS_06	
Lead	mg/kg	43	88	43	41	78	52	58
Mercury	mg/kg	0.12	0.12	0.05	0.07	0.1	0.06	0.09
Nickel	mg/kg	7.6	13	12	9.8	14	12	11
Zinc	mg/kg	330	490	190	250	360	240	310

Averages were calculated for each parameter based on all six samples. Sample DS_01 was included despite the very high nitrogen reading. This higher reading is likely due to its sampling location at the inlet with very thick sediment and the pond generally has a greater source of organic materials (large amounts of trees surrounding a small pond).

Site averages were calculated for each parameter based on the six samples. These averages were applied to the total site sediment mass, producing the following results:

- Total nitrogen accumulated in the pond = 85 kg/year
- Total phosphate (as P) accumulated in the pond = 14 kg/year
- Total Suspended Solids accumulated in the pond = 27 tonne/year

There were no heavy metal readings that exceeded the NEPM HIL (National Environment Protection Measure - Health Investigation Level). This indicates that any spoil removed from the pond would be likely to be suitable for landscaping soil within the site.

If the spoil was to be disposed of to a landfill, according to the ACT Waste Standard (2000), the heavy metal concentrations in the sediment from this pond are below "CT2" values, and therefore it is likely that the material would be classified as "Solid Waste" which incurs a disposal charge of $135.15/tonne (ACT Government 2014b). Levels of lead and zinc were higher at David Street Pond than other sites. Both metals were ~50% higher than the average site level – though both metals were still below investigation levels. See Figure 28 for a comparison of sites. There were no levels of cadmium detected at David Street Pond (limit of reporting is 0.4 mg/kg).

6.3.3 MUSIC modelling

Pollutant loads generated from David Street Pond catchment were estimated for total suspended sediments (TSS), total phosphorus (TP) and total nitrogen (TN) using MUSIC. The model set up and input parameters are detailed in Appendix A. It is noted that a number of scenarios were modelled for the David Street pond using different treatment nodes and catchment areas (refer to Table 30). As discussed above, the diversion into the pond is not effective, therefore for most of the time, the pond doesn't provide treatment for the entire catchment area of 301 hectares. The work as executed drawings (Young Consulting Engineers, 2001, drawing number 201571-100) indicates that a residential development to the north-west of the pond also drains to David Street pond. This local catchment drains directly into the pond and is not dependent on the function of the diversion. Therefore a scenario was modelled where this was the only catchment directed to the pond.

Table 30: David Street pond MUSIC modelling scenarios.

Scenario	Treatment Node	Catchment
1.	Pond	301 ha (entire catchment)
2.	Pond	1.95 ha (residential development only)
3.	Sedimentation Basin	301 ha (entire catchment)
4.	Sedimentation Basin	1.95 ha (residential development only)

The mean annual pollutant load removal for TSS, TP and TN are presented in Table 31. Table 31 also compares MUSIC pollutant load results to the sediment analysis. The scenarios produced similar results relative to their

catchments in terms of load reduction and removal, with the exception of TSS removal for the entire catchment where the pond model estimates 29 tonnes/year is removed and the sedimentation basin estimates 41 tonnes/year.

Table 31. MUSIC pollutant load results for David Street pond, and comparison to sediment analysis

	Entire Catchment (301 ha)				Sediment analysis results load accumulated (kg/year)
	Pond Node (Scenario 1)		Sedimentation Node (Scenario 3)		
	% load reduction	Load removed (kg/year)	% load reduction	Load removed (kg/year)	
TSS	22.6	29,100	32	41,400	27,000
TP	18.7	45	25.7	62	14
TN	7.9	140	13.2	230	85
	Residential Development (1.95 ha)				Sediment analysis results load accumulated (kg/year)
	Pond Node (Scenario 2)		Sedimentation Node (Scenario 4)		
TSS	93.5	1,552	92.1	1,547	27,000
TP	81.9	3	76.5	3	14
TN	75.7	25	70.3	23	85

In comparison to the sediment depth survey (refer to Section 6.3.1), the rate of sediment accumulation correlates best with Scenario 1 where the entire catchment is modelled with a pond treatment node. The rate of sediment accumulation is significantly overestimated when a sedimentation basin is used for the entire catchment (Scenario 3). Both models using only the residential development catchment (Scenario 2 and 4) significantly underestimate the rate of sediment accumulation in comparison to the sediment depth survey.

MUSIC predicts higher rates of TN and TP accumulation than suggested by sediment sampling for Scenario 1 and 3 where the entire catchment is modelled. The predicted rates of TN and TP accumulation are lower than those suggested by sediment sampling when the residential catchment is modelled.

