Existing Catchment MUSIC Model – Case 0

A *MUSIC* model of the catchment in the pre-developed (current, rural, degraded) state was created to calculate the existing pollutant export loads. Catchment delineations were those used for the XP-RAFTS modelling, outlined in Section 5.1.1 of the *Googong Creek Stormwater Strategy* prepared by Brown Consulting (2010) with the model layout presented in Figure 1.

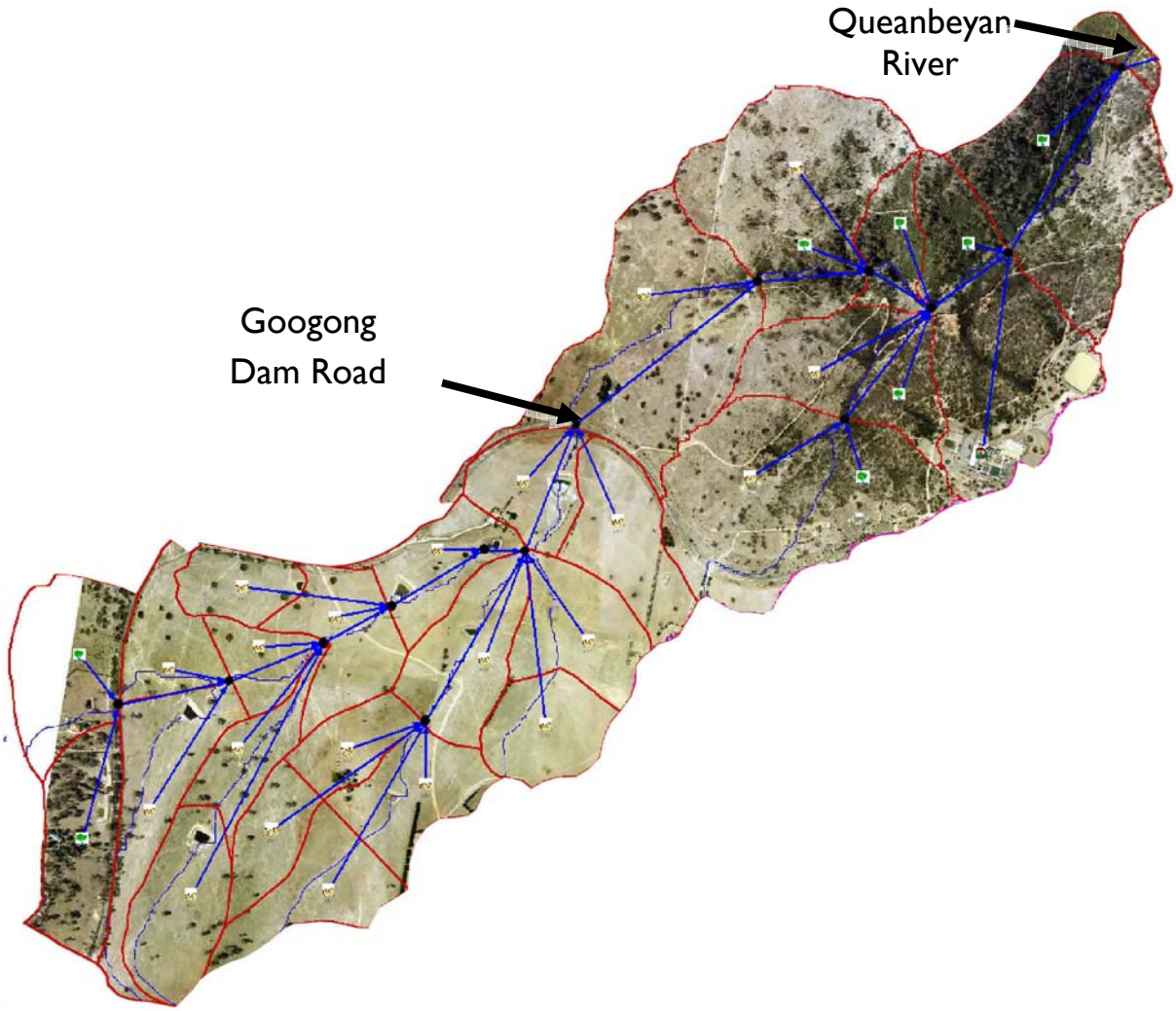

Figure 1 Existing Catchment MUSIC Model

Un-developed catchments in this case, and subsequent cases, were modelled as agricultural catchment nodes for the upper, grassland sub-catchments and as forested catchment nodes for the lower, steeper, more vegetated sub-catchments.

