Asset 27: Yerrabi Pond

General information

Description

Yerrabi Pond is located between MIrrabei Drive and Horse Park Drive and forms the boundary between Amaroo and Gungahlin. It is a large online pond treating a large mixed-use residential as well as a natural catchment (Mulligans Flat Nature Reserve).

This pond is "regional" infrastructure built downstream of a number of large development areas as a water quality control pond.

Asset type	Regional pond	**Asset context**	Greenfield
Year built	1993	**Year of handover to TAMS**	TBC
Catchment area	TBC	**Catchment type**	Mixed use
Normal water level (NWL)	612 m AHD	**Top of extended detention**	614 m AHD (major spillway level)
Surface area at NWL	Approx. 276,000 m^2	**Open water approx. %**	99%
Volume at NWL	TBC	**Volume at top of extended detention**	TBC
Average depth at NWL	TBC	**Maximum depth at NWL**	7 m
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	Two large open channels plus a number of large pipe inlets (with GPTs) around the pond	**Outlet/s**	Primary outlet: concrete overflow structure within pond. Secondary spillway: series of large box culverts below road embankment
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings		✓	✓

Site inspections

Site inspections have been undertaken on the following dates:

- 12 July 2014 – dry weather
- 24 November 2014 – wet weather

Design objectives

This pond pre-dates the ACT's WSUD Code (2009), and it is unknown whether it was designed to meet any particular pollutant removal targets. Given the bathymetry shown in the Work as Executed drawings it is evident that the pond was designed to be an open water body.

The pond is part of a treatment train:

- Some flows receive pre-treatment in grass swales upstream (although note that most flows bypass the swale in a concrete invert channel)
- There are GPTs and trash racks on a number of the inlets to the pond
- Many of the upstream development areas include their own smaller scale ponds as well as GPTs and swales
- Downstream flows receive further treatment in Gungahlin Pond and Lake Ginninderra. Note that Yerrabi Pond would be subject to the greatest pollutant load as it is first in the series of large ponds

In addition to pollutant load removal, it is clear that Yerrabi Pond has been designed to meet other objectives, including flood detention and landscape objectives. The landscape design includes landscaped edges, bridges with an island, paths and viewing areas.

Canberra's Urban Lakes and Ponds Plan of Management (Canberra Urban Parks and Places/Urban Services, 2001) identifies the prime management purposes of Yerrabi Pond as "water quality management", "informal recreation", "sport" and "conservation". It identifies the following values of Yerrabi Pond:

- Historic (high)
- Commercial (high)
- Flood management (high)
- Ecological/environmental (moderate)
- Fish (moderate)
- Visual/landscape amenity (moderate)
- Aboriginal (moderate)
- Recreation (moderate)

Yerrabi Pond has community facilities consistent with a major regional park, including paths, landscaping, toilets, barbeques, picnic tables, play and adventure play equipment. Permitted activities include fishing, model and recreational boating. Windsurfing regattas, motorised craft, special events and commercial activities are subject to permit.

Performance issues

The ACT Government has carried out water quality monitoring at Yerrabi Pond from 2009 to 2012. The monitoring data highlights the construction activity that has taken place within the catchment, with turbidity readings as high as 120 NTU. In addition to these pollution events there have also been occurrences of moderately high nutrient concentrations. Nitrogen concentrations have been recorded up to 1.9 mg/L, compared to the ANZECC guideline value of 0.35 mg/L for freshwater lakes and reservoirs. Total phosphorous was recorded up to 0.061 mg/L compared to the ANZECC guideline value of 0.01 mg/L (though ACT has a regulation limit of 0.1 mg/L).

There is also some limited Waterwatch data available which also reveals a number of high turbidity events. The pond is currently closed to activities that may result in contact with the water due to algae.

Yerrabi Pond has effectively acted as a sediment basin while significant construction has taken place in its catchment over the past 10 years, including in Bonner, Forde and Gungahlin. There is still residential construction underway in Bonner. Figure 1 shows stormwater with a high total suspended solids (TSS) load flowing into the south-eastern corner of Yerrabi Pond after a very small rainfall event. Aerial imagery also reveals a number of high turbidity events that are likely to have been caused by construction activities within the catchment (Figure 3 and Figure 4). Of the eighteen historic images available on NearMap from 2010 to 2014, eight reveal an episode of high turbidity inflows to the pond.

The pond was constructed with the eastern section of the pond (to the east of the island) having a water depth of 2 m. A bathymetric survey would be required to determine the volume of accumulated sediment but this zone of the pond is likely to have collected a large volume of sediment. Eventually desilting will be required to remove the sediment. The stored sediment may also be acting as a store of nutrients which can lead to algae issues.

Figure 1: Stormwater inflows to southeastern corner of Yerrabi Pond – 24 November 2014

It is too early to assess the pond's long-term water quality performance, however our review indicates that, sediment issues aside, there are some inherent design limitations which would limit the treatment effectiveness of the system:

- There is effectively zero macrophyte coverage, with turf extending to the water's edge
- The pond is deep and therefore at risk of thermal stratification, which tends to exacerbate water quality issues associated with anaerobic decomposition and re-release of pollutants from accumulated settled sediments

Figure 2: Aerial photo showing recent conditions (NearMap 29 October 2014)

Figure 3: Aerial photo showing turbid conditions (Nearmap 6 May 2011)

Figure 4: Aerial photo showing very high turbidity at Pond inlet (Nearmap 29 December 2011)

Anecdotal reports indicate that the water quality within Yerrabi Pond has worsened over 2013-14. One possible reason for this has been described (Joel Kelly, *pers. comm*.) as the effects of an increase in the swamp hen population. These birds are thought to have pulled up a large amount of the aquatic Ribbon Weed which subsequently decomposes, as shown in Figure 5. It is thought that this has led to increased nutrient concentrations in the pond which has caused algal blooms and potentially also lowers dissolved oxygen.

