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Title: The Need for a Single Drainage Authority for Metropolitan Sydney - a Case Study

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Management Implications of A'Becketts Creek Drainage Studies, Sydney
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SUMMARY: Ownership and maintenance of Metropolitan Sydney's stormwater drainage systems has for a long time been (and remains) fragmented. Local councils and state government organisations have both varying responsibilities and design and maintenance standards.

The paper examines, by way of a case study of A'Becketts Creek, the argument for a single drainage authority for Sydney. The A'Becketts Creek catchment in Western Sydney is not dissimilar to many of Sydney's urban catchments in its size (680 ha), in the fact that the catchment area lies within two local government areas who each own and control their respective pipe systems, and that two state government bodies (The Water Board and the Maritime Services Board) also have local trunk drainage responsibilities.

In the past seven years there have been a number of flood studies of the lower A'Becketts Creek catchment (and the receiving watercourse, Duck Creek) and yet today designated flood levels (and an associated floodplain management plan) along lower A'Becketts Creek have still not been finalised.

1. CATCHMENT DESCRIPTION

The A'Becketts Creek catchment totals 680 hectares and the extent of the catchment is shown in **Figure 1**. The catchment drains in an easterly to north-easterly direction and joins Duck Creek 200 metres downstream of the James Ruse Drive flyover (see **Figure 2**). A further kilometre downstream, Duck Creek flows into Duck River which in turn flows into the Parramatta River at Silverwater.

The upper catchment is undulating and slopes are typically of the order of 5 percent. In the lower reaches of the catchment, the floodplain areas are gently sloping and the gradient of the creek is 0.3-0.5 percent. Approximately the last 900 metres of A'Becketts Creek is tidal.

The catchment is substantially urbanised and therefore the catchment response to storm rainfall is such that the runoff peak is earlier and larger, and the total storm runoff volume is bigger than would be the case if the catchment was undeveloped. Given the paucity of flood events prior to 1986 it is not possible to assess the hydrologic impact of the changes in catchment urbanisation over say the last 50 years. However it is noted that the existing trunk stormwater systems were sized in accordance with the then accepted design practices, on the basis of an urbanised catchment.

Given that the existing catchment is substantially developed and that there are only minor pockets of land yet to be developed there are seen to be no major developments that would significantly alter the existing runoff regime. There are however, significant pressures to redevelop single dwelling allotments for medium density housing and such continuing activity will have some impact on runoff regimes.

This paper concentrates on the lowest reach of A'Becketts Creek, that is the stretch of (mainly) concrete-lined channel from the Main Railway Line downstream to the confluence with Duck Creek.

A'Becketts Creek generally traverses within the Western Freeway reservation or to one side of the freeway structure. Due to the freeway's elevation alignment (in the location it is a continuous viaduct) the local landscape is dominated by the freeway structure.

The predominate land use within this area is residential with 63% of the land being developed for residential purposes of which 6% is devoted to medium density housing. Some single detached dwellings within this area are generally in a poor or decaying condition whilst a few dwellings within isolated pockets of this area have been renovated. A number of existing dwellings are located within the Western Freeway reservation. Because of the freeway 23% of the land area is classified as vacant. The banks of the creek remain vacant with overgrown vegetation, dumped rubbish and substantial amounts of fill.

2. HISTORICAL FLOODING

Apart from a mid 1970s severe storm which was centred on the neighbouring Duck Creek catchment but which led to some significant flooding at the bottom of the catchment, there were decades of only nuisance flooding prior to August 1986. Since the major storm of that month, there has been six significant flood events in which low lying properties (including houses) have been regularly flooded, etc. The number of private properties and houses flooded in those floods were typically concentrated in the lower catchment area, see **Table 1**.

3. FLOOD STUDIES

3.1 GENERAL

In response to the on-going series of flood events there have been a total of six local area flood studies which have at least in part reported on A'Becketts Creek historical flood events and calculated designated 100 year flood levels. Those flood studies have been commissioned by differing and various combinations of four state and local government authorities. The flood studies were undertaken between 1985 and 1991, have involved the use of a number of different hydrological and hydraulic models and the designated 100 year flood levels for the downstream reach of A'Becketts Creek have been subject to change over that period of only seven years.

3.2 THE 1985 GRANVILLE DRAINAGE STUDY (Reference 2)

One of the principal tasks of this study was to identify the potential impact on downstream flood flows of the rezoning of part of the Duck Creek catchment to medium density residential landuse. The assessment of potential downstream impact included the calculation of 20year, 50year and 100year flood profiles along the entire length of Duck Creek (and its tributary, Little Duck Creek).

The study report identified that apart from "some localised flooding experienced during a number of historical storms (including March 1967, April 1969 and March 1977), for which there is only very limited information" only one major flood had occurred (in April 1974 in which the rainfall was estimated to have had an average recurrence interval (ARI) well in excess of 100years).

