Table 11: Tuggeranong reserve options - financial, performance management and cost effectiveness of pollutant reduction

Project Description	MCA	CAPEX	Renewal	OPEX $/yr	TP kg/yr	TSS Kg/yr	TN Kg/yr	Life cycle cost ($) 20 years
Reserve								
Proj. No.45—TG004: Tuggeranong (Marconi Cres, Taylor Primary School) Bioretention system & reuse (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media- reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	0.6	$2,736,000	$271,240	$62,828	38	25,220	217	$3,471,697
Proj. No.44—TG005: Tuggeranong (Drakeford Dr & Severne Cct, opposite Namadgi School) Bioretention system & reuse (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media- reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	0.6	$2,219,000	$277,384	$51,833	48	32,470	253	$2,839,797
Proj. No.33—TG007B: Tuggeranong (Drakeford Dr, Greenway lake surrounds, adjacent to large GPT) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media) Increased amenity of open space, relocation of bike path.	0.9	$2,439,000	$287,650	$56,483	60	48,280	368	$3,111,714
Proj. No.43—TG009: Tuggeranong (Longmore Cres & Sainsbury St, Wanniassa) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media).	0.7	$1,680,000	$248,304	$39,562	35	24,430	222	$2,163,284
Proj. No.46—TG013: Tuggeranong (between Athlon Dr & O'Halloran Cct, adjacent to Kambah Community Facilities & shops) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media) Increased amenity of open space.	0.5	$1,753,000	$223,330	$40,980	31	21,820	205	$2,244,856

Project Description	MCA	CAPEX	Renewal	OPEX $/yr	TP kg/yr	TSS Kg/yr	TN Kg/yr	Life cycle cost ($) 20 years
Proj. No.31—TG014: Tuggeranong (Sternberg Cres & Mcbryde St opposite Vikings Park) Bioretention system & reuse (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media- reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	1.0	$3,073,000	$440,464	$86,561	67	48,750	490	$4,827,857
Proj. No.35—TG015: Tuggeranong (Erindale Dr, Wanniassa adjacent to Vikings Park) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media) Increased amenity of open space.	0.8	$3,643,000	$535,120	$83,883	75	54,580	418	$4,669,939
Proj. No.42—TG016: Tuggeranong (Ashley Dr & Upton St, Monash) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media).	0.7	$1,648,000	$179,510	$38,357	34	24,200	190	$2,100,741
Proj. No.28—TG017: Tuggeranong (Bugden Ave, Gowrie playing fields) Bioretention system & reuse (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media-reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	1.3	$4,199,000	$473,390	$95,484	80	66,500	627	$5,332,889
Proj. No.34—TG018: Tuggeranong (Weathers St, Gowrie adjacent to Holy Family Primary School) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media) Increased amenity of open space.	0.9	$3,772,000	$712,680	$86,792	67	52,680	610	$4,875,650
Proj. No.40—TG031: Tuggeranong (Athlon Dr, Wheeler Cres open space upstream of GPT) Bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media) Increased amenity of open space.	0.6	$3,234,000	$439,224	$74,397	76	52,420	478	$4,022,166
Reserve Total		**$30,396,000**	**$4,088,296**	**$717,160**	**611**	**451350**	**4078**	**$39,660,590**
Priority + Reserve Total		**$56,557,000**	**$7,489,060**	**$1,235,351**	**1565**	**1,140,450**	**8611**	**$71,376,684**

Lake Tuggeranong boardwalk adjacent to the Community Centre.

3.1.4 Upper Molonglo

Catchment overview

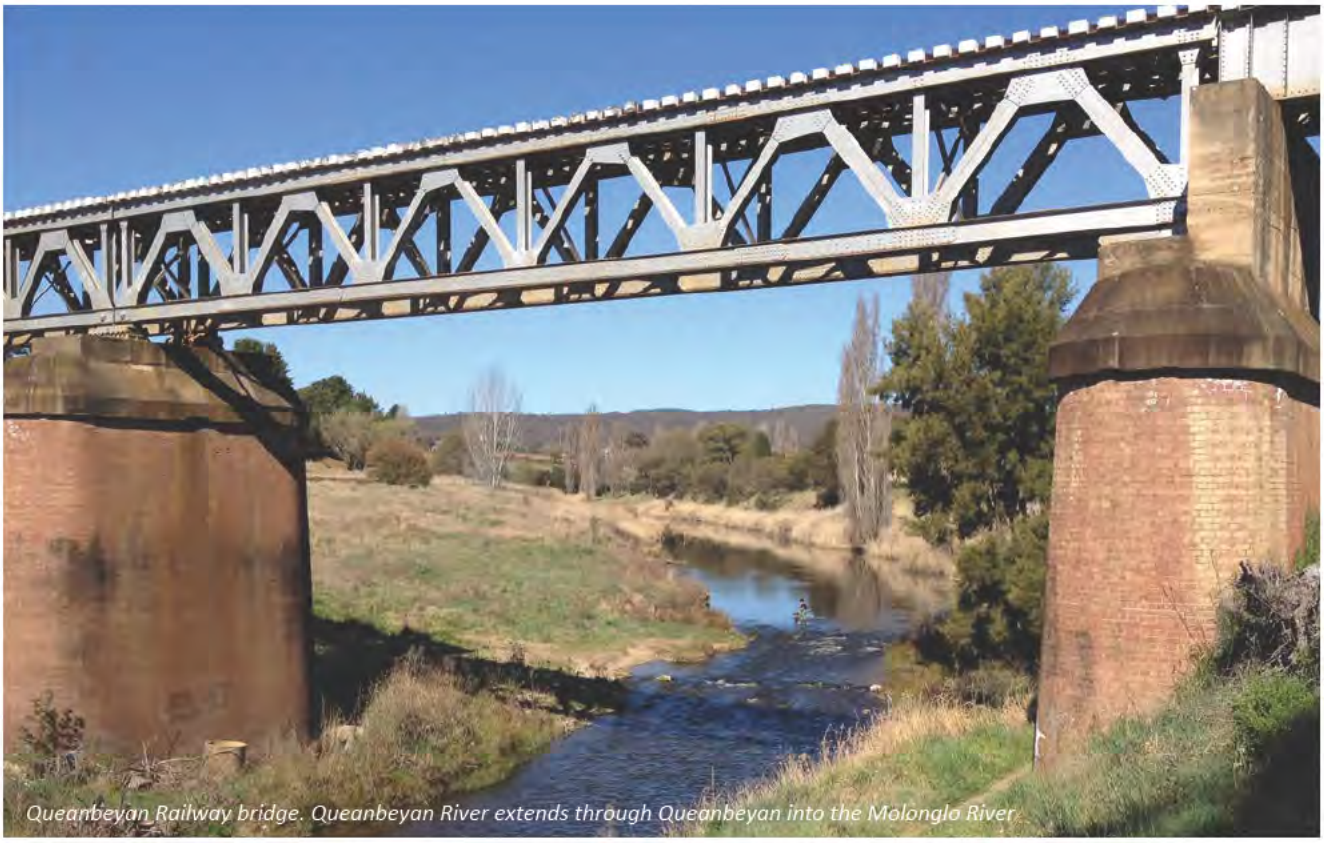
The study area includes the entire Upper Molonglo River catchment upstream of its confluence with Queanbeyan River, and the lower Queanbeyan River catchment downstream of the Googong Reservoir to the location of confluence. The aggregate study area is 65,140ha.

The Upper Molonglo is a major tributary of Lake Burley Griffin, with the other major tributary being the Queanbeyan catchment. It represents 37% of the Lake Burley Griffin catchment in the Southern Tablelands of NSW. From its confluence with the Queanbeyan River, the catchment of the Upper Molonglo River drains approximately 153,000ha of rural and urban land. Less than 6% of Upper Molonglo catchment is located in ACT and remaining area is located within NSW (Alluvium 2015e).

Alluvium (2015e) identifies the following key issues for the catchment are:

- runoff from Queanbeyan is dominated by older urban development with limited existing stormwater treatment systems (mainly GPTs)
- new development is occurring rapidly, which has additional impacts both during construction as well as in the long term
- significant industrial areas in Queanbeyan (including Dodsworth and Larmer) have untreated runoff.

There is a strong community interest in addressing urban growth and agricultural practices and in managing the impacts of surface water runoff on the receiving environment in this catchment (Alluvium 2015e).



Queanbeyan Railway bridge. Queanbeyan River extends through Queanbeyan into the Molonglo River.

Priority and reserve infrastructure options

Although the urban area of this catchment is relatively small (i.e. Queanbeyan), it has significant effects on quality of water flowing into the ACT. Space and opportunities for retrofitting are limited mainly due to the lack of open space within the older urban areas. This impacts on the potential for large assets and treatment of large urban areas. Bio-retention and wetland/swale (combination) ranked well in this catchment.

Map 7 shows the location of the priority and reserve options.

Table 12 shows the nature of pollutant generation in the Upper Molonglo and provides a summary (in terms of nutrient and sediment removal) of asset performance. Table 13 lists the specific projects (priority and reserve) along with asset performance and financials (CAPEX, OPEX and renewal cost, cost effectiveness).

Concept designs for these sites are at Appendix 7.

The report produced by Alluvium for the ACT Government is at Appendix 12. The MCA report is at Appendix 9.

Table 12: Pollutant reduction of options for the Upper Molonglo catchment

Upper Molonglo	TP	TSS	TN
Annual pollutant generation rate [Kg/Ha/Yr]	0.06	33.77	0.52
Base case [Kg/Yr]	3,630	2,200,000	33,800
Priority List ($79 mil.)			
Upper Molonglo	**Options: 2**	**CAPEX: $3,377,000**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	105	73,600	660
Proportion of pollutant reduction in catchment	2.9%	3.3%	2.0%
Priority + Reserve List ($ 151 mil.)			
Upper Molonglo	**Options: 3**	**CAPEX: $5,115,000**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	134	106,174	673
Proportion of pollutant reduction in catchment	3.7%	4.8%	2.0%

Note: The pollutant generation rate and base case of pollutants are given to show the relative difference in catchment processes

Map 7: Upper Molonglo catchment- priority and reserve options

Table 13: Upper Molonglo catchment priority and reserve options - financial, performance management and cost effectiveness of pollutant reduction

Project Description	MCA	CAPEX	Renewal	OPEX $/yr	TP kg/yr	TSS kg/yr	TN kg/yr	Life cycle cost ($) 20 years
Priority								
Proj. No.5—UM004: Upper Molonglo (Queanbeyan, Reserve north of Margaret Donoghoe Park) Two Bioretention sections -one within a roundabout, another on adjacent open space (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation & filter media).	1.7	$1,509,000	$310,186	$36,648	69	48,600	440	$1,966,777
Proj. No.15—UM015: Upper Molonglo (Riverside Reserve Morisset St, Queanbeyan) Wetland (physical & biological trapping of sediments & nutrients). Increased recreation diversity.	1.3	$1,868,000	$118,150	$13,280	36	25,000	220	$2,008,691
Reserve								
Proj. No.48—UM001: Upper Molonglo (Molonglo River corridoor Oaks Estate to Kowen Forest) Stock fencing, revegation & weed control (halting of direct erosion and sediment delivery to river).	0.3	$1,738,000	$0	$114,534	29	32,574	13	$2,951,377
Priority + Reserve Total		**$5,115,000**	**$428,336**	**$164,463**	**134**	**106174**	**673**	**$6,926,845**

3.1.5 West Belconnen

Catchment overview

The West Belconnen catchment area is approximately 14,700ha and is located in the north-west of the ACT. A significant portion of the catchment lies in NSW. The catchment is relatively undeveloped with 51% of the area classified as grazing pasture, 20% defined as rural residential and farm infrastructure, and only 18% as intensive urban area (AECOM 2015a). The catchment houses a number of residential suburbs (Hall, Dunlop, Charnwood, MacGregor, Spence, Evatt, Fraser, Flynn, Florey, Scullin, and Higgins) that drain, with minimal treatment, to the Murrumbidgee River via Ginninderra Creek.

The rural areas in the north of the catchment, predominantly in NSW are likely to pose sediment water quality challenges. Runoff from urbanised area is more likely to have nutrient pollutant challenges due to changes in imperviousness caused by urbanisation.