The results of the existing catchment *MUSIC* model are presented in Table 1, with results of average annual pollutant load reported at two locations; the downstream end of the development area at Googong Dam Road, and at the confluence of Googong Creek with Queanbeyan River.

Table 1 Existing Catchment Pollutant Export rates

Pollutant	*Pollutant Load* At Googong Dam Road *(kg/year)*	Removal Rate (%)	*Pollutant Load* At Queanbeyan River *(kg/year)*
TSS	37,800	-	64,300
TP	43	-	72
TN	738	-	1193
Gross Pollutants	1,950	-	4,750
Annual Flow Volume (ML/year)	179	-	329

The results in Table 1 indicate that in the undeveloped state, the catchment upstream of Googong Dam Road accounts for over half of the annual pollutant load for total suspended solids, and nutrients, and under half the gross pollutant exported from the catchment. This is due to the untreated loads coming from the Cook and Talpa properties on the northern side of Googong Dam Road. The area of these properties is as large as the site itself and generates loads of a similar magnitude to that of the site.

There has been no in-stream modelling of pollutant removal downstream of the site.

Developed Catchment MUSIC Model (No WSUD) – Case 1

A *MUSIC* model was for the developed catchment was built with no water sensitive urban design (WSUD) features included to manage water quality. This model was created in order to determine pollutant export rates from the urbanised catchment and measure their effects at the confluence with the Queanbeyan River. Catchment delineations were those used for the *XP-RAFTS* modelling, as outlined on page 3, with the model layout presented in Figure 2.