Figure 5: Image showing the floating ribbon weed at the south-eastern corner of the pond (24 November 2014)

Figure 6: Image showing the areas of ribbon weed in the eastern section of the pond (NearMap – 25 April 2013)

The small amount of macrophytes growing on the south-eastern side of the island as shown in Figure 7 illustrate how aquatic plants can act to trap pollutants within water bodies. However these plants appear to create a 'dead zone' which does not circulate as well as the channel on the northern side of the island.

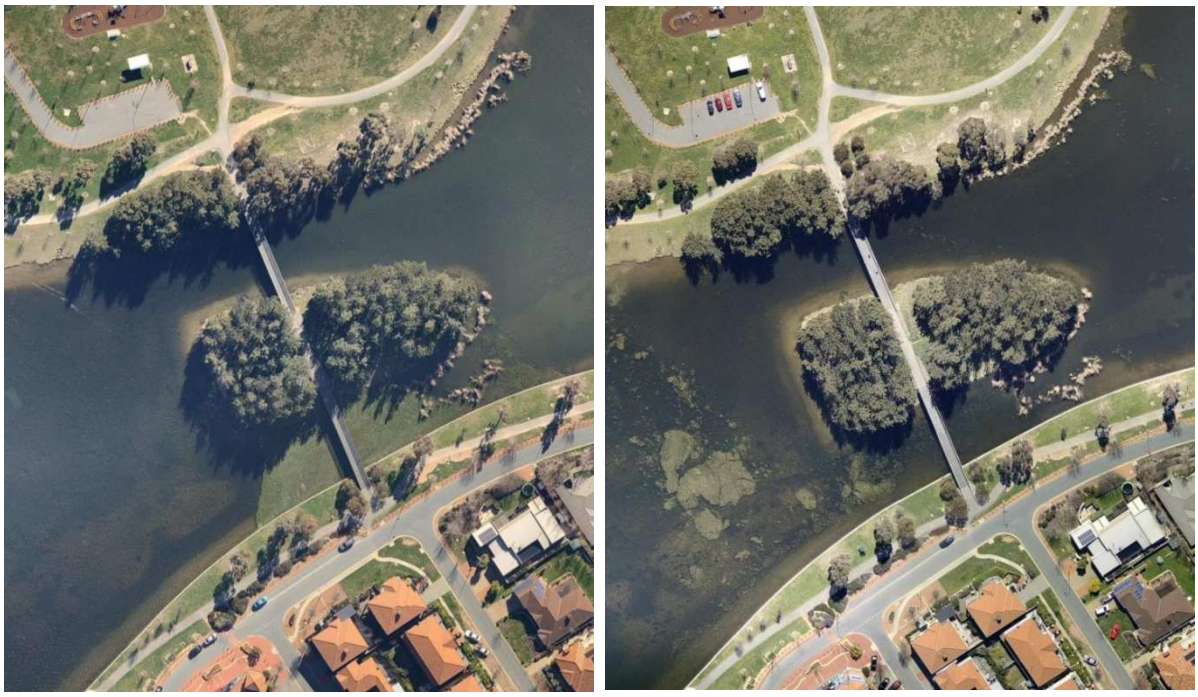

Figure 7: Accumulated algae/weed in the channel on southern side of island – 31 July 2014 (L) and 31 August 2014 (R)

The pond edge has no fringing macrophyte vegetation, typically with turf extending to the edge as shown in Figure 8. Macrophytes may have been unable to establish due to the soil properties or due to bird activity.

Note that to date we have not seen any landscape drawings for the pond, so it is not known if any areas were intended to have macrophyte edge plantings.

Figure 8: The pond banks with no fringing macrophytes (24 November 2014)

TAMS has allocated a significant maintenance budget to the removal of the floating Ribbon Weed, however ongoing maintenance issues could potentially limit the pond's long-term performance. The key issue will be the difficulty removing accumulated settled sediments from the pond. While the urban development upstream of Yerrabi Pond includes some treatment systems and this will reduce pollutant loads entering the pond, there will still be a significant residual load which enters the pond. This will be complex and expensive to remove, as:

- There is no separate sediment basin upstream of the pond
- The pond is large and deep, and not designed to be drained regularly
- While there is provision to drain the pond via a dam valve, this would take a considerable time to drain and a very long time to refill

Key causal factors and constraints

Yerrabi Pond was constructed prior to much of the new urban development upstream of the pond, and before upstream stormwater drainage systems and other infrastructure was installed. This has resulted in significant sediment loading on the pond while construction of estates has taken place including major earthworks.

Our review has also identified a number of design issues which will limit long-term performance of the pond. These will be difficult to rectify due to the size of the pond, however could be revisited at some stage in the future when major works are required to renew this asset. If this system is modified to improve its performance, the following key constraints will need to be accommodated:

- This is an online system and it would be prohibitively expensive to retrofit a high-flow bypass
- Existing topography and layout of the pond
- Location and levels of major structures
- Existing landscape features and vegetation around the system

Potential improvement options

The pond does not require any manor intervention and it is expected that as land development in the upstream catchments draws to an end that water quality issues (particularly turbidity) should reduce.

However in-pond water quality issues associated with high nutrient levels, decomposing organic matter, stratification, pollutant re-release and low dissolved oxygen could increase over time. If the opportunity arises for renewal of this asset, then some changes could be investigated to improve the long-term performance of this asset:

- Assess the feasibility of re-designing the inlet areas for the two main open channels to include stand-alone sediment basins upstream of the pond
- A riser outlet and extended detention may be able to be retrofitted to the outlet (Figure 9) which would allow more stormwater runoff to be retained for longer in the system
- A modified outlet could also allow better water level control in the upper zone, which would assist with macrophyte establishment along the pond edge. Note that there is limited opportunity to alter the pond's normal water level due to the wall treatment to much of the southern edge of the pond.
- Planting macrophytes would improve the pond's water quality performance, particularly in the inlet zone. This would require the construction of a bench to create an area of shallower water depth (around 0.5m). The bench would ideally be constructed to ensure that no flows could short circuit around the shallow zone, forcing all flows through the vegetation.