Given the age mix of the suburb there is a variety of stormwater management approaches, these range from engineered systems similar to those in the Yarralumla catchment through to current 'best practice' WSUD standards (i.e. West Macgregor).

AECOM (2015a) notes that key issues for the catchment are:

- the reliance on Ginninderra Creek to improve water quality before entering the Murrumbidgee River
- the inability to control the quality of water received from adjoining NSWs rural areas.

Ginninderra Creek downstream of Lake Ginninderra

There is a strong community preference for the inclusion of wetlands due to the nature of existing sites and the aesthetic benefit associated with providing open water (AECOM 2015a).

ACEOM (2015a) suggests that, given the relatively developed nature of the catchment, proposed treatment options should be focused on retrofitting of the established catchment with water quality improvement infrastructure.

In the West Belconnen catchment, major contributors to the current water quality condition are considered the large rural/grazing areas and the established urban areas in the catchment. Given the developed nature of the downstream portion of the catchment, the placement and sizing of options is considered to be limited by the amount of available space, where the topography was favourable, and where nearby infrastructure or community needs aligned to provide an opportunity. Where possible, options were identified along existing drainage paths to maximise their treatment potential.

Priority and reserve infrastructure options

Wetland systems and ponds ranked highly in this catchment due to the large area available for positioning and the need to reduce hydraulic load.

Map 8 shows the location of the priority and reserve options.

Table 14 provides a summary of asset performance (nutrient and sediment removal) against the base case for the catchment. Table 15 lists the specific projects (priority and reserve) along with asset performance and financials (CAPEX, OPEX and renewal cost, cost effectiveness).

Concept designs for these sites are at Appendix 7.

The report produced by AECOM for the ACT Government is at Appendix 13. The MCA report is at Appendix 9.

Table 14: Pollutant reduction of options for the West Belconnen catchment

West Belconnen	TP	TSS	TN
Annual pollutant generation rate [Kg/Ha/Yr]	0.08	402.70	6.50
Base case [Kg/Yr]	11,400	5,920,000	95,500
Priority List ($79 mil.)			
West Belconnen	**Options: 2**	**CAPEX: $6,530,000**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	158	112,300	804
Proportion of pollutant reduction in catchment	1.4%	1.9%	0.8%
Priority + Reserve List ($ 151 mil.)			
West Belconnen	**Options: 5**	**CAPEX: $14,040,000**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	350	236,300	1,804
Proportion of pollutant reduction in catchment	3.1%	4.0%	1.9%

Note: The pollutant generation rate and base case of pollutants are given to show the relative difference in catchment processes

Map 8: West Belconnen catchment - priority and reserve options

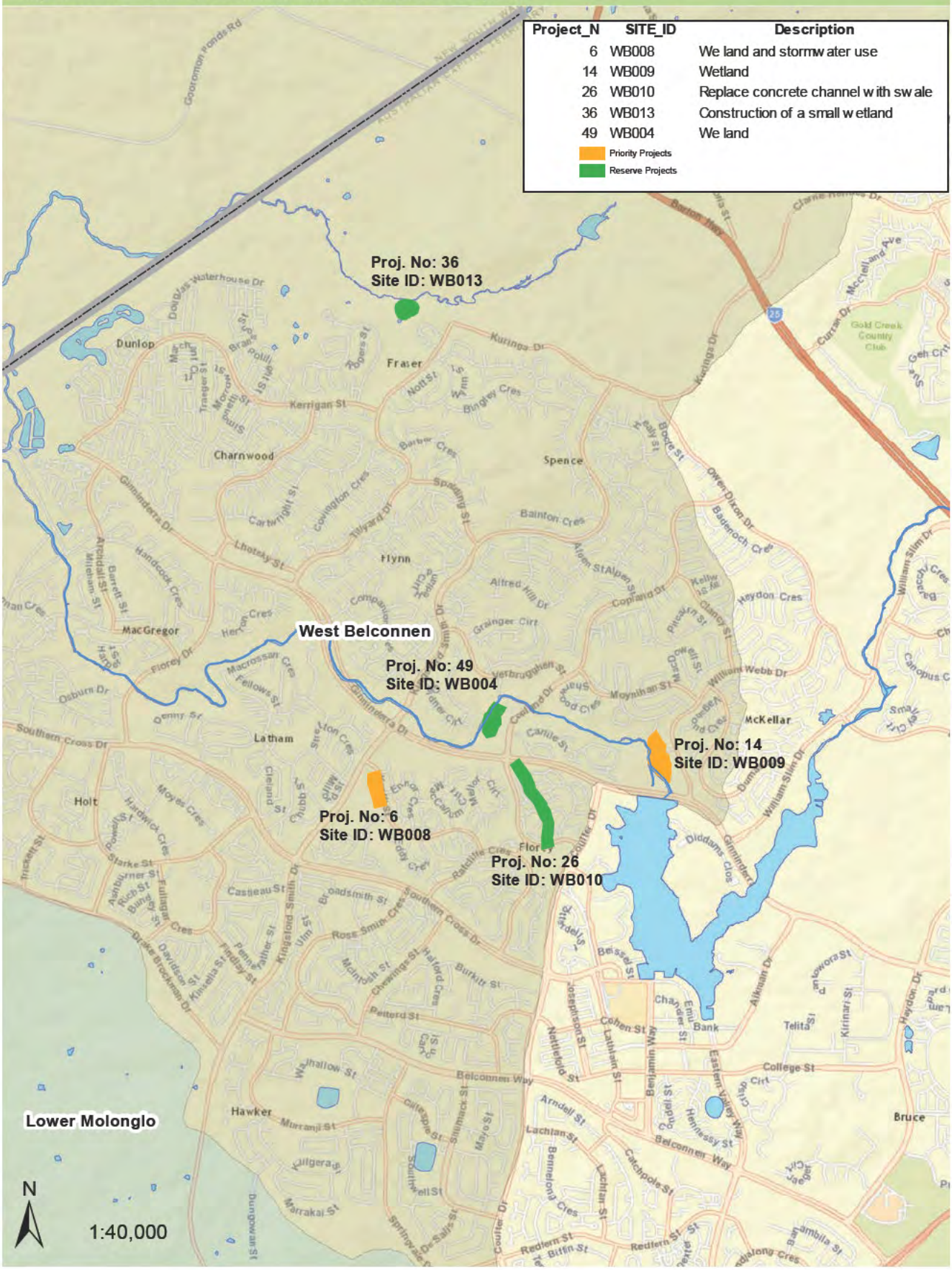


Table 15: West Belconnen catchment priority and reserve options - financial, performance management and cost effectiveness of pollutant reduction

Project Description	MCA	CAPEX	Renewal	OPEX $/yr	TP kg/yr	TSS kg/yr	TN kg/yr	Life cycle cost ($) 20 yrs
Priority								
Proj. No.6—WB008: West Belconnen (Latham, Kingsford Smith Dr / St Francis Xavier College) Wetland & reuse (physical & biological trapping of sediments & nutrients reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	1.6	$2,930,000	$200,000	$12,800	80	40,000	400	$3,117,287
Proj. No.14—WB009: West Belconnen (Downstream of Ginninderra Dam) Wetland treating low flows from open channel under Ginninderra Dr (physical & biological trapping of sediments & nutrients).	1.5	$3,600,000	$290,000	$15,700	78	72,300	404	$3,841,268
Reserve								
Proj. No.49—WB004: Propsoed offline wetland along Ginninderra Creek near Copland Drive.	1.6	$5,200,000	$0	$21,900	99	64,800	480	$5,517,287
Proj. No.26—WB010: West Belconnen (Tattersalls Cres, Florey) Channel naturalisation (slower water velocities, trapping and uptake of sediments & nutrients in vegetation). Enhanced recreation & amenity zone.	1.3	$240,000	$0	$5,300	54	37,300	290	$296,148
Proj. No.36—WB013: West Belconnen (Shakespeare Cres, Fraser Grassland adjacent to Halls Ck) Wetland (physical and biological trapping of sediments & nutrients).	0.9	$2,070,000	$167,000	$9,400	39	21,900	230	$2,212,740
Priority + Reserve Total		**$14,040,000**	**$657,000**	**$65,100**	**350**	**236300**	**1804**	**$14,984,730**

3.1.6 Fyshwick

Catchment overview

The Fyshwick catchment is approximately 8600ha. It is a mixed land use catchment of predominantly grazing pasture (56%) with 30% of the area also defined as intensive urban. This includes industrial and commercial areas (Fyshwick, Hume, Symonston, Narrabundah, Oaks Estate, Beard, East Lake and a part of the Kingston Foreshore) downstream of the Jerrabomberra Wetlands and upstream of the confluence with the Molonglo River (AECOM 2015b).

AECOM2015b notes that no purpose built water quality management wetlands exist within the catchment. They identify key issues for the catchment as:

- industrial runoff from Fyshwick and Hume into Jerrabomberra Creek and the Molonglo River
- the potential for large sediment loads coming from the upper part of the Jerrabomberra catchment entering Lake Burley Griffin
- discharge of treated effluent from the Queanbeyan Sewage Plant into the Molonglo River
- accelerated delivery of sediment and nutrient from urban areas into the Molonglo River
- proposed and current urban development located upstream in the Jerrabomberra headwaters catchment will likely change the flow regime along Jerrabomberra Creek- this will impact on flows and erosion in the Jerrabomberra Creek.

There is a strong community preference for waterway naturalisation and revegetation options. The community was more focused on creek health compared with the construction of wetlands and water bodies in the catchments (AECOM 2015b).

Molonglo River and Jerrabomberra Creek flowing through the wetlands into Lake Burley Griffin

AECOM (2015b) suggests that further to the longer term approach detailed above, focus should be given to:

- opportunities for retrofitting the catchment with water quality interventions – these were considered most promising along the Jerrabomberra Creek where open space was available (this options would treat low flows and have relatively high hydraulic loading)
- managing livestock and their interaction with the waterways
- revegetating portions of Jerrabomberra Creek as this would also minimise stock access and resultant problems to the waterways
- a review of practices and behaviours of industrial groups operating in Fyshwick and the other industrial areas.

Priority and reserve infrastructure options

Retrofitting the catchment with water quality interventions was most promising along Jerrabomberra Creek where the open space was available to implement treatment options that would constantly treat low flows and have relatively high hydraulic loading.

Constructed wetland options targeting the Fyshwick industrial runoff have not ranked highly, as the sites only provide treatment during rainfall events due to the impervious nature of the catchment and subsequent lack of baseflow.

Map 9 shows the location of the priority and reserve options.

Table 16 shows the nature of pollutant generation in Fyshwick and provides a summary (in terms of nutrient and sediment removal) of asset performance. Table 17 lists the specific projects (priority and reserve) along with asset performance and financials (CAPEX, OPEX and renewal cost, cost effectiveness).

Concept designs for these sites are at Appendix 7.

The report produced by AECOM for the ACT Government is at Appendix 14. The MCA report is at Appendix 9.