6.4 Coombs Pond A

Coombs Pond A is located at Terry Connolly Street in Coombs. Built in 2011, it is a large online pond treating a large mixed-use residential catchment (Indesco 2011).

This pond is regional infrastructure built downstream of the estate to polish stormwater and meet the regional targets in the ACT's WSUD Code.

Key features of the pond are:

- Pond surface area: 1.73 ha
- Pond water volume: 35,674 m^3 or 35.7 ML
- Normal water level: 549 m AHD
- Catchment area: 135.4 ha
- Pond area as % of catchment area: 1.3%
- Land use in the catchment is primarily lows density residential as indicated in Table 32 below.

Table 32: Coombs A Pond catchment land use.

Land Use	Area (ha)	Area (%)	Total Impervious Area (ha)
Residential – Higher density	18.79	13.88%	14.09
Residential – Lower density	70.58	52.14%	42.35
Commercial	7.20	5.32%	6.48
Urban Open Space	14.19	10.48%	0.85
Natural / Bushland	17.09	12.63%	0.00

Land Use	Area (ha)	Area (%)	Total Impervious Area (ha)
Roads / Transport	7.52	5.55%	4.51
TOTAL	**135.35**	**100**	**68.27**

6.4.1 Sediment accumulation

A physical survey of the pond was undertaken in April 2015 in order to gauge sediment depth and thickness. A qualitative description of the sediment (or base surface of pond) was also noted. The survey covered the area of the pond with measurements taken at a spacing of approximately 10 m. Survey data points are shown in Figure 43.

Measurements from the physical survey were analysed to quantify sediment collected in Coombs A pond. With a total volume of 38,480 m^3, sediment accounted for 2805 m^3 (13.8 %). Water volume was 35,675 m^3. Figure 44 shows the sediment thickness in Coombs A Pond, and Figure 45 shows the water depth.

The bulk density of the sediment is estimated at 1.5 tonnes/m^3, resulting in

- A mass of 4,200 tonnes of sediment capture
- Over the four year period since construction, this means that the pond has collected 1,050 tonnes of sediment per year from the catchment.

Note that the bulk density estimate is based on a *dry* density of sediment, assuming that the volume would not change substantially if the sediment was in a dry state. TSS quantities in MUSIC are based on the dry weight of suspended solids.

This also assumes no sediment removal over the life of the pond.