Figure 9: Existing primary (low flow) pond outlet

Asset 39: Isabella Pond

General information

Description

Pond located online on Monks Creek, upstream of Lake Tuggeranong.

There are also smaller tributaries which enter Isabella Pond from the north and south.

The main and northern inlets are pre-treated in GPTs. The southern tributary is pre-treated in Upper Stranger Pond.

The pond was built when Tuggeranong was developed in the 1980s.

Asset type	Pond	**Asset context**	Greenfield
Year built	1980s	**Year of handover to TAMS**	TBC
Catchment area	TBC	**Catchment type**	Predominantly urban; some rural in upper catchment
Normal water level (NWL)	TBC	**Top of extended detention**	TBC ~200 mm above NWL
Surface area at NWL	6.8 ha	**Open water approx. %**	100%
Volume at NWL	TBC	**Volume at top of extended detention**	TBC
Average depth at NWL	TBC	**Maximum depth at NWL**	TBC (>5 m)
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	Online on Monks Creek. Also inflows from northern tributary and from Upper Stranger Pond	**Outlet/s**	Large concrete weir with two small low-flow notches
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings	✓	one drawing of outlet	

Site inspections

Site inspections have been undertaken on the following dates:

- 16 October 2014 – dry weather
- 24 November 2014 – wet weather

Design objectives

Isabella Pond was designed and built before there were any specific design objectives for water quality treatment in urban ponds, or guidelines with specific advice on sizing and design.

It is understood that the broad design objectives at the time included:

- Flood detention
- Stormwater treatment upstream of Lake Tuggeranong
- Amenity
- Recreational objectives

Canberra's Urban Lakes and Ponds Plan of Management (Canberra Urban Parks and Places/Urban Services, 2001) identifies the prime management purposes of Isabella Pond as "water quality management" and "informal recreation". It identifies the following values of Isabella Pond:

- Commercial (high)
- Flood management (moderate)
- Ecological/environmental (low)
- Fish (low)
- Historic (low)

The only facilities provide at Isabella Pond are a path system and basic landscaping. Permitted activities include fishing, model and recreational boating. Motorised craft, special events and commercial activities are subject to permit.

Monks Creek and two smaller tributaries drain into Isabella Pond. Upstream of the pond there is limited pre-treatment of stormwater flows, which are delivered to the pond via concrete channels. There is basic pre-treatment in large GPTs at the eastern (main) and northern pond inlets. Upper Stranger Pond provides pre-treatment upstream of the southern inlet.

Downstream of Isabella Pond, flows drain into Lake Tuggeranong and then into the Murrumbidgee.

Performance issues

There has been Waterwatch monitoring at Isabella Pond over 2012-2014. It appears that monitoring is undertaken at each of the two GPTs (on the main inlet and northern inlet). Waterwatch data highlights the following issues:

- Turbidity, nitrogen and phosphorus are variable and often high
- Dissolved oxygen is sometimes low
- pH is high (likely due to prevalence of concrete drainage infrastructure in the catchment)

We reviewed past aerial images and saw that algal blooms have been recorded in Isabella Pond in 2009 (refer to Figure 1) and 2014 (refer to Figure 2). It is not known how common these are. TAMS has noted that over the last few years, Lake Tuggeranong has been closed to recreation every Jan/Feb/March, due to algal blooms.

Figure 1: Algal bloom in Isabella Pond, 2009 (ACTmapi)

Figure 2: Algal bloom in Isabella Pond, 17 March 2014 (Nearmap)

In terms of the pond's performance as a water quality treatment and flood detention system, this has never been measured, however our observations are that:

- The pond is probably functioning as per its hydraulic design intent and therefore meeting flood detention objectives
- It is typical of many 1980s stormwater ponds in that it is online and lacks any high flow bypass, meaningful extended detention or macrophyte zone
- Although intended to act as a water quality treatment system, it is not easy to remove accumulated sediments from the pond. This means that accumulated sediments could be contributing to in-pond water quality issues by re-releasing pollutants into the water body
- The pond becomes very deep by its downstream end (more than 5 m) therefore stratification is likely to be an issue, which would exacerbate re-release of pollutants and in-pond water quality issues
- The GPTs become anaerobic during low-flow conditions and then rain events shift poor-quality water from the GPTs in to the pond

Key causal factors and constraints

Isabella Pond is typical of its era, however stormwater treatment practices have evolved significantly since the 1980s.

This system could be modified to improve its performance, however the following key constraints will need to be accommodated:

- Location and levels of major structures
- Existing vegetation including established trees
- Value of the existing landscape

Potential improvement options

A range of options could be considered to improve the water quality treatment performance of Isabella Pond. These range from minor interventions to major re-design options. Each would require significant additional investigation in order to define the options, costs and benefits:

- Accumulated sediments could be removed from the pond (we would recommend a study first to identify the quantity and quality of accumulated sediments)
- The upstream catchment could be retrofit with stormwater treatment to improve water quality reaching the pond
- The normal water level could be lowered and a new riser outlet could be installed so that extended detention could be incorporated into the pond
- In conjunction with the above, additional macrophyte planting could be established in the edge zone, including the ephemeral zone which would be created
- The pond could be completely rebuilt as an offline wetland with a separate sediment basin and high-flow bypass

References

Canberra Urban Parks and Places/Urban Services, 2001 “Canberra’s Urban Lakes and Ponds Plan of Management”

Asset 40: Lower Stranger Pond

General information

Description

Pond located online on a small tributary of the Murrumbidgee, between Lake Tuggeranong and Point Hut Pond. Lower Stranger Pond appears to treat that part of Tuggeranong which cannot drain to either Lake Tuggeranong or Point Hut Pond.

The two main inlets are pre-treated in GPTs.

The pond was built when Tuggeranong was developed in the 1980s.