Table 16: Pollutant reduction of options for the Fyshwick catchment

Fyshwick	TP	TSS	TN
Annual pollutant generation rate [Kg/Ha/Yr]	1.00	518.60	6.80
Base case [Kg/Yr]	8,250	4,460,000	58,200
Priority List ($79 mil.)			
Fyshwick	**Options: 6**	**CAPEX:$15,883,960**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	2,630	1,755,100	9,797
Proportion of pollutant reduction in catchment	31.9%	39.4%	16.
Priority + Reserve List ($ 151 mil.)			
Fyshwick	**7**	**CAPEX: $27,203,621**	
	TP	**TSS**	**TN**
Reduction of pollutants [Kg/Yr]	2,760	1,825,100	10,697
Proportion of pollutant reduction in catchment	33.5%	40.9%	18.4%

Note: The pollutant generation rate and base case of pollutants are given to show the relative difference in catchment processes

Map 9: Fyshwick catchment - priority and reserve options

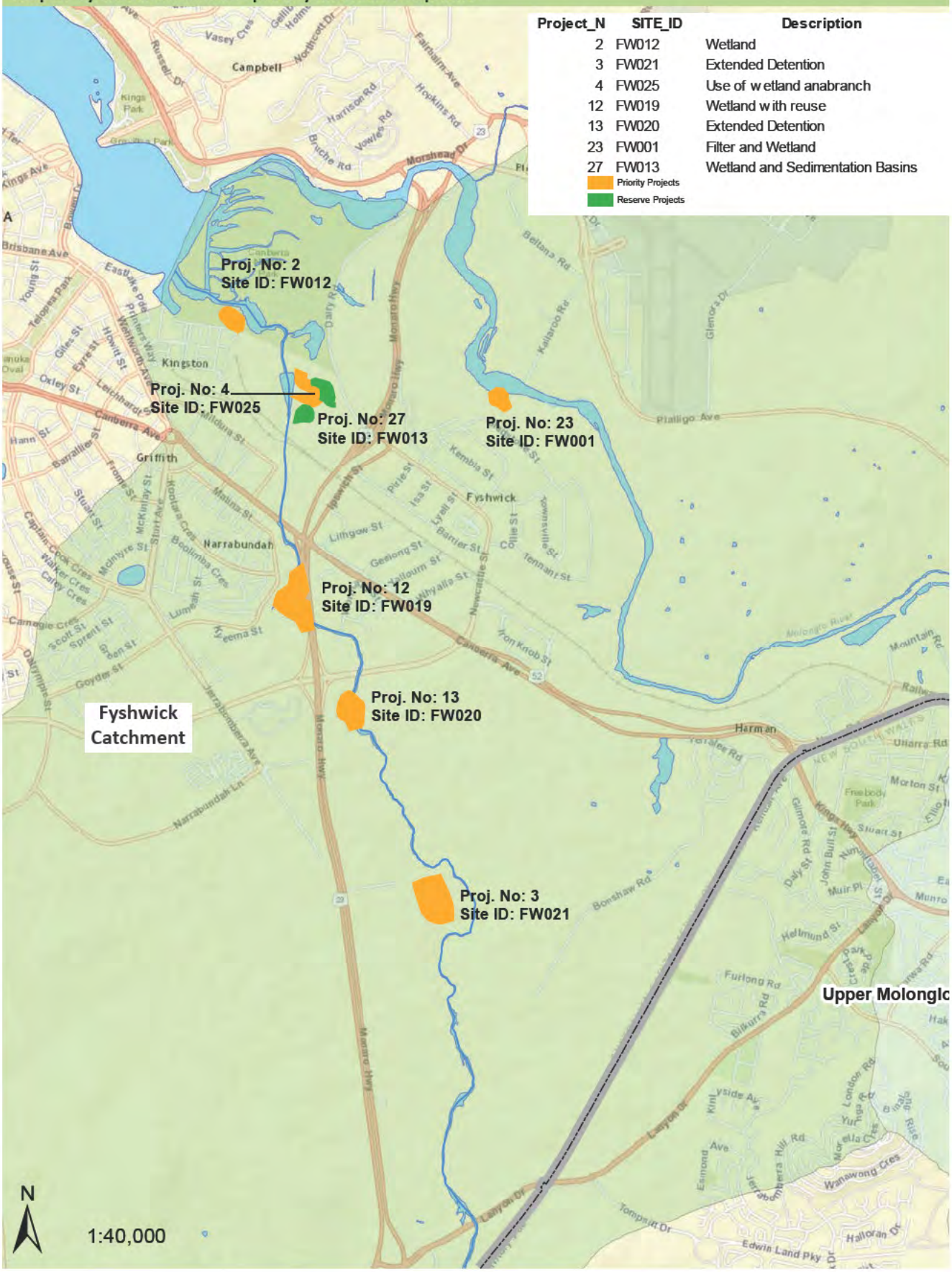


Table 17: Fyshwick catchment priority and reserve options - financial, performance management and cost effectiveness of pollutant reduction

Project Description	MCA	CAPEX	Renewal	OPEX $/yr	TP kg/yr	TSS kg/yr	TN kg/yr	Life cycle cost ($) 20 yrs
Priority								
Proj. No.23—FW001: Fyshwick (Gladstone Street and Molonglo River) Wetland (physical & biological trapping of sediments, nutrients, metals and hydrocarbons from industrial stormwater).	0.7	$2,423,421	$206,000	$10,800	40	23,100	297	$2,591,071
Proj. No.2—FW012: Fyshwick (Eastlake/Causeway) Wetland (physical and biological trapping of sediments and nutrients) Adjacent to Jerrabomberra Creek links with Jerrabomberra wetlands.	1.8	$2,148,467	$194,000	$9,700	170	100,000	800	$2,301,362
Proj. No.12—FW019: Fyshwick (between Matina Street, Narrabundah and Monaro Highway) Wetland with reuse (physical and biological trapping of sediments and nutrients- reuse offsets alteration of hydrograph by urban impervious areas and puts nutrients back on landscape).	1.5	$10,972,700	$0	$43,900	670	430,000	2,000	$11,669,321
Proj. No.13—FW020: Fyshwick (Corner of Monaro Highway and Hindmarsh Drive) Modification of existing offline pond with low flow diversion to treat more catchment flows (physical trapping of sediments).	1.5	$112,869	$560,000	$3,200	730	512,000	2,400	$291,484
Proj. No.3—FW021: Fyshwick (Monaro Highway Jerrabomberra Creek downstream of ACT Jail) Modification of existing offline pond with a low flow diversion to treat more catchment flows (physical trapping of sediments).	1.7	$150,707	$1,790,000	$3,200	950	650,000	3,800	$647,178
Proj. No.4—FW025: Fyshwick (Jerrabomberra wetlands/Eastlake) Diverting low flows from the existing silt trap to the Jerrabomberra anabranch wetland area (low flows treated by more biological processes removing nutrients without resuspension during high flows) enhancement of wetland complex.	1.7	$75,796	$0	$3,200	70	40,000	500	$109,697
Proj. No.27—FW013: Fyshwick (Eastlake, Jerrabomberra creek silt trap and anabranch) Modification of pond and old creek channel to wetland and bioretention system (extended detention of runoff then multiple treatment processes, nutrient & sediment removal through the vegetation and filter media).	1.5	$11,319,661	$850,000	$45,300	130	70,000	900	$12,019,226
Priority + Reserve Total		**$27,203,621**	**$3,600,000**	**$119,300**	**2760**	**1825100**	**10697**	**$29,629,339**

3.1.7 In-lake research

Lake Tuggeranong and Jerrabomberra Wetlands will be part of a three year cross-catchment research project. The project is included as part of the BPP to improve understanding of treatment options including a trial of sediment curtains and bubblers in Lake Tuggeranong, and an earth bank to control wetland wetting and drying regime for carp control at Jerrabomberra Wetlands. The project has an estimated implementation cost of $850,000. Community feedback from the Lake Tuggeranong and Jerrabomberra catchment supported this work.

The outcomes from these research projects are not fully captured in the catchment treatment train assessment criteria and modelling. Research is fundamental to understanding pollutant removal processes of in-lake options.

3.2 Benchmarking

As part of the business case and due diligence criteria for Phase 2, the ACT Government has been asked to determine the value for money of the projects. Specifically the ACT Government has been asked to show:

Projects must have a suitable dollar / pollutant-reduction benchmark against similar Australian projects and represent cost-effective and time-effective strategies for achieving water quality improvements.

A benchmarking exercise has undertaken by Alluvium (2015e) to determine the dollar: pollutant-reduction for the proposed projects.

3.2.1 Benchmarking pollution reduction of WSUD projects

A dollar / pollutant- removal benchmark requires specific information on a given project including:

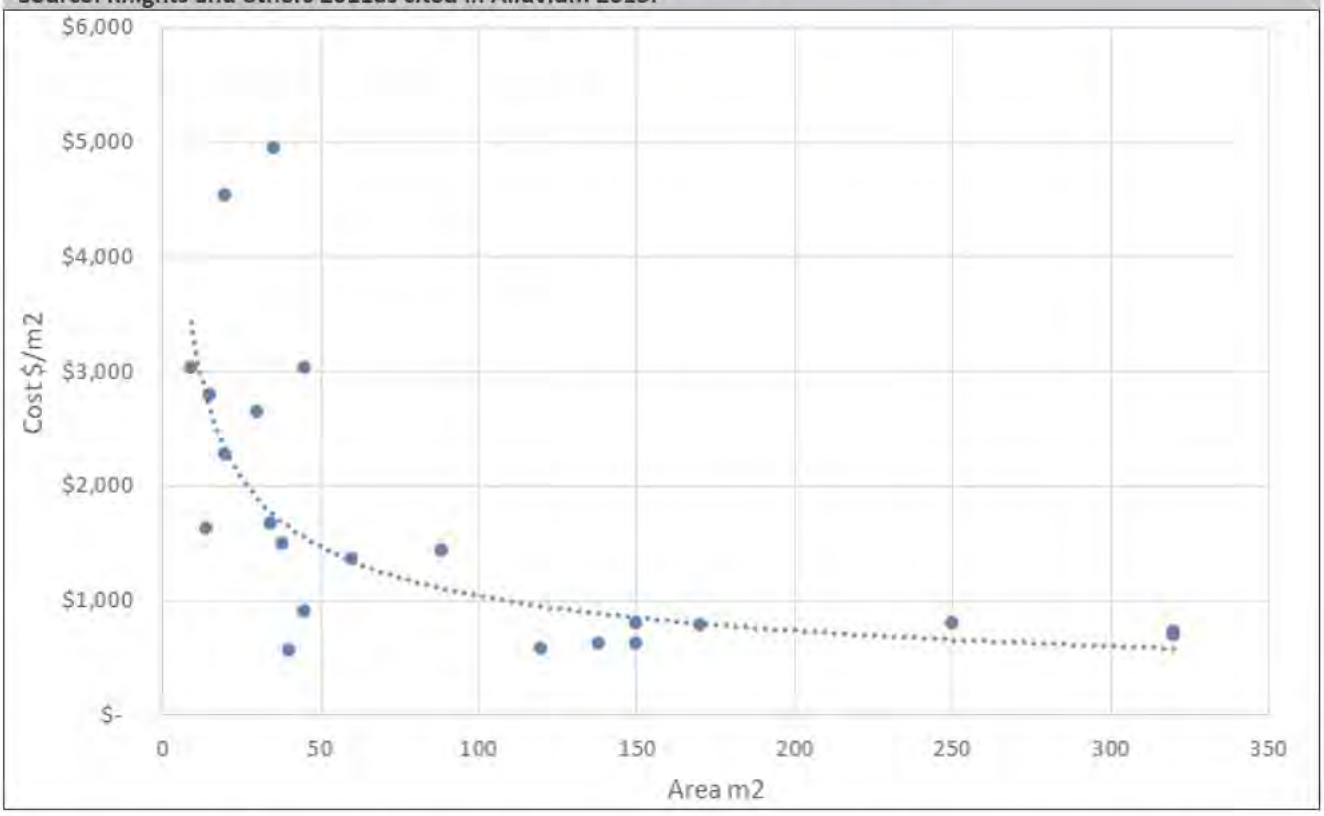
- type of treatment system (e.g. wetland, bio-retention system, pond etc)
- size of treatment system
- capital cost of treatment system (CAPEX and OPEX)
- pollutant removal of the treatment system.

Benchmarking of treatment systems needs to consider the following:

- type of treatment system – due to varying treatment performances of stormwater treatment
- systems- any benchmarking of projects should compare similar treatment types.
- context of the treatment system proposed – specifically to identify whether the treatment system is in a greenfield area or is an infill or retrofit situation. Many of the costs of stormwater treatment systems in greenfield areas can be integrated into the development as a component of the civil works (roads and drainage), and the stormwater treatment element is delivered as an element of the civil works. This means that:
  - there is limited need for diversions to address level changes across the site, and
  - some of the costs of the treatment systems such as planting, drainage and soils would be required as part of the development, which make the standalone cost of the treatment element often less expensive than in retrofit situations.
- size of the treatment system – there are economies of scale in the construction of treatment systems, with larger systems costing less per m^2 than smaller systems. Alluvium (2015e) indicates that Knights and others (2011) showed that small streetscape bio-retention systems typically cost two to four times as much as larger systems (greater than 100 m^2). Larger bio-retention systems show much less variation in cost, being typically $500 to $750/$m^2$ of treatment area (Figure 2).
- key pollutant for benchmarking – most stormwater treatment systems are designed to remove TN, TP, TSS and gross pollutants. The process used by treatment systems to remove these pollutants can also remove other pollutants such as heavy metals and hydrocarbons. Typically total nitrogen is used as a surrogate for all pollutant removal as it is the limiting pollutant. This means that once you get to a target level of total

nitrogen removal, the treatment system also will be removing other pollutant loads to best practice targets, and the relativity of these pollutant removals is typically consistent. For example, the ACT WSUD Code sets best practice targets of 40% reduction of total nitrogen, 45% reduction in total phosphorus and 60% reduction in total suspended solids. Once the target removal of 40% reduction for total nitrogen is met, the other pollutant targets are also met.