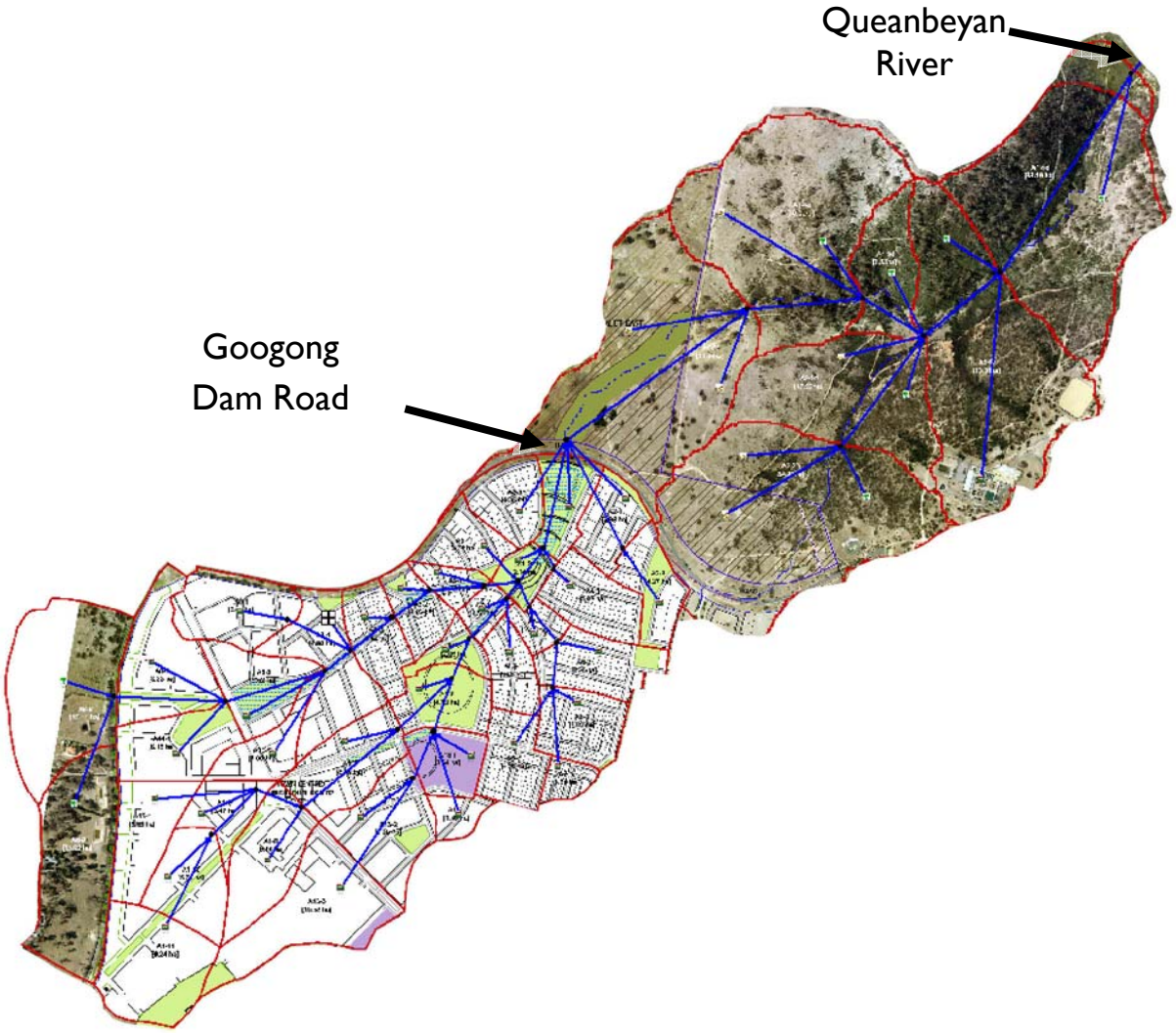

Figure 2 Developed Catchment *MUSIC* Model (No WSUD)

Un-developed catchments were modelled as in the existing catchment model, with developed catchments impervious percentages measured from Roberts Day – Yield Analysis Table dated 24 June 09 and the drawing (UD1104 rev H, dated 24.06.09).

The results of the *MUSIC* model of the developed catchment with no WSUD features are presented in Table 2. Results of average annual pollutant load reported at two locations; the downstream end of the development area at Googong Dam Road, and at the confluence of Googong Creek with Queanbeyan River.

Table 2 Developed Catchment (No WSUD) Pollutant Export rates

Pollutant	*Pollutant Load at Googong Dam Road (kg/year)*	*Removal Rate (%)*	*Pollutant Load at Queanbeyan River (kg/year)*
TSS	171,000	0%	202,000
TP	150	0%	184
TN	2,030	0%	2,580
Gross Pollutants	24,800	0%	29,200
Annual Flow Volume (ML/year)	680	0%	851

The results in Table 2 indicate that in the developed state with no WSUD, the catchment upstream of Googong Dam Road would account for approximately 80-90% of the annual pollutant load for total suspended solids, nutrients and gross pollutant at the confluence with the Queanbeyan River.

Developed Catchment MUSIC Modelling Options – Case 2

A *MUSIC* model was for the developed catchment was built that included the water sensitive urban design (WSUD) features included in drawing UD1104 rev H, dated 24.06.09, Trunk Stormwater Drainage Concept Plan for Neighbourhood 1 and Town Centre" X07008.02.SK01 Issue C with Wetland dimensions from drawing dated 16 Dec 08 (C8006/DE/SW). This model was created in order to determine the effects of these measures to manage water quality and reduce pollutant export rates from the urbanised catchment upstream of Googong Dam road and also to measure their effects at the confluence with the Queanbeyan River. Catchment delineations were those used for the *XP-RAFTS* modelling, outlined in Section 5.2.1 the *Googong Creek Stormwater Strategy* prepared by Brown Consulting (2010), with the model layout presented in Figure 3.