Asset type	Pond	**Asset context**	Greenfield
Year built	1980s	**Year of handover to TAMS**	TBC
Catchment area	TBC	**Catchment type**	Urban
Normal water level (NWL)	TBC	**Top of extended detention**	TBC ~50 mm above NWL
Surface area at NWL	4.1 ha	**Open water approx. %**	100%
Volume at NWL	TBC	**Volume at top of extended detention**	TBC
Average depth at NWL	TBC	**Maximum depth at NWL**	TBC (approx. 5 m)
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	One main inlet at eastern end and several smaller inlets around edges	**Outlet/s**	Concrete weir with low-flow notch
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings	✓		

Site inspections

Site inspections have been undertaken on the following dates:

- 16 October 2014 – dry weather
- 24 November 2014 – wet weather

Design objectives

Lower Stranger Pond was designed and built before there were any specific design objectives for water quality treatment in urban ponds, or guidelines with specific advice on sizing and design.

It is understood that the broad design objectives at the time included:

- Flood detention
- Stormwater treatment upstream of the Murrumbidgee River
- Amenity
- Recreational objectives

Canberra's Urban Lakes and Ponds Plan of Management (Canberra Urban Parks and Places/Urban Services, 2001) identifies the prime management purposes of Lower Stranger Pond as "water quality management" and "informal recreation". It identifies the following values of Lower Stranger Pond:

- Visual/landscape amenity (high)
- Recreation (moderate)
- Flood management (moderate)
- Ecological/environmental (moderate)
- Fish (low)

The only facilities provided at Lower Stranger Pond are basic landscaping. Permitted activities include fishing, model and recreational boating. Motorised craft, special events and commercial activities are subject to permit.

Upstream of the pond there is limited pre-treatment of stormwater flows, which are delivered to the pond via concrete channels and pipes. There is basic pre-treatment in GPTs at the eastern (main) and northern pond inlets.

Downstream of Lower Stranger Pond, flows drain into a small creek and then into the Murrumbidgee.

Performance issues

Waterwatch monitoring has been undertaken only twice at Lower Stranger Pond, in August and September 2012. Both monitoring events were undertaken in dry weather after relatively dry periods. Monitoring was undertaken at the outlet. Both samples show reasonably good water quality.

We reviewed past aerial images and saw limited evidence of algal blooms. The only image which looks like it could be an algal bloom is the ACTmapi image from 2004, shown in Figure 1.

Figure 1: Possible algal bloom in Lower Stranger Pond, 2004 (ACTmapi)

In terms of the pond's performance as a water quality treatment and flood detention system, this has never been measured, however our observations are that:

- The pond is probably functioning as per its hydraulic design intent and therefore meeting flood detention objectives
- It is typical of many 1980s stormwater ponds in that it is online and lacks any high flow bypass, meaningful extended detention or macrophyte zone
- Although intended to act as a water quality treatment system, it is not easy to remove accumulated sediments from the pond. This means that accumulated sediments could be contributing to in-pond water quality issues by re-releasing pollutants into the water body
- The pond becomes very deep by its downstream end (approximately 5 m) therefore stratification is likely to be an issue, which would exacerbate re-release of pollutants and in-pond water quality issues

Minor bank erosion was observed in one location at Lower Stranger Pond – refer to Figure 2.

Figure 2: Minor bank erosion in Lower Stranger Pond

Key causal factors and constraints

Lower Stranger Pond is typical of its era, however stormwater treatment practices have evolved significantly since the 1980s.

This system could be modified to improve its performance, however the following key constraints will need to be accommodated:

- Location and levels of major structures
- Existing vegetation including established trees
- Value of the existing landscape

Lower Stranger Pond is a similar size to Isabella Pond and was constructed around the same time with a similar design, however it is worth noting a few key differences from Isabella Pond:

- A smaller upstream catchment area
- Smaller GPTs with less propensity for anaerobic conditions
- Lower Stranger has a shallow inlet area (constructed some time between 2004 and 2009) which appears to be partially effective as a pre-treatment zone. Figure 3 shows an example where the water quality is distinctly different in the inlet zone and main pond, with higher turbidity in the inlet zone. A small band of macrophytes forms a partial barrier between the inlet zone and main pond. This macrophyte band is shown in Figure 4.
- Higher landscape value in the pond surrounds

Figure 3: Lower Stranger Pond, 19 January 2010 (Nearmap) showing distinctly different water quality in the inlet zone and main pond

Figure 4: Band of macrophytes in Lower Stranger Pond

Potential improvement options

A range of options could be considered to improve the water quality treatment performance of Lower Stranger Pond. These range from minor interventions to major re-design options. Each would require significant additional investigation in order to define the options, costs and benefits:

- Accumulated sediments could be removed from the pond (we would recommend a study first to identify the quantity and quality of accumulated sediments)
- The upstream catchment could be retrofit with stormwater treatment to improve water quality reaching the pond
- The normal water level could be lowered and a new riser outlet could be installed so that extended detention could be incorporated into the pond
- In conjunction with the above, additional macrophyte planting could be established in the edge zone, including the ephemeral zone which would be created
- The pond could be completely rebuilt as an offline wetland with a separate sediment basin and high-flow bypass

Note that we would not recommend significant effort to establish more macrophytes in the inlet zone unless other measures are also undertaken to reduce high flows and velocities through this area.

References

Canberra Urban Parks and Places/Urban Services, 2001 “Canberra’s Urban Lakes and Ponds Plan of Management”

Asset 41: Two ponds below Point Hut Pond

General information

Description

Two ponds located immediately downstream of Point Hut Pond.

The ponds are located online in the waterway.

Ponds have been constructed with rock chute outlets.