Figure 2: Capital cost of bio-retention systems in Sydney (Knights and others 2011)
Source: Knights and others 2011as cited in Alluvium 2015f



Based on the above discussion the benchmarking of dollar / pollutant-reduction against similar Australian projects will include:

- comparison of similar treatment types, bioretention systems are compared against other bioretention systems, and wetlands against other wetland systems.
- using treatment systems in retrofit situations, not greenfield.
- using systems that are over 100m^2 in size.
- using total nitrogen as the key pollutant indicator.

3.2.2 Data sources of appropriate information for benchmarking

The data required for benchmarking treatment systems would include at a minimum- type: size, capital cost, and pollutant removal of the treatment system.

There is no common database or repository of information for benchmarking the performance of stormwater treatment systems. Stormwater treatment case studies on regional capacity building do exist (e.g websites such as Clearwater in Melbourne and Water by Design in South East Queensland) however these projects are often missing one of more of the data requirements, typically the pollutant removal of the treatment system.

Alluvium (2015f) notes that Knights and others (2011) identify a key barrier to further stormwater treatment implementation (in existing developed areas) is lack of good quality and easily accessible data on construction costs.

To address this gap two sources of information were used in this benchmarking exercise:

- Melbourne Water's stormwater offset scheme which benchmarks the cost to Melbourne Water of building large wetland treatment systems.
- project examples in Sydney of large scale (>100m²) bio-retention systems for a variety of sources, including online case studies, consultant records and technical papers (Knights and others (2011) as cited in Alluvium 2015f).

3.2.3 Melbourne Water stormwater offset (wetlands)

In Melbourne, a stormwater offset contribution can be paid by developers. This offset allows developers to pay an offset rather than undertake the works on-site, to reduce the impacts of stormwater pollution from urban developments (Melbourne Water 2015 as cited in Alluvium (2015f)).

Nitrogen is the currency for the Stormwater Offsets Program as it's typically the limiting pollutant. If nitrogen targets are achieved, then phosphorus and suspended solids objectives are also achieved.

Alluvium (2015f) notes that the cost of offsite nitrogen treatment was calculated in 2014 at $6,645/kg TN (per kilogram of annual total nitrogen load). This rate is based on Melbourne Waters cost to construct large stormwater treatment wetlands, as outlined in Table 18.

Alluvium (2015f) indicates that with these funds Melbourne Water oversees and/or undertakes the construction of the following wetland systems:

- about 5-8 per year of greenfield scheme wetlands funded by developers that become Melbourne Water assets.
- about 2-3 times as many greenfield scheme wetlands funded by developers that become Council assets.
- about 2 Melbourne Water wetlands per year funded by capital delivery.

Table 18: Treatment systems used to determine the Melbourne Water Offsets

Treatment System	Approx. Size (m²)	Capital Cost
Hallam Valley	150,000	$19,000,000
Braeside South	40,000	$6,000,000
Westfield Reserve, Fairfield	7,000	$1,300,000
Clayton South Wetlands	2,300	$7,360,000

Source: Alluvium (2014) as cited in Alluvium (2015f)

Data mining for bio-retention systems

A range of projects have been identified in a variety of sources, including online case studies, consultant records and technical papers (Knights and others (2011) as cited in Alluvium 2015f).

Eleven projects are summarised in Table 19, varying in size from 125m² to 3,000m². The average cost of nitrogen removal for these systems is $4,800/kg TN.

Table 19: Treatment systems used to determine the Sydney Water Offsets

Location	Treatment Size (m^2)	Capital Cost	TN Removal (kg/yr)	$/kg TN	$/$m^2$ treatment
Suburban Sydney	2,400	$1,500,000	520	$2,885	$625
Suburban Sydney	840	$1,000,000	170	$5,882	$1,190
Regional CBD Sydney	380	$500,000	89	$5,618	$1,316
Regional CBD Sydney	300	$160,000	70	$2,286	$533
Regional CBD Sydney	250	$150,000	50	$3,000	$600
Regional CBD Sydney	125	$145,000	40	$3,625	$1,160
Regional CBD Sydney	200	$400,000	45	$8,889	$2,000
Suburban Sydney	837	$1,000,000	160	$6,250	$1,195
Inner City Sydney	250	$580,000	55	$10,545	$2,320
Inner City Sydney	3,000	$900,000	563	$1,599	$300
Inner City Sydney	2,000	$1,000,000	440	$2,273	$500
Average				**$4,800**	**$1,050**

Source: Alluvium (2014) as cited in Alluvium (2015f)

Mandang Beach, Lake Tuggeranong closed to primary contact activities, due to poor water quality

Benchmark of proposed options

Benchmarking of the priority wetland and bio-retention system projects was undertaken against the two methods outlined above. It should be noted that the proposed Phase 2 options projects include a 40% contingency, which may inflate the actual capital cost.

Priority wetland treatment systems

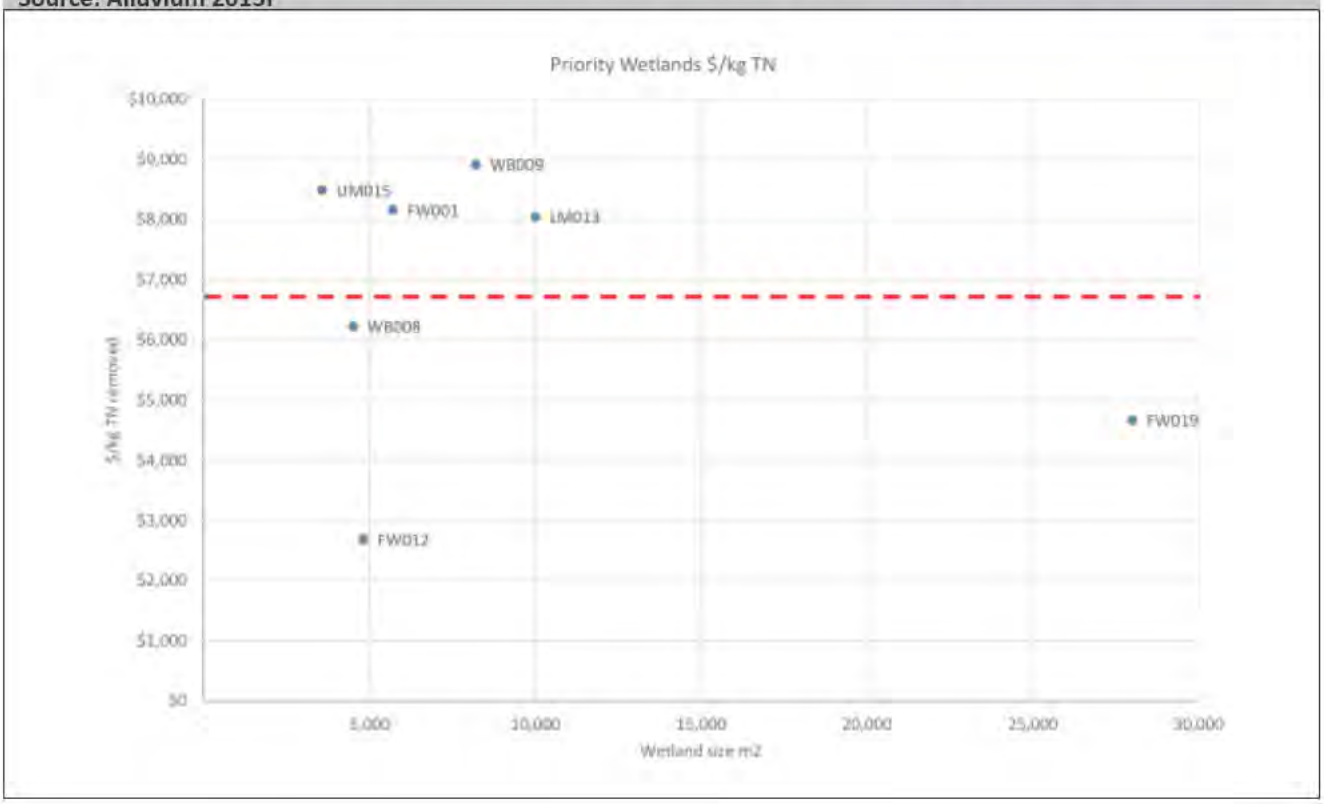
There are seven priority wetland sites as identified in Table 20 and Figure 3. These sites have an average cost of removal of TN of $6,740/kg TN. This is similar to the Melbourne Water offsite calculated at $6,645/kg.

Table 20: Priority wetland sites proposed in Phase 2

Site ID	Treatment Size	MCA Score	Cap Ex	TN Removal kg/year	$/kg TN	$/m² treatment
FW001	5,700	0.8	$2,423,421	297	$8,160	$425
FW012	4,810	1.8	$2,148,467	800	$2,686	$447
FW019	28,000	1.5	$9,326,795	2,000	$4,663	$333
LM013	10,000	1.4	$9,649,000	1,200	$8,041	$965
UM015	3,570	1.4	$1,868,000	220	$8,491	$523
WB008	4,500	1.6	$2,490,500	400	$6,226	$553
WB009	8,200	1.4	$3,600,000	404	$8,911	$439
Average					**$6,740**	**$527**

Source: Alluvium (2014) as cited in Alluvium (2015f)

Figure 3: $/TN removal of priority wetland systems proposed in Phase 2 (benchmark shown as dashed line)
Source: Alluvium 2015f



Priority bio-retention treatment systems

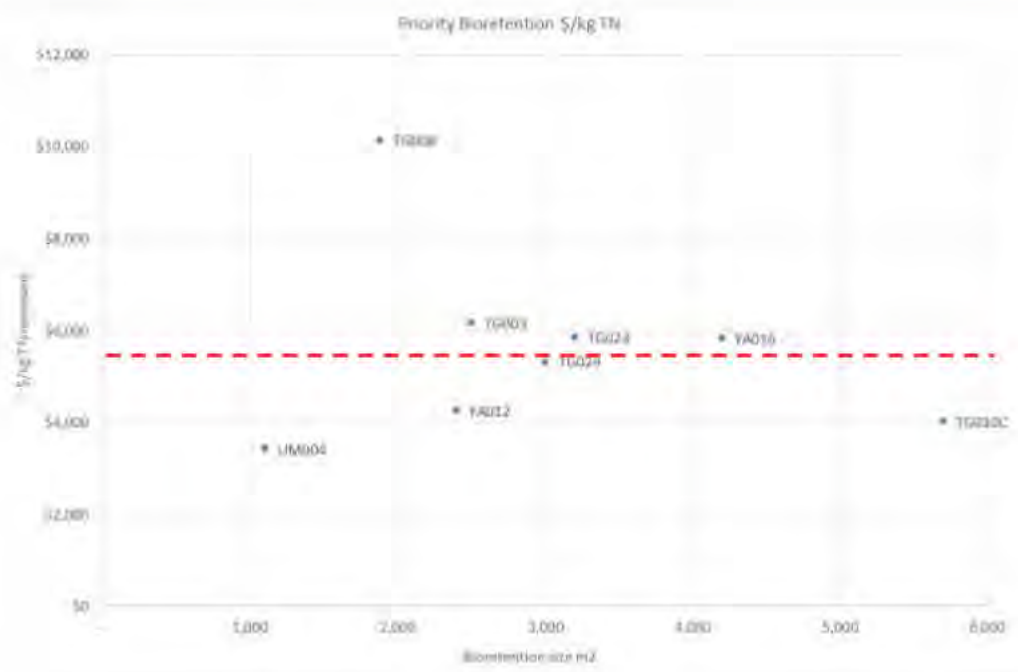
There are eight priority bio-retention sites as identified in Table 21 and Figure 4. These sites have an average cost of removal of TN of $5,630/kg TN. This is slightly more than the Sydney examples of $4,800/kg.