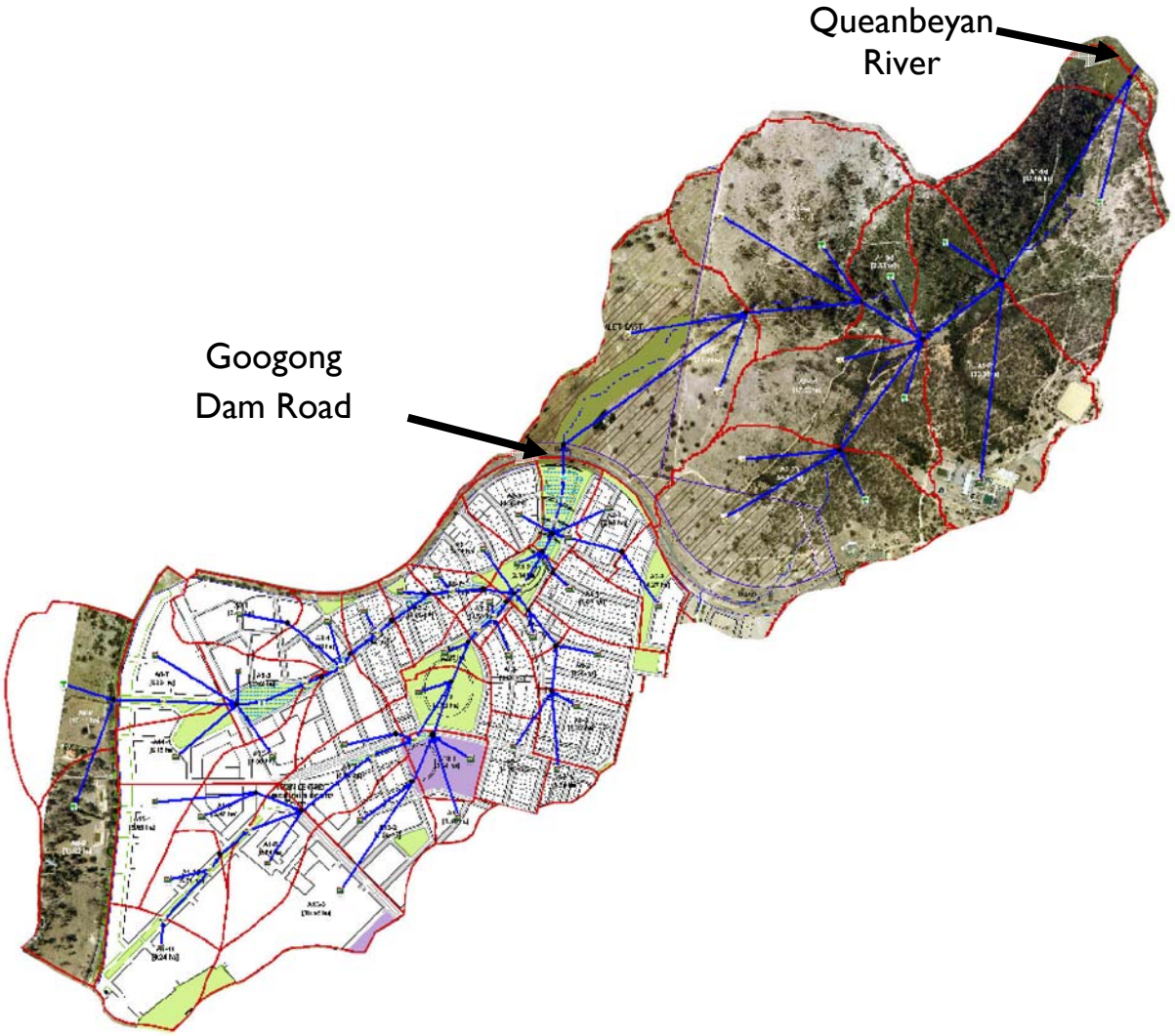

Figure 3 Developed Catchment *MUSIC* Model (WSUD)

The results of the *MUSIC* model of the developed catchment incorporating WSUD features are presented in Table 3. Results of average annual pollutant load reported at two locations; the downstream end of the development area at Googong Dam Road, and at the confluence of Googong Creek with Queanbeyan River, along with pollutant removal rates for the developed catchment upstream of Googong Dam Road.

Table 3 Developed Catchment (WSUD) Pollutant Export rates

Pollutant	*Pollutant Load at Googong Dam Road (kg/year)*	*Removal Rate (%)*	*Pollutant Load at Queanbeyan River (kg/year)*
TSS	7,540	95.6%	39,200
TP	52	65.1%	87
TN	765	62.3%	1,310
Gross Pollutants	0	100.0%	4,390
Annual Flow Volume (ML/year)	614	9.7%	784

The results in Table 3 indicate that the WSUD features presented on in Trunk Stormwater Drainage Concept Plan for Neighbourhood 1 and Town Centre" X07008.02.SK01 Issue C and Wetland dimensions from drawing dated 16 Dec 08 (C8006/DE/SW) would allow the proposed development to meet the pollutant removal targets set in the Googong New Town DCP within Googong Creek.