Asset type	Pond	**Asset context**	Engineered waterway
Year built	1980s	**Year of handover to TAMS**	TBC
Catchment area	TBC	**Catchment type**	Urban
Normal water level (NWL)	TBC	**Top of extended detention**	None
Surface area at NWL	2,800 + 2,000 m^2	**Open water approx. %**	90%
Volume at NWL	TBC	**Volume at top of extended detention**	N/A
Average depth at NWL	TBC	**Maximum depth at NWL**	TBC
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	Point Hut Pond outlet	**Outlet/s**	Rock chutes downstream of each pond
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings	✓		

Site inspections

Site inspections have been undertaken on the following dates:

- 16 October 2014 – dry weather
- 3 December 2014 – wet weather

Design objectives

This pair of ponds appears to function mainly as waterway stability features. Being located downstream of Point Hut Pond, they would have negligible water quality function, as any water quality improvement that could be achieved in a pond has already been achieved by Point Hut Pond upstream.

They have minimal landscape value and the edge vegetation limits views and discourages public access to the ponds. The ponds may have some habitat value, however their construction has also potentially replaced other habitat values which were present in the original creekline.

Downstream of these ponds, flows drain into the Murrumbidgee via a small natural creek. It seems likely that urban development upstream of this creek would have affected its stability and it may also the ponds may have been constructed to stabilise the creek.

Performance issues

As these ponds do not have a stormwater treatment function, their performance in this regard is not relevant.

There is no known data available on in-pond water quality, however it is reasonable to expect that the water quality in these ponds would reflect the water quality in Point Hut Pond and be governed largely by the processes within Point Hut Pond.

One key performance issue which appears to have occurred in the past is scour and erosion of the embankment below the downstream pond. The rock chute was originally constructed with a rock-lined section approximately 10 m wide, with a vegetated bank on either side of the rock. Past aerial images show that a large scour hole formed in the vegetated bank, beside the rock chute, over 2010-2014. Figure 1 shows the scour hole in March 2014. It was approximately 50 m^2 in area and appeared to be several metres deep.

The scour hole was repaired in 2014 and Reno mattresses were installed either side of the rock chute. The finished works are shown in Figure 2. These works are now relatively stable. We observed minor erosion at the top of the embankment, on the edge of the Reno mattress (refer to Figure 3), however this is not yet threatening the stability of the structure. We observed the site after a moderate rain event on 3 December 2014 and flows were confined to the central (older) part of the chute.

We also inspected the upper rock chute and vegetated bank in December 2014 and found that there is another scour hole starting to form in this embankment. This is shown in Figure 4. At this stage the hole is small (approximately 1 m^2 and 1 m deep) however it also has the potential to expand over time into a large hole, as occurred on the lower embankment. The same flow conditions occur at each chute and the original design of each was very similar.

We inspected the creek upstream of the upper pond and the only stability issue noted here was minor damage to the concrete structure at the causeway between Point Hut Pond and the downstream ponds. A crack has opened between the main concrete structure and the concrete apron on the downstream side. This is shown in Figure 5.

Note that the creek downstream of the ponds appears to be relatively stable. The lower section has been rock-lined.

Figure 1: Scour hole in downstream embankment beside rock chute (Nearmap, 17 March 2014)

Figure 2: Completed works in 2014

Figure 3: Minor erosion at the top of the new Reno mattress

Figure 4: Scour hole developing in the upper embankment

Figure 5: Minor damage (crack) to concrete structure at causeway

Key causal factors and constraints

Stream erosion is a common issue downstream of urban development, due to increased frequency of erosive flows. The events which cause particularly high stream erosion are typically 1-2 year ARI events, which are large enough to cause bank-full flows and high velocities, and also occur frequently enough that they are significant in short-term geomorphological processes. Typically, stormwater detention is designed for larger events (e.g. 10-100 year ARI) and therefore 1-2 year ARI events are typically unattenuated. It is unknown whether Point Hut Pond reduces flows in events of this scale.

The creek downstream of Point Hut Pond is relatively steep and the soils in the region are highly erosive, therefore erosion may also have been an issue prior to urbanisation of the catchment.

Potential improvement options

It is recommended that the scour hole forming on the upper embankment should be monitored and it will need to be repaired at some stage. Options are:

- Keep the pond and embankment and undertake repairs similar to the downstream site
- Remove the pond and embankment and restore a stable creekline between Point Hut Pond and the lower pond.

Other considerations at this site include potential improvements to the habitat and landscape value.

Asset 42: Knoke Ave Constructed waterway

General information

Description

Constructed waterway flowing through Gordon and into Point Hut Pond via Knoke Avenue. This review has focussed on the section from Tharwa Drive to Point Hut Pond.

The majority of the waterway consists of a small concrete low flow channel invert at the base of a mown turf trapezoidal channel. On the banks of the channel are scattered trees. At regular intervals there are large concrete drop structures. There is an online trash rack immediately downstream of Knoke Ave.

At the downstream end of the waterway, the last approximately 200 m of the waterway enters a relatively large area of macrophytes.

Asset type	Constructed waterway	**Asset context**	Residential development
Year built	TBC (late 1980s?)	**Year of handover to TAMS**	TBC
Catchment area	TBC	**Catchment type**	Mixed rural and urban
Length	> 1 km	**Depth**	>2 m
Width	Typically 20 m	**Grade**	TBC
Total area	TBC	**Construction cost**	TBC
Inlet/s	Multiple inlets from urban residential area	**Outlet/s**	Directly into Point Hut Pond downstream of Knoke Ave
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
DA report	✓		
Design drawings		✓	

Site inspections

Site inspections have been undertaken on the following dates:

- 16 October 2014– dry weather
- 16 November 2014 – wet weather

Design objectives

The Knoke Ave waterway has a primary function of conveyance. It appears to have been designed to meet the standards set out in the ACT's Design Standards for Urban Infrastructure – DS01 Stormwater (Chapter 1.7 Engineered Waterways). It is unlikely that the waterway was designed to achieve water quality treatment objectives due to the use of the concrete invert in the base of the waterway. The majority of the stormwater flows do not come into contact with any vegetation and hence there is likely to be little water quality improvement.