Table 21: Priority bio-retention sites proposed in Phase 2

Site ID	Treatment Size	Cap Ex	TN Removal kg/year	$/kg TN	$/m² treatment
TG003	2,500	$3,305,000	536	$6,166	$1,322
TG008	1,880	$3,731,000	368	$10,139	$1,985
TG010C	5,700	$5,752,000	1,430	$4,022	$1,009
TG023	3,200	$4,171,000	712	$5,858	$1,303
TG029	3,000	$2,625,000	493	$5,325	$875
UM004	1,100	$1,509,000	440	$3,430	$1,372
YA012	2,400	$2,235,000	524	$4,265	$931
YA016	4,200	$3,484,000	598	$5,826	$830
				$5,630	**$1,203**

Source: Alluvium (2014) as cited in Alluvium (2015f)

Figure 4: $/TN removal of bio-retention systems proposed in Phase 2 (benchmark shown as dashed line)
Source: Alluvium 2015f



This benchmarking exercise demonstrates that the proposed projects have dollar:pollutant-reduction comparable with major water quality infrastructure projects constructed in Australian capital cities.

The benchmarking exercise undertaken by Alluvium for the ACT Government is at Appendix 15.

3.3 Cost Benefit Analysis - Project Outcomes

As part of the business case and due diligence criteria for Phase 2, the ACT Government has been asked to determine the value for money – cost benefit of the projects. Specifically the ACT Government has been asked to show that the preferred projects demonstrate:

- a positive cost–benefit outcome compared with a no-change option
- a range of social benefits such as improved aesthetics, health related benefits, and improved tourist, commercial and recreational outcomes.

3.3.1 Approach and methodology

Based on the results of the MCA, EPD and other stakeholders completed a process to select the highest priority individual treatment options for inclusion in the CBA assessment. This resulted in two scenarios that combine a number of individual options. The cost benefit analysis (CBA) considered each scenario as 'discrete' incorporating total costs and benefits of the collective interventions therein, compared to a base case of 'do nothing'.

The CBA is undertaken at the scenario level because: the MCA previously considered the individual options (at a site level); it is impractical to assess dozens of individual options in a CBA; and most importantly, because the system-wide benefits of the scenarios are greater than the sum of the benefits at the individual treatment option level (e.g. the reduced incidence of algal blooms that is only realised where multiple options are constructed).

- Scenario A contains 24 options distributed across all catchments, with a greater proportion of options in Tuggeranong, Fyshwick and Yarralumla.
- Scenario B includes all options from Scenario A, plus an additional 24 options across all catchments.

This mix of options will give the highest pollutant reductions and the highest possible CBR.

Consistent with Commonwealth guidance, this CBA has been prepared using a 7% real social discount rate over 40 years of analysis. The sensitivity analysis includes tests at different discount rates, as is common practice in CBA.

All prices used for costs and benefits in the discounted cash flow analysis are in 2015 dollars. Residual values are incorporated and calculated as the discounted value of the future stream of expected benefits from year 2055.

The base case reflected assumptions about what the future may hold given a scenario of no BPP investment. This included assuming that blue green algae events and lake closures would worsen over time, pollutant loads to waterways would increase, and current regulatory and institutional arrangements would remain in place.

Gross pollutant trap with decaying algal bloom

3.3.2 Project costs and benefits

The main cost and benefit items that were considered as part of the CBA process can be summarised as:

- Costs – Capital construction costs; annual operating and maintenance costs; and decommissioning or renewal costs, associated with the individual treatment train options.
- Benefits – The benefits of the scenarios have been quantified with respect to:
  - » water quality improvements associated with water flowing to the Murrumbidgee River
    - » valued using an avoided treatment cost method, with three different valuations provided based on different treatment types in different locations (due to uncertainty and different contexts from which the values were derived).
    - » this approach was taken due to an absence of information required to implement a willingness to pay methodology associated with environmental or other improvements downstream
  - » improved recreational use of Lake Burley Griffin and Lake Tuggeranong associated with a reduced incidence of algal blooms, including:
    - » water-based activities (e.g. swimming, windsurfing, canoeing, boating etc.)
    - » land-based activities (e.g. cycling, running, walking, picnics, BBQs, attending lakeshore events etc.)
  - » reduced potable water use associated with stormwater harvesting attached to individual treatment interventions
  - » reduced impacts on users of lake water for irrigation purposes associated with lake closures (ability to pump water due to algal outbreaks)
  - » reduced management costs for Lake Burley Griffin and Lake Tuggeranong associated with a reduced BGA bloom outbreaks
  - » improved amenity for residents in proximity to Lake Burley Griffin and Lake Tuggeranong associated with a reduced incidence and intensity of algal blooms
  - » improved amenity (measured as housing up-lift) associated with the catchment treatment train options themselves
  - » improved recreation (or similar) uses associated with the treatment option sites.

Collectively, the individual treatment options proposed under the two scenarios may also provide benefits in other areas. These were not quantified as part of the discounted cash flow analysis, but may include:

- amenity benefits proximate to Lake Burley Griffin and Lake Tuggeranong.
- catchment management actions or activities that control sources of pollutant loads.
- benefits to migratory and threatened species of birds.
- benefits associated with in stream water quality or flow rates (within the ACT) .
- flood mitigation benefits.
- public health benefits.
- ecosystem services provided by individual treatment interventions.

A discussion of costs and benefits detailed in Section 3 and 4 of the CBA (Appendix 16) undertaken by Aither.

3.3.3 Economic value and non-market valuation

Quantifying the cost inputs was more straightforward than the benefits. Notwithstanding the need for accurate estimates of operating costs of water quality treatment options into the future, capital and operating costs are relatively easy to estimate and quantify. This is because there are established markets and revealed prices for the cost items associated with building water treatment options, and substantial engineering experience in constructing them.

Benefits can be more challenging to quantify, and to monetise. This is especially the case with water and environmental related investments. Where the dollar estimates of environmental benefits are not available they have been quantified in non-monetary terms.

3.3.4 Comparison of benefits and costs

The benefit cost ratio (BCR) for the project has been assessed as 1.3, confirming that expected project benefits exceed costs. Sensitivity analysis on the discount rate and capital cost has also been undertaken and is detailed below. It is important that in considering the overall economic benefit of this project that the qualitative assessment of benefits are taking in to account as being additional to the BCR.

Sensitivity Analysis

Key parameters sensitivity tested include:

- the discount rate, which was tested at 3% and 10%
- capital costs, including a 15% reduction, and 30% increase in total capital costs.

These parameters were selected for testing based on their materiality for the results.

The analysis has used 7% as the core discount rate given Infrastructure Australia and other Commonwealth guidance on this matter.

Capital cost contingency

A 40% contingency allowance is included to cover costs that cannot be identified at the time of the estimate, but which are known to occur from past projects. It is therefore not appropriate to think of the contingency as an additional margin that arbitrarily uplifts the price; in all likelihood the final cost should be expected to align with the cost estimate including contingency.

However, cost estimates do vary as projects progress, by simple virtue of changing circumstances and additional information becoming available over time. This is the basis for setting asymmetric bounds for this sensitivity test at-15% and +30%.

Findings and results

The most substantial benefit area of the BPP (by value) is associated with water quality improvements downstream. Because these benefits were valued using a proxy measure (an avoided treatment cost method was used, rather than willingness to pay for explicit downstream benefits due to lack of information) results are presented using ranges, which reflect three different sets of avoided treatment cost values. These are:

- the marginal values for various treatments suitable within the ACT context to reduce nutrients (lower estimate)
- the estimated marginal operating costs of the Lower Molonglo Water Quality Control Centre to reduce nutrients
- a Victorian approach that calculates the marginal costs of nutrient abatement based on the lifecycle cost for building wetlands (higher estimate).

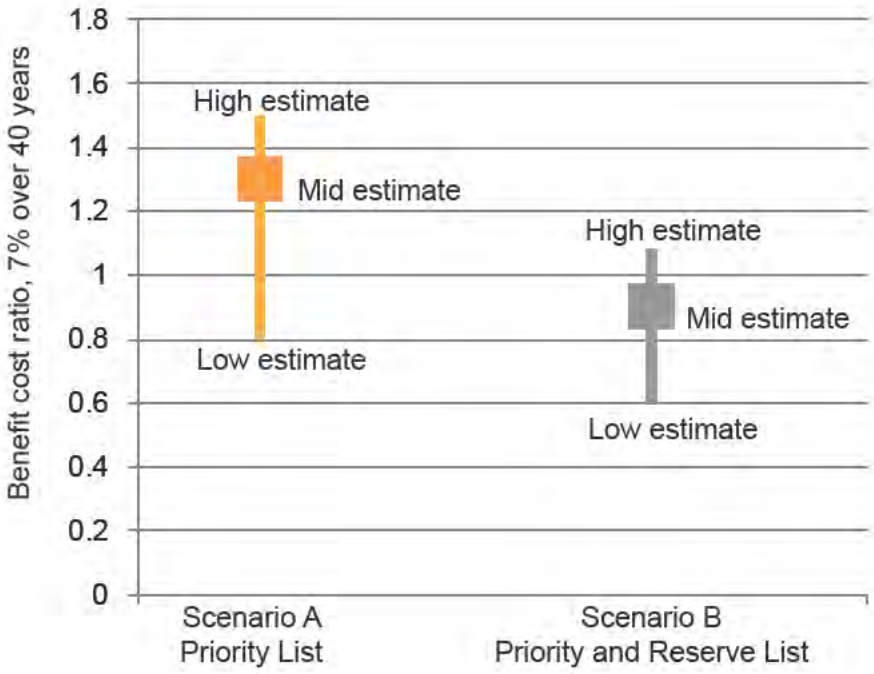
The results demonstrate that at a discount rate of seven per cent over a 40 year assessment, the median net present value (NPV) for Scenario A is 1.3 (Table 22 and Figure 5).

Table 22: Final benefit cost ratios

$, discounted at 7% over 40 years	Benefit Cost Ratio		
	Low estimate	Median estimate	High estimate
Benefits of Scenario A[1]	0.8	1.3	1.5
Benefits of Scenario B[2]	0.6	0.9	1.1

Note: 1: Priority list and 2: Priority and reserve list

Figure 5: Final benefit cost ratios



BPP Lower Molonglo Community consultations held in August 2015

4. Community and Stakeholder Engagement

Community and stakeholder consultations have been used to:

- raise awareness of the BPP and manage community and stakeholder expectations;
- inform and support the MCA process; and
- understand the role community groups, individuals and businesses can play in improving water quality, this includes understanding attitudes, values and behaviours in relation to waterways.

Consultation has been undertaken across government, with the BPP governance bodies (PAG – community and technical; and MCA expert panel) and broader community. Detailed information on consultation has been provided in Milestone Reports.

A survey was undertaken to explore attitudes, values and behaviour of ACT residents and NSW Local Government Areas regarding their use of waterways, lakes and wetlands and factors affecting water quality. The outcomes informed the MCA process and will assist in the development of a community awareness (education) and behavioural program (to be delivered as part of Phase 2) to improve the community's understanding and practices.

Consultation to be undertaken, as part of detailed design (Phase 2), will create opportunities for community and stakeholders to raise specific design issues and enable these to be appropriately addressed in the design process.

The following provides a summary of consultation activities undertaken as part of Phase 1.

Governance Bodies

The BBP Team facilitated meetings of the PAGs and MCA Expert Panel. These groups have guided the delivery of Phase 1 and have provided specific input at key stages of the Project. For example, input into the development of the MCA criteria and indicators, and endorsement of the final criteria and indicators. They have also acted as a conduit to raise awareness (and manage community expectations) of the BPP across member's individual areas of expertise.

In addition to these meetings Advisory Group members were engaged in the Project through individual and stakeholder meetings with consultants in the early stages of option identification. These meetings were successful and crucial to gaining community confidence in the assessment approach.

Cross directorate consultation, particularly with CMTEDD and TAMS has assisted with options identification, assessment and costing (capital, operation and maintenance).

Consultation – Specific to Prefeasibility Assessment, Treatment Option Identification and Assessment

Consultation was undertaken to provide the community and stakeholder with information about urban water quality treatment systems, the BPP, and to present the range of treatment options identified as possible in each catchment.