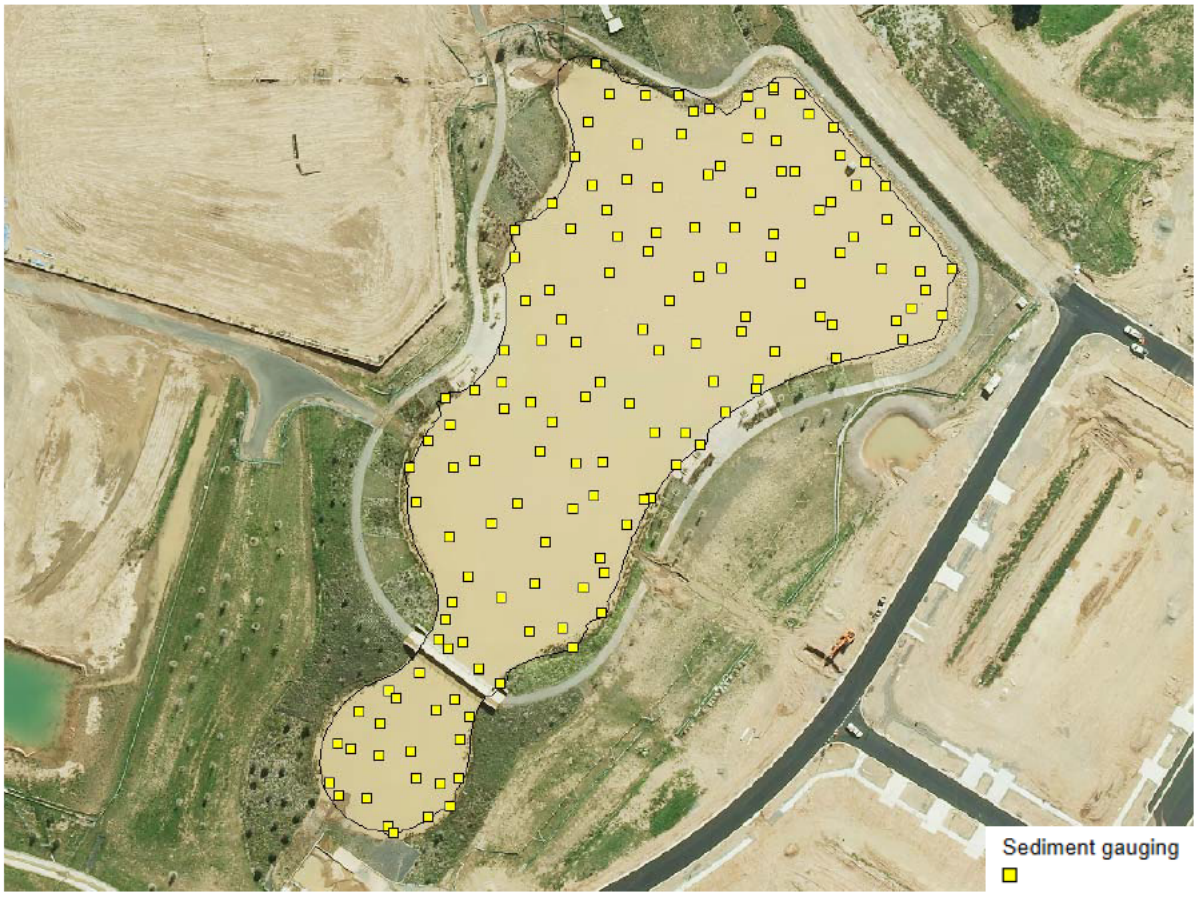

Figure 43. Gauging locations, Coombs A Pond

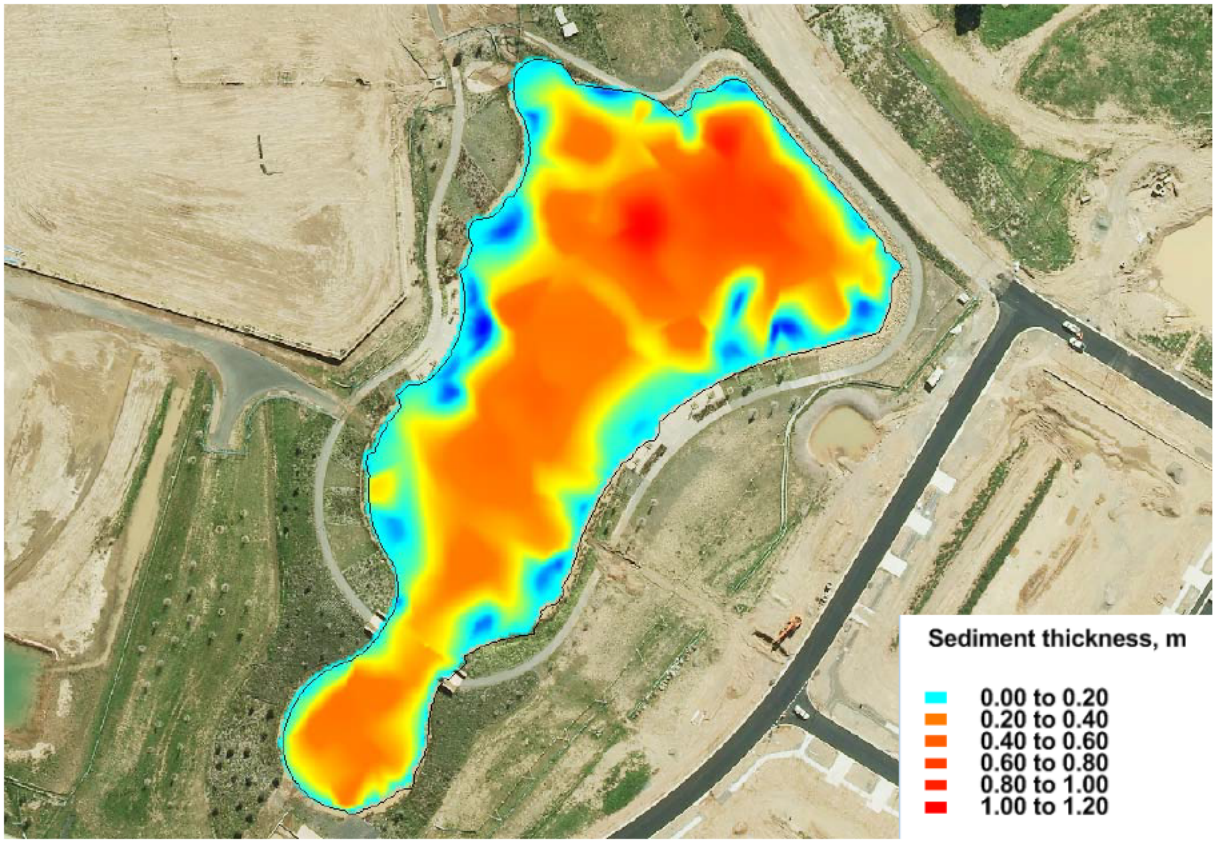

Figure 44. Sediment thickness, Coombs A Pond

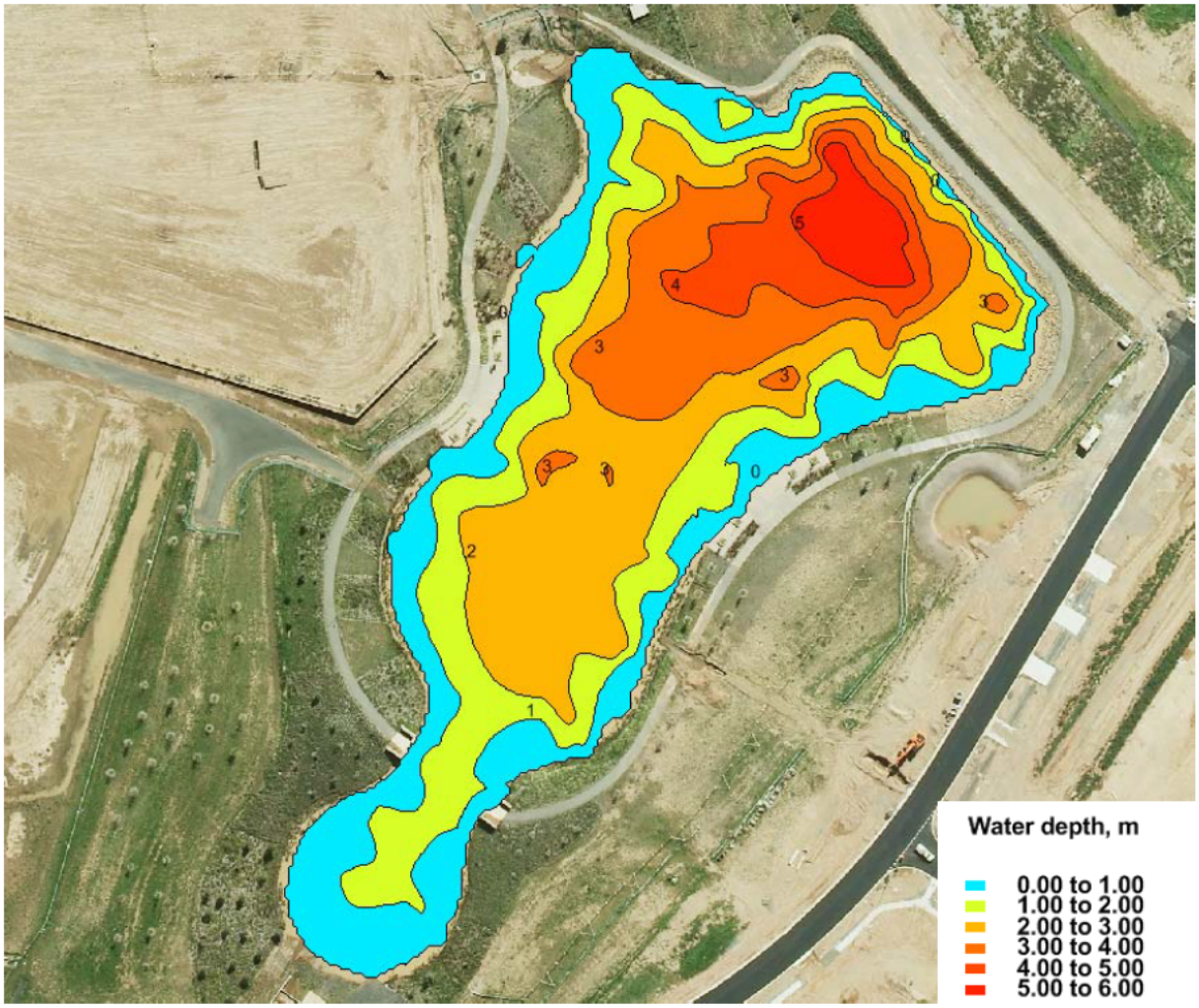

Figure 45. Pond depth contours, Coombs A Pond

The catchment of Coombs A pond has changed significantly since its construction in 2011. Prior to development the area was rural/bushland with a small area of built-up residential area (7%). This pond was constructed at the time of development of Coombs and has effectively acted as a sediment basin during the (ongoing) construction phase of development. This significant construction activity in the pond's catchment would account for the high rate of sediment accumulation in the pond. For reference Figure 46 and Figure 47 show the catchment pre-development (July 2010) and in January 2015 respectively (most recent image available on Nearmap). At the time of the gauging survey there were buildings and ongoing construction surrounding the site. Approximately 46% of the catchment is currently under development.

No sediment samples were collected at Coombs Pond it was not expected that the sediment would include significant nutrients or heavy metals, as it's mostly clean soil.