The exception to this is the large vegetated section of the channel immediately upstream of Point Hut Pond. This section of the waterway is extensively vegetated and including the north-eastern branch, this is a large vegetated area greater than 1 hectare in size. Unusually for an online vegetated waterbody such as this there do not appear to be significant preferential flowpaths in the vegetated section of the channel, which indicates that there is good contact of the flows with the vegetation, providing good treatment. It is unclear whether this vegetated section is consistent with the original design intent or whether it has gradually evolved to its current form.

Most of the catchments draining into the waterway are residential and do not have any form of treatment prior to entering the waterway. Downstream of Point Hut Pond, the waterway flows into the Murrumbidgee River.

Performance issues

While the Knoke Ave waterway as a whole is relatively stable, it has a number of key performance issues that need to be addressed in the short term. Site observations have indicated that:

- There is a serious headcut forming in the vegetated section at the downstream end of the waterway immediately upstream of Point Hut Pond (refer to Figure 1, Figure 2 and Figure 3)
- The channel is scouring at the interface between the concrete low flow channel and the mown turf channel. It appears that over time this interface has eroded and has been patched with a concrete pad. The waterway is still eroding however in those sections which have not been protected with additional concrete (refer to Figure 4, Figure 5 and Figure 6)
- A small number of the inlets from the residential catchments are on steep grades and are eroding, particularly where the low flow channel is being outflanked

The headcut at the downstream end of the waterway is shown in Figure 1. There is a significant drop (approximately 1 to 2m) where water is cascading from the upper vegetated bench of the waterway into the ponded water level below (approximately the same water level as Point Hut Pond). Water is flowing over the drop in multiple locations as can be seen in Figure 1.

A review of Nearmap has shown that the headcut has increased in size over the last 2 to 3 years as shown in Figure 2 and Figure 3. This is typical for headcuts as they propagate upstream. If left without any works to stabilise the headcut, over time the headcut will propagate further upstream, eroding and undermining the vegetated waterway. The headcut will continue to propagate upstream, typically during large events and in noticeable discrete stages. Based on a review of Nearmap imagery the headcut has undergone these discrete changes at the following times in the last three years:

- In early 2012

- June-July 2013
- August 2014

Figure 1: Knoke Ave waterway major headcut, upstream of Point Hut Pond

Figure 2: Headcut area shown in blue in September 2011

Figure 3: Headcut area in October 2014 (blue shows area of headcut in Sep 2011 for comparison to show expansion)

Figure 4, Figure 5 and Figure 6 show the erosion of the waterway at the interface of the concrete low flow channel and the adjacent mown grass channel. The area shown in Figure 4 is significantly eroded with a depth of erosion of approximately 300 mm from the adjacent base. It can be seen that erosion is occurring at the interface of the patchwork scour protection (likely undertaken to address previous erosion). Where the scour protection has ended further erosion has occurred and in this instance been exacerbated by the works undertaken as it has concentrated the erosion in this location.

Figure 4: Knoke Ave waterway with significant erosion at the end of the concrete scour protection to low flow channel

Figure 5: Scouring at interface of low flow channel and mown turf (note debris indicating water level mark, centre)

Figure 6: Scouring at interface of low flow channel and mown turf (note debris indicating water level mark, left of photo)

A number of other observations were made on site including:

- There was very little litter in the waterway
- The gross pollutant trap had accumulated almost no litter and very small amounts of sediment (refer Figure 7)
- The drop structures were generally stable and did not have obvious signs of instability or scouring (refer Figure 8).
- Safety is a potential concern at the drop structures as they are generally easily accessible to the public and it is relatively easy to gain access to the top and bottom of the drop structure. Water is flowing with relatively high velocities at the drop structure and in even small events it would be difficult to cross the channel without being knocked over. It is unlikely that the safety criteria would be met at these locations.
- In some locations the drop structures were better screened with vegetation which reduce the accessibility of the drop structures to the public.

Figure 7: Gross Pollutant Trap in wet weather event

Figure 8 Example of drop structures in wet weather event

There is no known monitoring of water quality in the Knoke Ave waterway.

Key causal factors and constraints

It is not known whether the vegetation at the end of the channel was planted at the time of construction or whether macrophytes have colonised the area after construction. However at present this stand of vegetation is likely to be providing good water quality treatment, provides good habitat for a range of species. Despite being online it appears generally stable throughout the vegetated area, with the exception of the headcut at the downstream end.

The headcut at the downstream end of this section is undermining these values. This is being caused by the steep gradient change between the vegetated portion of the channel and Point Hut Pond, the nature of the soils and the quantity of the water flowing in the channel. As the water is flowing over this steep gradient change in an un-controlled manner the bed is eroding and has formed its own informal drop structure to reduce the erosive forces in the channel.

The erosion to the edge of the low flow channel is also a similar process where the gradient of the waterway and the quantities of flows are causing erosive forces greater than the bed can withstand. The concrete low flow channel is protecting the invert of the channel, but at the interface of the channel and the mown turf it is eroding. This area is the most frequently wetted area of grass and also as water spills out of the concrete channel at a fast velocity (low friction of the concrete) water is flowing at higher velocities at the interface (in comparison to a location a few metres away from the channel where the friction forces of the grass is higher and the velocities are lower).

The general stability of the waterway is assisted by the following factors:

- The site's natural topography combined with drop structures in the waterway have generally allowed for gentle grades and low velocities
- The design of the waterway itself is simple and robust with low maintenance requirements
- Concrete low flow channels eliminate the risk of erosion to the invert of the channel
- The vegetation consisting of turn and trees is well established and relatively robust

Potential improvement options

Works are required to protect the propagation of the headcut from Point Hut Pond through the vegetated section of the waterway. There are a number of potential options to address this structurally. These options revolve around the use of a bed-grade control structure to prevent the bed from further incision. The bed grade control structure could include a drop structure, a rock chute or a rock cascade within the waterway. Downstream of the waterway the water level could be raised at the entrance to the pond (e.g. immediately downstream of the pedestrian bridge) to also reduce the hydraulic grade and raise the tail water level over the current head cut. This has the potential to reduce the velocities by changing the hydraulic grade. These options need to be explored further with appropriate hydraulic and waterway engineering assessment.