Consultation assisted in shaping the monitoring framework implemented across the six catchments and the identification of capital, and operation and maintenance costing formulas.

In determining treatment options, consultants held initial meetings with government stakeholders (including the Queanbeyan City Council) and community groups in each catchment to introduce the BPP and to identify any particularly favoured sites for stormwater treatment or any issues of particularly concern from the perspective of the stakeholder. The meetings also served to discuss the assessment approach: MCA and BCA.

Open house public consultation sessions were held across each of the catchments to allow the public to provide feedback on the water quality issues they were most concerned about and what they deemed to be the most important aspects of water quality management. The open house forums were supported by "e-Open Houses", with information provided on-line.

Participants at the open house sessions indicated which of the water quality treatment systems presented were their most and least preferred. They also commented on aspects of recreational use and amenity that may be gained or lost that they were most and least concerned about. Finally they provided feedback on their general level of support or otherwise for the water quality treatment options presented for the catchment.

There was strong support for the assessment approach and the range of intervention options identified within the catchments.

Community catchment reports detailing community's perceptions of the options presented at the open house sessions are available at: http://www.environment.act.gov.au/water/act-basin-priority-project

Consultation - Catchment Groups, Community Councils and Conservation Council

The BBP team has met frequently with catchment groups, community councils and the Conservation Council. The groups have been actively involved in the identification and assessment of treatment options.

Survey - Social Expectations of Water Use and Water Use Behaviour

The University of Canberra completed data collection for a survey (social expectations of ACT and region waterways) which explored attitudes, values and behaviours of ACT residents and NSW Local Government Areas (LGA) regarding their use of waterways, lakes and wetlands and factors affecting water quality. This reports is referred to as Schirmer (2015). The final report is due in early 2016. The following is a summary of the method and initial findings.

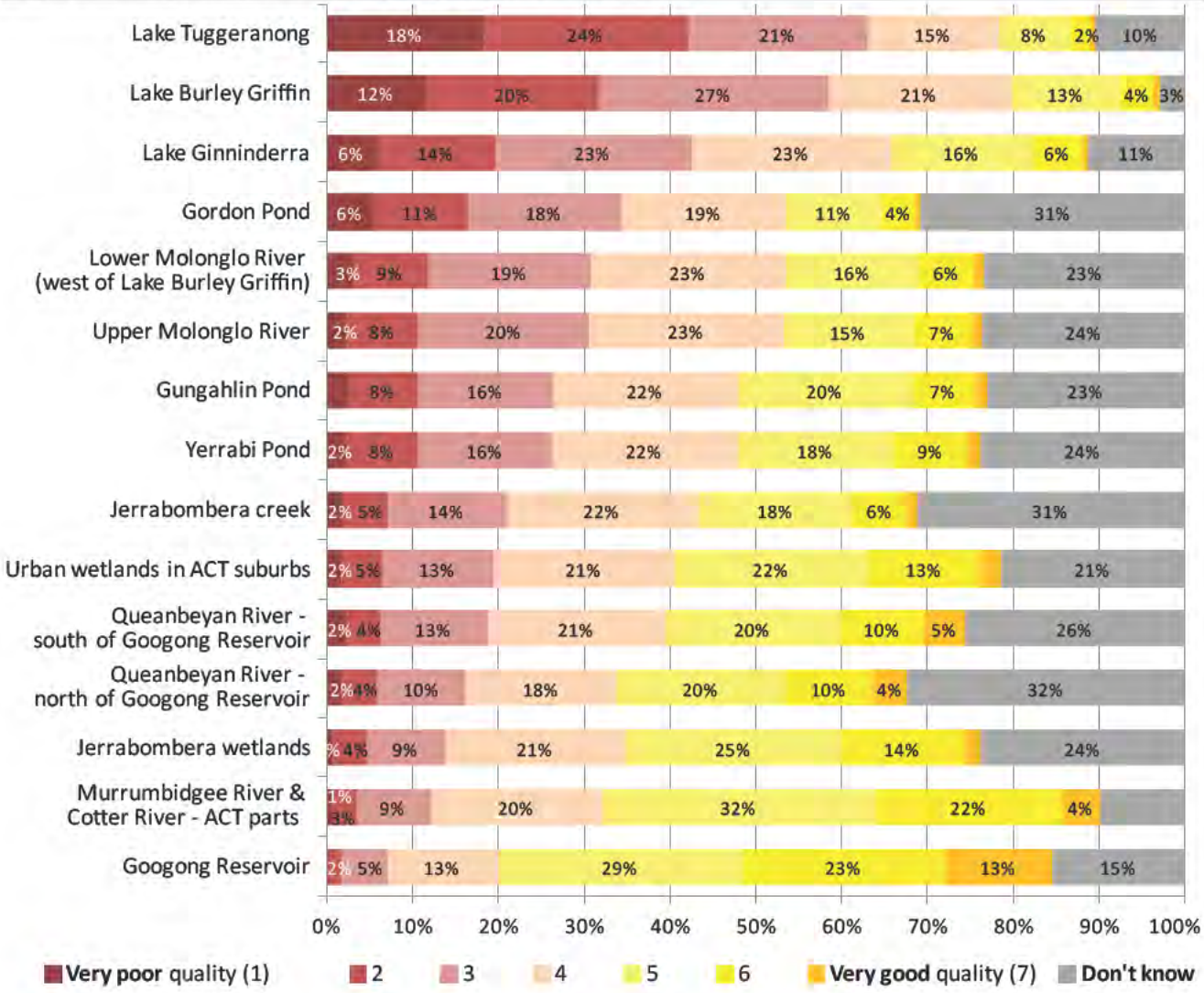
The survey was carried out on an internet-hosted platform. This ensured that the data collected included all the elements needed to inform the design of a behavioural change campaign, which included:

- demographic information (e.g. age, gender, education, income, occupation)
- type of dwelling (behaviours may differed for those living in houses versus units)
- geographic location (enabled comparison of behaviours of people living in different areas of the ACT)
- water interactions (e.g. living near a drainage line, visiting Lake Ginninderra, going to the Cotter) and purpose of these interactions (e.g. recreation, commuting)
- engagement in behaviours relevant to water quality (e.g. whether people swept up autumn leaves, how they disposed of dog droppings on walks, how they disposed of oil)
- awareness of water quality issues
- values regarding water quality and desired benefits from ACT's waterways.

BPP Upper Molonglo Community consultations held in August 2015

The survey target response of 3000 was substantially exceeded with a total of 4701 respondents (approximately 4200 complete and 500 partially completed but still useable surveys).

Figure 6: Perceptions of lake water quality, Source Schirmer (2015)



The gender distribution was representative – very close to the ACT's gender distribution. The age distribution exhibited a slight bias compared with the ACT's age distribution with younger age groups (especially the under 25s) underrepresented and older age groups (over 75-79s) overrepresented. The sample size allowed for an effective weighting of the data set, ensuring no one group was over (or under) represented in the final results.

Key messages emerging from the survey include:

- our waterways are well used and highly valued by the community
- most people rate water quality in Canberra's lakes as poor
- most people support actions to improve water quality
- awareness campaigns are required to change behavior.

In respect to water quality, Schirmer (2015) make the following preliminary findings:

- Poor water quality in lakes was one of the top three environmental problems in the ACT and region (feral animals and invasive weeds were the others), with concern for water quality in local lakes being greatest among residents of the Tuggeranong catchment.
- The top three causes of water quality problems were considered to be pollution from road traffic; erosion of stream banks; and soil/dirt entering waterways in established suburban areas.
- People most commonly believed that water quality problems are caused by blue green algae, pest fish and littering. Few were aware that quality problems result from leaf litter, runoff after rain or soil/dirt washing into waterways.

In respect to infrastructure, Schirmer (2015) notes that survey participants:

- Very strongly supported: provision of more drop-off points for hard rubbish; improvement to stormwater drains such as gross pollutant traps that feed into rivers and lakes; more planting of vegetation along waterways; establishment of new wetland areas to help filter stormwater; and greater use of rainwater tanks.
- Strongly supported: establishment of rain gardens, community education campaigns, increased use of mulching, and conversion of storm drains to more natural waterways.
- Moderately supported: Reducing use of fertiliser, pesticides and herbicides in suburban gardens or on rural properties, and more frequent street sweeping, were strongly supported by less than half of people, and opposed by around 10%, with the remaining 40-50% being either neutral, unsure, or weakly to moderately supporting. This indicates higher potential for these actions to have poor uptake or to be controversial.

Schirmer's final report is due in early 2016. A copy will be provided to the Commonwealth on receipt.

The BPP Team is confident that the scope of consultation and engagement has secured stakeholder and community support and confidence, of the approach taken in identification and prioritisation of options.

The survey results will help provide data and strategies on which to base an effective behaviour change campaign and have helped support decision making on infrastructure options identified within the six catchments.

It is anticipated the community awareness and behavioural change campaign will be delivered in late 2016. The program will focus on reducing the pollutant load from the household demographics that are able to be targeted according to the outputs of the survey.

A range of options are being considered to promote behavioural change and raise awareness of the impacts of household activities on water quality. More detailed information on the scope will be provided as part of the Phase 2 communications plan.

Further, the ACT is working with its regional partners to develop an integrated catchment management strategy (referred to as a catchment management master plan in the initial ACT businesses case). The ACT and Region Catchment Management Strategy will set out the principles for governance and the key influences that will affect the catchment over the next 25 to 30 years.

The catchment includes the land governed by the National Capital Authority, the ACT Government, and the NSW Government (South East Local Land Services) including the NSW local councils of Cooma-Monaro Shire, Palerang, Queanbeyan and Yass Valley Councils. Icon Water and the Upper Murrumbidgee Catchment Coordinating Committee are also part of this governance structure. Collectively they form the ACT and Region Catchment Management Coordination Group who oversee the Catchment Strategy.

The Strategy establishes the collective commitment to strengthen collaboration between all stakeholders and their organisations, and represents an agreed vision and direction for the future.

Figure 7: Support for water quality improvements, Source: Schirmer (2015)

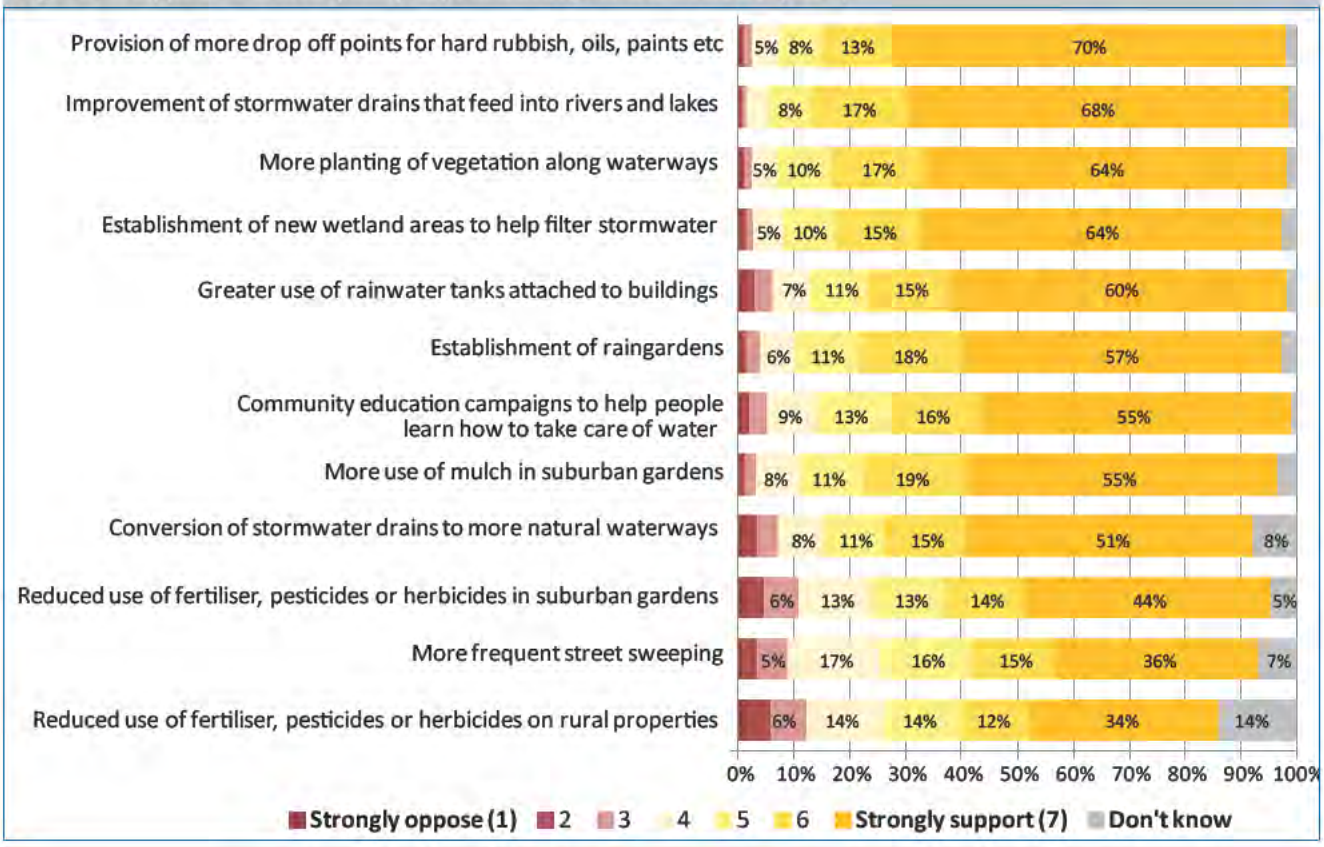


Figure 8: What goes down stormwater drain, Source: Schirmer (2015)