Comparison of these results with those presented in Table 1 indicate that exported pollutant loads at the Queanbeyan River from the developed catchment with WSUD would be 60-80% of those for the existing catchment for total suspended solids and total phosphorous, slightly higher for total nitrogen and about 90% of the gross pollutants.

INTEGRATED WATER MANAGEMENT

This section outlines the integration of stormwater treatment measures with the water quality measures outlined in MWH (Montgomery Watson Harza Pty Ltd) *Googong Design Assumptions for Potable and Recycled Water System*. This section also outlines how the WSUD measures meet the requirements of the Googong Water Cycle Project Environmental Assessment.

Performance Targets

The performance targets required in the *ACT Planning and land Authorities Industrial Zones Development Code* (March, 2008) is outlined below

> *Evidence is provided that shows the development achieves a minimum 40% reduction in mains water consumption compared to an equivalent development constructed in 2003 using the ACTPLA on-line assessment tool or the NSW BASIX tool. The 40% target is to be met without any reliance on landscaping measures to reduce consumption.*

The achievement of water conservation measures as required for Water Sensitive Urban Design (WSUD) is requires the implementation of water demand management measures at each individual lot These measures include applying water efficient fittings and fixtures, Water efficient mechanical plant, Water efficient landscaping and rainwater capture, storage and use. The use of rain water tanks are to be compulsory on the lots and utilisation of rainwater would be used for reuse in toilet flushing, landscape irrigation and general wash down.

The adoption of these strategies will depend on the nature of development to be occupies by each individual lot and will be the responsibility of each individual lot to achieve the performance targets required by the *ACT Planning and land Authorities Water Sensitive Urban Design General Code* (March, 2008). The development of each lot will be subject to individual future applications.

MUSIC WATER QUALITY MODELLING (INCLUDING RECYCLED WATER)

The performance of the proposed water quality treatment strategy has been modelled using the *MUSIC* water quality model (Version 3.0). The parameters adopted for *MUSIC* modelling are as recommended in Appendix B of the *ACT Planning and Land Authorities Water Sensitive Urban Design General Code* (March, 2008) and are provided in Appendix C.

A series of *MUSIC* models has been developed to establish the treatment targets required to compensate for development within Googong Creek catchment. A model of the existing catchment, based on rural land use, was developed to set baseline pollutant export conditions. This existing condition model is discussed on page 3. A model of developed catchment with no water sensitive urban design treatment features was developed to calculate pollutant export loads from the site. This developed with no treatment is discussed on page 5. Models were developed for various treatment options the catchment, including rainwater tanks and roadside swales along with bioretention were modelled. These options were modelled along with the use of recycled water from the Googong

wastewater treatment plant as environmental flow in Googong Creek. Data used the existing condition and developed condition models was used in this modelling, along with additional data from the following sources:

- **Time series data** on the discharge of recycled water from the WRP supplied from *WATNET* modelling undertaken by MWH dated 29 Oct 09 (graphically provided in Attachment D)
- **Pollutant Concentrations in recycled water**
    - **TSS** – 5.0 mg/L
    - **TN** – 10 mg/l
    - **TP** – 0.2 mg/L
- **Rainwater Tank volume** – 65.6 m^3/ha (based on lot layout and lot yield of 12.81 lots/ha calculated from Roberts Day – Yield Analysis Table dated 24 June 09 and the drawing (UD1104 rev H, dated 24.06.09)
- **Rainwater tank daily demand** of 2.88kL/ha/day, determined by MWH *WATNET* modelling

The cases modelled are as follows –

CASE 3: has been superseded and is not discussed in this report

CASE 4: has been superseded and is not discussed in this report

CASE 5: has been superseded and is not discussed in this report

CASE 6: Developed Case With Treatment (WSUD) + Water Recycling Plant Discharging into Basin 4

CASE 7: Developed Case With Treatment (WSUD) + Water Recycling Plant Discharging into Basin 4 + Rainwater Tanks