Scour along the edge of the concrete channel could be addressed through stabilising the entire edge. Assessment of velocities would confirm appropriate treatment measures that could be adopted. Continuation of the current treatment would likely be successful from an engineering stability perspective, but would reduce the water quality performance (by reducing the filtering by overbank flows over the grass).

Consideration could be given to achieving multiple objectives with the waterway including improving water quality similar to the large vegetated waterway that has formed at the downstream end. Consideration would need to be given to any potential impacts on flooding as well as structural stability. Additional flow control structures may be required to prevent further erosion if this option was adopted.

ACTGPT-1a

Address	**Medhurst Crescent, Crace**
Device	Minor GPT, (then Bio-retention system)
Site Details	Access way off Medhurst Crescent, parking area for cleaning
Estimated catchment area	-
Device Status at Nov 2014	Operational, device 35% full
Device comments and recommendations	The GPT is too small and the racks are not long enough or tall enough for pollutant volume. The water in chamber is chemically brown with oily layer on top. The existing chamber should be used to retro-fit a GPT. Recommend de-commission and the addition of CDS unit to run alongside existing structure.
Rectification works required	De-commission. Chamber can be used to install a GPT.
Existing maintenance	TBC
Maintenance expectations with rectifications	A mid-sized CDS unit will work really well to protect the bioretention system and should be cleaned quarterly
GPS Coordinates	-
Notes	There is excellent access for cleaning the current GPT, and plenty of space for further works.

Trash builds up on the end rack very quickly there are tide marks on the wall showing water has built up and been in line with the top of the racks for some time.

Inlet into the chamber, again tide marks show that backwater has occurred up into the pipe, this is due to the racks being too small and blocking quite often.

Outlet pipes, there is some sediment build up on the wrong side of the trash racks. One pipe in and 2 pipes out, presumably due to grade or size to get under services.

Site and metal grating lids. The site is clean and has plenty of room for maintenance or extra works. For a brand new, high quality residential development, the bioretention system is appropriate, but the GPT is not. This is having a notable negative impact on the bioretention system, letting large volumes of sediment and litter through.

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Address	**Medhurst Crescent, Crace**
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Device comments and recommendations	The GPT is too small and the racks are not long enough or tall enough for pollutant volume. The water in chamber is chemically brown with oily layer on top. The existing chamber should be used to retro-fit a GPT. Recommend de-commission and the addition of CDS unit to run alongside existing structure.
Rectification works required	De-commission. Chamber can be used to install a GPT.
Existing maintenance	TBC
Maintenance expectations with rectifications	A mid-sized CDS unit will work really well to protect the bioretention system and should be cleaned quarterly
GPS Coordinates	-
Notes	There is excellent access for cleaning the current GPT, and plenty of space for further works.

Trash builds up on the end rack very quickly there are tide marks on the wall showing water has built up and been in line with the top of the racks for some time.

Inlet into the chamber, again tide marks show that backwater has occurred up into the pipe, this is due to the racks being too small and blocking quite often.

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Site and metal grating lids. The site is clean and has plenty of room for maintenance or extra works. For a brand new, high quality residential development, the bioretention system is appropriate, but the GPT is not. This is having a notable negative impact on the bioretention system, letting large volumes of sediment and litter through.

ACTGPT-1c

Address	**Tabbara Crescent, Crace**
Device	Minor GPT
Site Details	Off Tabbara Cres in large concrete area
Estimated catchment area	
Device Status at Nov 2014	Operational, device 5% full
Device comments and recommendations	The device had obviously been recently cleaned. High sediment levels in the chamber suggest a smaller aperture required or a GPT which would remove silt and organics. A Vortex style GPT would best suit this arrangement as well as the change in direction Replace with or construction of an additional CDS unit would greatly improve performance.
Rectification works required	De-commission, chamber can be used to be a diversion chamber for a new CDS unit.
Existing maintenance	TBC
Maintenance expectations with rectifications	Quarterly
GPS Coordinates	-
Notes	There is excellent access for cleaning the current device, and plenty of space for further works.

High quality construction in the chamber, but only an average design.

Pollution is pushed to the back rack which is the first place the device overtops.

The trash rack has been cleaned recently but there is a large build up of sediment on the downstream side of the trash rack, that was not removed. This shows there is a need for a different type of GPT that will better capture and remove silts/sediment. If this volume was captured purely by deposition in elevated levels of standing water during a storm, imagine how much has come down the line.

The outlet pipe into the downstream pond is submerged, which is good, but the GPT offtake is not, which is also good. There are some positive elements to this GPT, but it could be massively improved.

ACTGPT-12

Address	**Dickson Wetland, Dickson**
Device	Trash Rack
Site Details	Access way off Majura Ave, Opp 112
Estimated catchment area	-
Device Status at Nov 2014	Operational, device 35% full
Device comments and recommendations	The device is not large enough for the size of the upstream channel and catchment area; there is clear evidence of bypass downstream. The rack space is too small and would block too easily causing stormwater and pollution to top the weir and bypass the trash rack & pond. There is a lot of room for new racks and other options. The angle of the vertical bars makes it more likely that pollution will settle on the racks and will help to ramp floatables up over the device. The existing racks could stay, but if you were going to build a massive new rack, it would pay dividends in ease of cleaning to replace the existing rack as well.
Rectification works required	Install new racks across the length of the sediment basin in front of weir. Rack length could be increased up to 30m long in addition to existing rack.
Existing maintenance	TBC
Maintenance expectations with rectifications	Quarterly cleaning and after major storms.
GPS Coordinates	-
Notes	There is excellent access for cleaning the current trash rack, and plenty of space for further works.

Open channel upstream of Trashrack showing current vehicle access point.

Upstream showing weir and trashrack, and location of new trashrack extension

The Trashrack was placed in the smallest cross section of the upstream stormwater to save money on construction, but this means it blocks quickly, then bypasses flow and pollution. In this case, note the tide mark. Pollution higher than this bypasses in the main channel, not over the trashrack and into the pond.