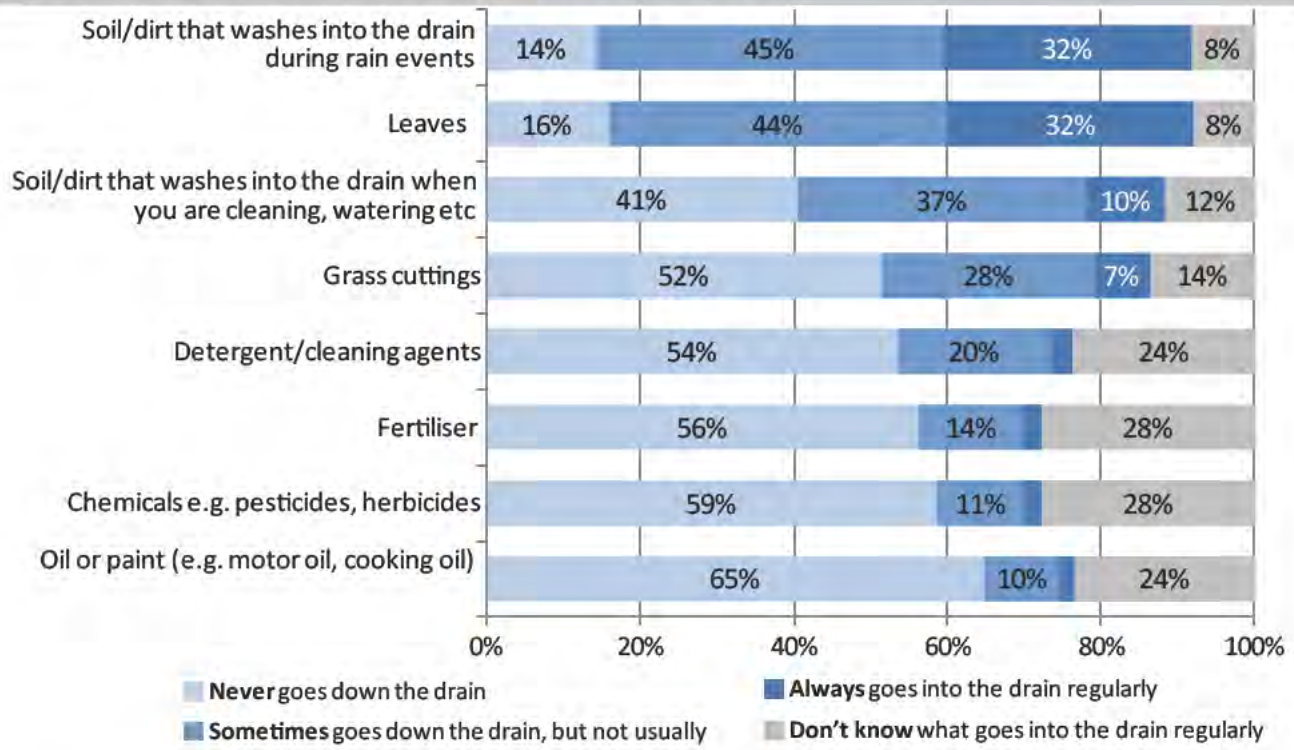
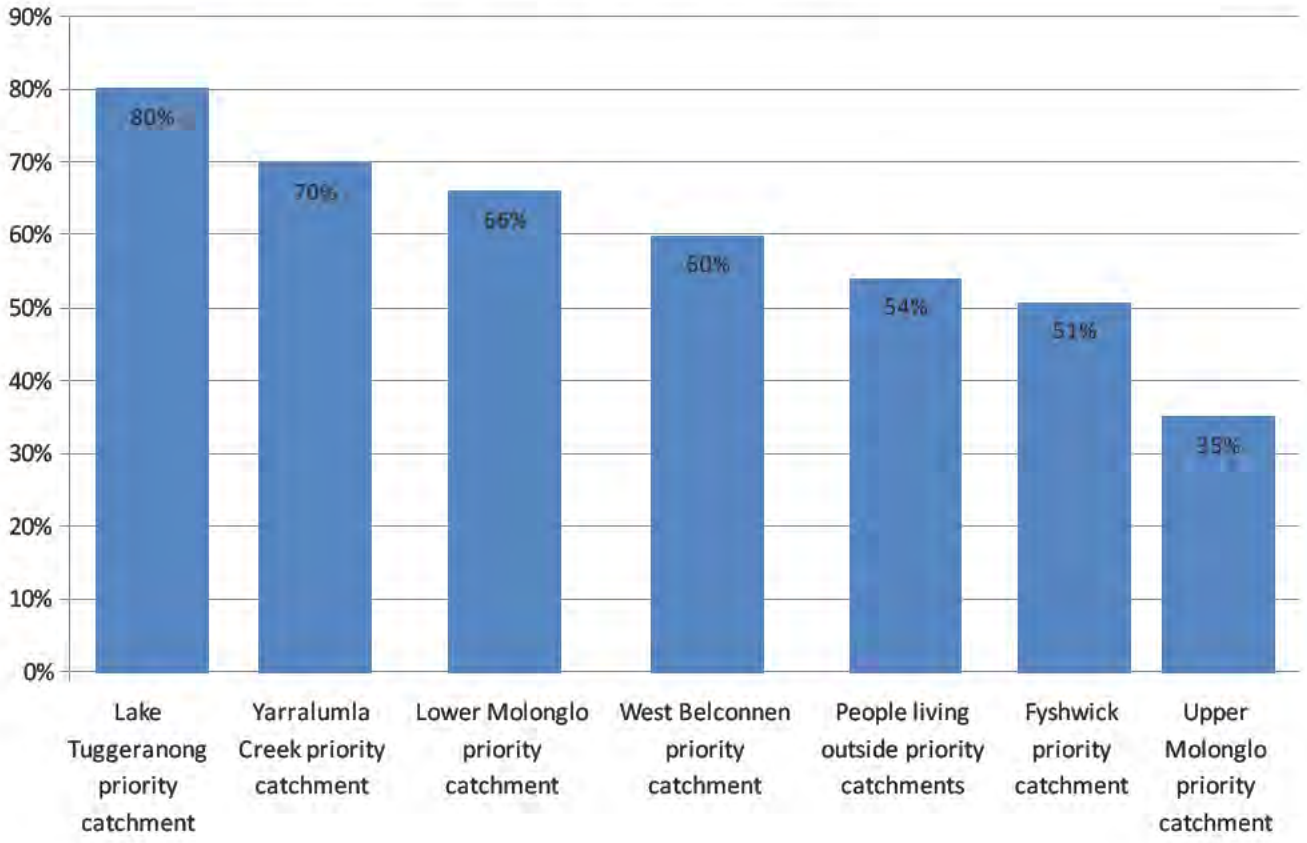


Figure 9: Perceived poor water quality in ACT Lakes, Source: Schirmer (2015)



Pollen washed and blown into the Dickson Pond

Goodwin Village Pond is a small pond built into a natural drainage line at the southern end of the suburb of Monash.

5. Phase 2 Implementation Strategy

5.1 Governance and project management

Detailed governance arrangements are currently being developed. These will respond to risks:

- outlined by the ACT Auditor-General's report into the North Weston Pond Project (No. 3 / 2011)
- findings from the December 2014 strategic review and analysis of ACT water quality management infrastructure (by Alluvium 2015a)
- identified in Milestone Reports to the Commonwealth
- that emerge as part of/during delivery

The Phase 1 governance arrangement will be enhanced to ensure delivery and maintenance entities are further integrated. The governance approach proposed for Phase 2 will comprise of three primary tiers:

- Commonwealth and ACT Steering Committee (established in Phase 1)
- Inter-Agency Project Control Group (IACG)
- Project Management Team (PMT).

The role of the ACT and Commonwealth Steering Committee remains unchanged. Its purpose is to ensure that the investments made meet the requirement of the Project Schedule. The Steering Committee will meet at key program milestones and where critical program issues require it.

An IACG will be established. This Group will, on a regular basis, review project risks, progress and costs. The Group will provide whole of government strategic oversight and ensure coordination, cooperation and direction of effort in regard to the BPP. To this end it is proposed that membership consist of Executive Directors from EPD, CMTEDD, TAMS, and the EPD Executive Manager and BPP Program Manager. The Deputy Director-General of EPD will chair the IACG This Group is expected to meet bimonthly.

The IACG will be supported by a PMT. The PMT will be responsible for the delivery of the BPP and comprise membership from across Directorates. It is proposed that the PMT will be co-located, and report through the BPP Program Manager.

The PMT would be delegated authority and accountability to implement the strategic direction set by the Control Group, including:

- defining, scoping and project briefing documentation;
- approving tenders and contracts;
- commensurate financial delegation to prevent delays in tenders, contracts and operations; and
- managing consultants, payments and general administration.

EPD (as project owner) will remain responsible for delivery of the project with CMTEDD (as procurement contract manager) and TAMS (as asset owner) both playing critical roles in the both the Inter-Agency Control Group and PMT. As project owner, EPD will be accountable for the day to day delivery of the BPP, including reporting and accountability.

The collaborative governance approach proposed for Phase 2 provides the framework for adaptive management. It enhances mutual understandings across delivery partners and can be a source of innovation in design, construction, establishment, and operation and maintenance. This approach will ensure that the BPP remains aligned with, and delivers against the objectives of the ACT Water Strategy, and the ACT and Region Catchment Management Strategy (currently under development).

Adaptive management ensures we can continually learn and improve our management approaches. Focused monitoring, investigations and research will continue to be undertaken across the ACT. This will continue to build our knowledge of waterways and changing environmental conditions, outcomes of management approaches (and inform the need for new management approaches) and the effect of external drivers such as climate change. The outcomes of monitoring, investigations and research will also help test and refine critical assumptions, and validate and calibrate models.

The ACT has a significant experience in working across stakeholders (ACT and Commonwealth, industry, community) to manage adaptively – examples being the implementation of drought environmental flows, construction of wetlands and stormwater harvesting and reuse schemes as part of the Sullivans Creek / Inner North Reticulation Scheme, Lower Cotter catchment rehabilitation and construction of Cotter Dam/ Murrumbidgee to Googong pipeline.

The project plan required as part of Milestone Report 10 will provide further detail on the Phase 2 governance arrangements.

Broader engagement with community and catchment representatives has been invaluable during delivery of Phase 1. Phase 2 should be focused on engaging with community that are materially affected by the option.

In delivery of Phase 1, the BPP Team has developed strong working relationships with the community, non-government organisations, and technical experts. It is proposed that these relationships be harnessed through existing ACT Government engagement processes.

Further, mechanisms will be established to maximise community participation in the management of the assets.

Targeted consultation will be undertaken with stakeholders directly affected by the BPP on a project by project basis as part of detailed design. For example, consultation will be undertaken at the site level (site specific) with the residents immediately affected by the option, and the broader catchment community. The objectives being:

- to inform these stakeholders of the intent for the site;
- to inform these stakeholders of scope of proposed work; and
- to better understand stakeholder views regarding the proposed works; and
- seek stakeholder input into the design to ensure that the output addresses local needs.

This will create opportunities for community and stakeholders to raise specific design issues and enable these to be appropriately addressed in the design process.

A range of consultation techniques (e.g. open house, letter box drops) will be used to ensure that the views of both residents and the broader catchment community are identified and addressed.

Site specific consultation will also be undertaken as part of the development assessment process for each of the proposed projects.

5.2 Funding and procurement

Phase 2 budget

Phase 1 investigations have considered over $1 billion worth of potential infrastructure investments and within the available project funds ($85 million Commonwealth and $8.5 million ACT Government) have prioritised to two capital expenditure scenarios- $79 million (priority list, which utilises all available funding, acknowledging allowances for complementary activities eg catchment and project management, water quality monitoring, etc) and $151 million (priority plus reserve list).

These lists have been developed based on the MCA and qualitative assessment. The $151 million threshold includes additional “reserve” projects and provides opportunities for implementation contingencies to deal with

emerging issues during the design and implementation stage in the event that a particular option(s) is no longer considered viable.

The initial ACT business case identified total expenditure on capital (design and construction) of $69.8 million to be funded by the Commonwealth and the ACT's 10% contribution.

The budget also includes commitments made under the ACT business case for monitoring and evaluation, public education, development of a catchment strategy and project management costs

The Project Schedule provides for maximum Commonwealth Government funding of $76.18 million in Phase 2 to cover the cost of capital and all other expenditure outlined in the business case. The amount available for design and construction for Phase 2 is estimated at $67.314 million. This does not include the ACT's 10% contribution. The Territory expects to provide a significant percentage of its contribution through capital expenditure. This commitment is currently subject to the ACT's budget process.

It is expected that capital expenditure Inclusive of the ACT 10% contribution will exceed the commitment of $69.8 million contained in the business case.

This is a complex project being implemented across a large number of sites and involving diverse asset classes, as such project management costs for Phase 2 are estimated at 5–10% of capital. This includes program administration, procurement services and contractor supervision.

Table 23 outlines the proposed expenditure of Commonwealth Phase 2 contribution including the costs associated with commitments made under the business case.

Coombs Pond in the new Molonglo development draining into the Molonglo River below Scrivener Dam

Table 22: Proposed expenditure of Commonwealth Phase 2 contribution

	2015-16	2016-17	2017-18	2018-19	Total
Commonwealth funding	1.500	27.000	30.000	17.671	76.171
ACT funding	0.325	2.700	3.000	2.056	8.081
Commonwealth plus ACT funding	**1.825**	**29.700**	**33.000**	**19.728**	**84.253**
Water quality - monitoring and evaluation	0.092	1.499	1.666	0.996	4.254
Public education	0.016	0.258	0.287	0.171	0.732
Catchment Strategy	0.007	0.121	0.134	0.080	0.342
Other	0.003	0.049	0.054	0.033	0.139
Expense total	**0.118**	**1.927**	**2.141**	**1.280**	**5.467**
Fyshwick	0.344	5.599	6.221	3.719	15.884
Lower Molongolo	0.209	3.401	3.779	2.259	9.649
Tuggeranong	0.567	9.222	10.247	6.126	26.161
Upper Molonglo	0.073	1.190	1.323	0.791	3.377
West Belconnen	0.141	2.302	2.558	1.529	6.530
Yarralumla	0.354	5.758	6.398	3.825	16.335
In-lake research trial	0.018	0.300	0.333	0.199	0.850
Capital total (incl. governance, detailed design, procurement and project management)	**1.707**	**27.773**	**30.859**	**18.448**	**78.786**
Capital plus expenses	**1.825**	**29.700**	**33.000**	**19.728**	**84.253**

BPP Funding - ACT costs

If this Report is endorsed by the Commonwealth, the ACT will be required to provide an $8.5 million (10 per cent) cost share contribution (over 2014-15 to 2018-19) and confirm funding for ongoing operation and maintenance of new infrastructure.

Operation and maintenance funding is expected to be at least $2 million annually (Tables 4, 6, 8, 10, 12 and 14). Recurrent operation and maintenance funding will be subject to the ACT budget process.

Without effectively operated and maintained WSUD assets, the Territory will be unable to meet its statutory obligations of stormwater quantity and water quality treatment. EDP and TAMS are working to implement a process of change management with respect to operation and maintenance. This work will be coupled with the implementation of a community awareness and behavioural change program.

Work is also continuing on identifying alternative management and funding mechanisms for operation and maintenance of stormwater / WSUD assets.

These actions will ensure infrastructure is appropriately managed throughout its lifecycle and will guide the ACT's exploration of options to improve the efficiency and cost effectiveness of its stormwater investments including identification of operational efficiencies.

It is proposed that the ACT 10 % contribution be funded through a combination of Waterwatch funding ($2.4 million over 2014-15 to 2015-19 – already committed to in the ACT budget) and new capital works. The Commonwealth has accepted ongoing funding of Waterwatch as part of the ACT contribution.

Opportunities are currently being progressed for projects that can be included in the ACT contribution. These include:

- water quality improvement work (constructed pond) in conjunction with flood mitigation/spillway upgrades at Isabella Weir and Pond;
- combining the flood retention structure on Mawson playing fields with water quality bio-retention system and downstream pond; and
- retrofit of underperforming water quality infrastructure.

Funding for these projects would be sought as part of the ACT budget process.

Procurement

A procurement framework will form part of the detailed project plan required as part of Milestone Report 10. The Phase 2 governance framework identifies responsibility for procurement sitting within the PMT. The procurement and capital works division of CMTEDD will be providing procurement specific expertise and will be embedded in this Team.

While a number of procurement models are feasible for delivery of the BPP costings assume a combination of design and construct and design, construct and establish procurements. This best manages the risks associated with implementing a range of assets.

Bio-retention systems feature prominently due to their increased treatment efficiency per m^2 over other water quality treatment types. These are an emerging practice that has significant potential. The ACT has limited experience with the design construction and operation and maintenance of this asset class. It will be important to be able to closely manage the process for these assets.

5.3 Monitoring and reporting

Project management - construction

As per the Project Schedule, milestone reporting will continue to be used to report on delivery of Phase 2 of the BPP.

Performance monitoring of infrastructure

Water quality and flow monitoring will be built into representative assets types during construction. Flow weighted water quality sampling will be preformed which captures events and base flow. These monitoring activities will be incorporated into the ACT Government component of the ACT-wide monitoring network.

Following completion, ongoing monitoring will determine whether the asset:

- performs in accordance with the MUSIC model used in its design; and
- it efficacy in reducing pollutants over the life of the asset.

The sampling outcomes, along with data from the ACT monitoring network, will form inputs for a catchment wide model – which will identify pollutant generation and transport within the ACT, and from the ACT input to the MDB.

Reporting of water quality outcomes will be incorporated into the Annual Water Report required by the MDBA for the Basin Plan.

5.4 Communication and engagement

The communication and engagement strategy for Phase 1 is currently under review. This will inform the development of a Phase 2 strategy.

Submission of this Report to the Commonwealth is unlikely to generate significant community interest, however, the outcomes of the Commonwealth's assessment will, if positive, generate both community interest and media opportunities (for both the ACT and Commonwealth Government's).

It is proposed that the following be undertaken, subject to a positive assessment;

- Joint Commonwealth/ ACT ministerial media release and event:
- Provide a briefing to stakeholders on the outcomes of investigations and proposed way forward with respect to infrastructure sequencing, design and construction. EPD would take the lead role to:
  - » facilitate stakeholder briefings – detailing projects across catchments, anticipated outcomes (reduction in pollutant load) and timeframes for delivery
  - » produce and distribute factsheets to the stakeholders involved in Phase 1
  - » update website and post information of social media platform (Twitter and Facebook)
  - » commitment to detailed briefings on the way forward for Phase 2.

A Phase 2 communication and engagement strategy will be included in the Project Plan accompanying the Milestone Report 10 to the Commonwealth. It will provide strategies to:

- Communicate effectively with internal and external stakeholders.
  - » Develop key messages, these will generally be similar across the catchments, however, each will require a nuanced approach in the way the message is presented.
- Engage with stakeholder in respect to detailed design.
  - » Create opportunities for stakeholders to provide relevant information.
  - » Target stakeholders directly affected by options and, where feasible, address issues.
- Respond to the outcomes of the community expectation survey
  - » Undertake a community education program(s) to improve water quality management practices at a block, neighbourhood and catchment scale.

5.5 Risk Management

Risks to humans and the natural environment will be managed through the detailed design process. Assets will be designed and constructed in accordance with relevant ACT government municipal infrastructure and technical specifications.

The ACT Government has significant experience in managing public liability issues associated with the construction of ponds and wetlands. This is demonstrated through the delivery of its capital works program and the Canberra Integrated Urban Water Ways System, and most recently the Inner North Reticulation System.

The control of feral species, both plants and animals, on and around assets will be undertaken, where necessary, in accordance with relevant ACT government strategies.

The net result will be lower risk at the selected options compared to their current condition/state. For example, modification of old storm water infrastructure will by default be of lower risk than what is currently in place. The unimpeded access to a sudden 1.5 metre drop onto a hard surface represents higher risk than signalised access to a gently sloping body of water.

5.6 Project Plan

The Project Schedule requires that a detailed project plan be developed and submitted as part of Milestone Report 10. The following will form part of the Project Plan:

- governance arrangements
- risk management strategy
- procurement framework
- detailed project budget
- work break down structure
- communication and engagement framework.

The project planning process will identify critical risks, opportunities for value engineering and other efficiencies. Although the Project Schedules states that a project plan be included for each of the priority catchments, it is not clear that breaking the plan down to catchment scale will allow this project to be delivered as efficiently as possible.

Yarralumla Creek, Mawson stormwater drains

6. Appendices

Appendix 1: ACT Government State Priority Project – Investment Framework, Aither 2015

Appendix 2: Report for ACT Government- EPD- Basin Priority Project (Pre-feasibility Study), GHD 2015

Appendix 3: Development of an integrated water quality monitoring framework for the ACT, GHD 2015

Appendix 4: A strategic review and analysis of ACT urban water quality management infrastructure – initial assessment report, Alluvium 2014

Appendix 5: A strategic review and analysis of ACT urban water quality management infrastructure – Final report on asset life cycle costs and functional performance (Costing Figures and MUSIC Parameters, Alluvium 2015

Appendix 6: List of ranked options (priority and reserve) across catchment

Appendix 7: Concept Plans

Appendix 8: Water Quality Improvements in 4 Priority catchments in the ACT – Yarralumla, Alluvium 2015

Appendix 9: Multi-Criteria Analysis Report

Appendix 10: Water Quality Improvements in 4 Priority catchments in the ACT – Lower Molonglo, Alluvium 2015

Appendix 11: Water Quality Improvements in 4 Priority catchments in the ACT – Tuggeranong, Alluvium 2015

Appendix 12: Water Quality Improvements in 4 Priority catchments in the ACT – Upper Molonglo, Alluvium 2015

Appendix 13: ACT Basin Priority Project – West Belconnen Options, AECOM 2015

Appendix 14: ACT Basin Priority Project – Fyshwick Options, AECOM 2015

Appendix 15: Phase 2 benchmarking exercise, Alluvium 2015

Appendix 16: ACT Basin Priority Project: multi-criteria and economic analysis for water quality improving catchment options: a report on economic benefit cost analysis, Aither 2015

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Alluvium 2015a. A strategic review and analysis of ACT urban water quality management infrastructure – Final report on asset life cycle costs and functional performance (Costing)

Figures and MUSIC Parameters

Alluvium 2015b. Water Quality Improvements in 4 Priority catchments in the ACT – Yarralumla

Alluvium 2015c. Water Quality Improvements in 4 Priority catchments in the ACT – Lower Molonglo

Alluvium 2015d. Water Quality Improvements in 4 Priority catchments in the ACT – Tuggeranong

Alluvium 2015e. Water Quality Improvements in 4 Priority catchments in the ACT – Upper Molonglo

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