Upstream there is plenty of area for pollution storage, with good access.

Trashrack under footbridge. This is way too small for the catchment. This could stay, with a massive new trashrack added across the main channel, down to where the yellow joins the main rack here.

ACTGPT-13a

Address	**Goodwin St, Lyneham**
Device	Nettech 2x750 Nets
Site Details	Access way off Goodwin street
Estimated catchment area	-
Device Status at Nov 2014	Operational, device 5% full
Device comments and recommendations	For the catchment area, the nets are too small and will block after one storm event. The Nettech has also clearly become detached from the pipes as there are large floatables around them. There is also clear evidence of bypass downstream but this is not surprising as this is not a good location for this device. The weir is also too small and in any sort of high flow would just be completely bypassed. This site would be perfect for a CDS unit to be retrofitted and the existing chamber could be used as the diversion chamber. After speaking with TAMs we have been informed that the device is already being replaced.
Rectification works required	Retrofit to GPT
Existing maintenance	TBC
Maintenance expectations with rectifications	TBC
GPS Coordinates	-35 15 15, 149 07 51
Notes	There is excellent access for cleaning the current trash rack, and plenty of space for further works.

Small diversion weir and inlets into Nettech Chamber.

The “flume weir” is in the shade of the bridge, and is roughly the same height at the pipes.

Site and access to Nettech Chamber. Outlet approx. here

There is good access to the site, but with 15 lid sections to come off, this does not make for easy maintenance. These all need to be greased, and so do the removable beams.

The treated flow appears to go back into twin pipes and heads out where the rock groyne extends into the pond.

Nettech device over the inlet pipes

This was never the intention of the Nettech inventors from Port Macquarie. It was designed to go onto a pipe outlet, where all other options were unfeasible. This site has lots of options, a nice hydraulic drop at the back of the chamber, and Nettechs is a strange solution for this site.

To increase the efficiency and ease of cleaning, a very large screening area could be created inside this device. There is a full bypass arrangement upstream so the nets should never come off and the "mouse trap" above the main cylinder is all for nothing.

There is a drop at the outlet, so an offline device could be installed next to the chamber, or a far more effective screening system built inside the chamber.

Downstream of the weir showing signs of bypass and some organics build up

ACTGPT-13b

Address	**DeBurgh St, Lyneham**
Device	Trash Rack
Site Details	Access way off DeBurgh St
Estimated catchment area	-
Device Status at Nov 2014	Operational, device 0% full
Device comments and recommendations	Device is almost useless, the device is far too small, the rack slopes upwards to allow floatables to just flow over the top. There is clear evidence of bypass downstream. It could be replaced with a new rack or multiple racks. The site would be perfect for a small CDS unit that would be covered leaving a better looking channel through the park.
Rectification works required	Create offline GPT by installing weir and offline chamber
Existing maintenance	TBC
Maintenance expectations with rectifications	Quarterly cleaning
GPS Coordinates	-
Notes	There is excellent access for cleaning the current trash rack, and plenty of space for further works, to put in something a lot more appropriate and effective.

Trash rack which in high flow would almost just become a ramp for floatables and other pollution. Its undersized and online, with bypass straight over the top.

The trash rack is very small and has almost no capture area

It must have been just cleaned, with no rain before this photo.

The site has plenty of room for an offline GPT.

As can be seen, the current trashrack eliminated over 80% of the channel capacity!

It might be appropriate to move the offline GPT further upstream.

ACT GPT-22

Address	**Ian Potter Crescent, Gungahlin**
Device	Twin Cleansall 750s
Site Details	Corner of Ian Potter Cres and Tesselaar St
Estimated catchment area	-
Device Status at Nov 2014	Only just operational, device 5% full
Device comments and recommendations	These devices could work well but the downstream vegetation is creating a permanent backwater. Downstream of the devices surrounding outlet vegetation has become overgrown and is now dramatically affecting the performance of this device.
Rectification works required	5m of vegetation downstream of outlet should be cleared
Maintenance expectations with rectifications	Device will be working with twice the efficiency, so twice the pollution could be expected. So cleaning would increase.
GPS Coordinates	-
Notes	There is excellent access for cleaning the current devices, and good areas for dewatering.

CleansAll site from downstream

Downstream outlet from CleansAll showing vegetation build up and pollution that has bypassed the device. The water has to jump up to a height that will send the Cleansalls into bypass as it hits this vegetative barrier.

Little pollution inside the Cleansall unit, because the downstream vegetation keeps it regularly in full bypass.

ACTGPT-23

Address	**Dodwell St, Giralang**
Device	Trash Rack
Site Details	Access way off Dodwell St
Estimated catchment area	-
Device Status at Nov 2014	Operational, device 40% full
Device comments and recommendations	There is not enough rack space for the flow rate during storm events. There is evidence of bypass downstream of the existing rack and plenty of room for other sets of racks on the site. The site has easy access for cleaning and easy access to downstream of the existing trash rack.
Rectification works required	A Boom should be added after the trash rack Extra racks with controlled overflows to allow bypass in storm events whilst minimizing loss of pollution Optionally run racks along the length of the basin and create a bypass overflow
Existing maintenance	TBC
Maintenance expectations with rectifications	This type of device can be dewatered easily and should be cleaned quarterly
GPS Coordinates	-
Notes	There is excellent access for cleaning the current trash rack, and plenty of space for further works.

Sediment basin upstream of existing trash rack

Trash rack showing evidence of overtopping and bypass

Length of trashrack, there is plenty of room with easy access in front of existing racks

There are lots of opportunities to dramatically improve performance at this device

When debris blocks on the vertical racks during a storm, it will eventually slide down or peel off, except if it gets caught partially over the top. This sort of pollution can simply be cleaned from the racks back into the water. It will waterlog and sink, for removal with the other pollution later.

This is a very large and very open GPT that would attract children, so Work Health and Safety might also be a consideration. Some signage as a minimum would be advisable.