Due to the size of the 1974 flood event the study consultant found that there was a considerable data base of historical flood levels. However the flood level information was rather sparse in the vicinity of the confluence of Duck Creek and A'Becketts Creek and downstream to the former creek's confluence with Duck River.

Given the lack of historical storm temporal patterns (which would have allowed calibration of a hydrologic model) the consultant determined that the use of a rainfall-runoff routing model was not appropriate and catchment flows were generated using the Rational Method.

The HEC-2 model was adopted to calculate the flood profiles. Not unexpectedly the 100year

designated flood profile was determined to be below the 1974 flood levels. The study brief called for the definition of "floodway" and "flood fringe" areas (and the related restrictions on development within both areas) but this was limited to the area proposed for medium density residential development rather than the lengths of all modelled floodplains.

Hence apart from the publication of 20year, 50year and 100year flood levels at the confluence of Duck Creek and A'Becketts Creek there was no assessment of local floodplain development guidelines at that location. (The local 20year and 100year flood levels were calculated to be RL 3.9m and 4.7m AHD respectively.)

3.3 THE 1987a A'BECKETTS CREEK FLOOD STUDY (Reference 3)

In response to major flooding experienced in early August 1986 the Parramatta City Council commissioned an assessment of several severely flooded areas; one of those was lower A'Becketts Creek (from the Main Western Railway Line downstream to the confluence with Duck Creek).

The study consultant undertook extensive interviews with local floodprone residents and factory occupiers. A number of the residents made comments (and produced photographs) concerning the way that a twin bridge structure (serving freeway access ramps) that had been under construction at the time of the August 1986 flood event had acted as a dam due to the trapping of debris, etc against the bridge formwork. Apart from August 1986 data, the residents also provided information about the 1974 flood and a later flood in November 1986.

A RORB model of the A'Becketts Creek catchment was developed in order to try and achieve calibration to the historical August 1986 flood levels. The study consultant found that the two nearest rainfall recorders had generated near identical temporal patterns and therefore the storm details from the closer recorder (Guildford) were adopted as representative of the A'Becketts Creek catchment. Unfortunately due to a pronounced "backwater" affect along much of the channelised creek within the lower A'Becketts Creek area there was no satisfactory calibration data for the RORB model. 20year and 100year flood flows were subsequently developed using standardised design storm temporal patterns and estimated loss rates.

The HEC-2 program was used to calculate 20year and 100year flood profiles throughout the studied lower reaches of A'Becketts Creek. Initially the 1985 Granville study (**Reference 2**) design flood levels at the confluence with Duck Creek were adopted for the HEC-2 model but these were found to be inconsistent with the significant flood levels experienced in August and November 1986. (The 1974 flood levels at the confluence were considered to be unrepresentative of the situation in A'Becketts Creek since the 1974 flood levels in A'Becketts Creek were entirely a function of backwater flooding from Duck Creek.) The 20year and 100year confluence flood levels were reassessed to be RL 4.0m and 5.3m AHD (compared with RL 5.2m AHD experienced in the August 1986 flood).

Although no conclusions were drawn regarding potential restrictions on local floodplain development (that is, along lower A'Becketts Creek) the study report did assess the potential impact of catchment redevelopment on lower catchment flood flows. Following that assessment the report

included the recommendation that on-site detention storage should be required for all future site developments within the A'Becketts Creek catchment.

3.4 THE A'BECKETTS CREEK FLOOD 1987B STUDY (Reference 4)

Essentially this study was an extension of the **Reference 3** report. This time the study looked closely at the flood regime in lower A'Becketts Creek (and the downstream portion of Duck Creek as far as the latter's confluence with Duck River) in both the August and November 1986 floods. Additional interviewing was undertaken along lower Duck Creek and some lower A'Becketts creek residents were re-interviewed about the November 1986 event.

Given the "extension" of the study area - to incorporate lower Duck Creek - the earlier RORB model of A'Becketts Creek was extended to include both the Duck Creek and Duck River catchments. Due to a breakdown in the Guildford rainfall recorder during the November 1986 storm event, the available storm temporal data from the next two closest recorders were compared and they revealed markedly different patterns and storm totals. Indeed the RORB flood peaks based on the use of those two recorder patterns differed by a factor of two. In addition there was a pronounced "backwater" effect along lower A'Becketts Creek and few reliable flood levels along lower Duck Creek
and therefore once again it was found that the historical flood data was insufficient to allow calibration of the RORB model. Designated flood flows were generated using standardised design storm temporal patterns and estimated loss rates.

Again historical and design flood profiles were calculated using the HEC-2 program. Special attention was made to the impact of concurrent freeway ramp bridge construction during both 1986 flood events; localised floodplain filling and the mangrove-lined reach of lower Duck Creek.

With regard to the issue of the freeway ramp twin bridge construction the study consultant found that the temporary coffer dam and scaffolding works had behaved as an obstruction and that the obstruction had become more severe as flood-borne debris had collected behind the scaffolding. In the November 1986 flood event the scaffolding had eventually collapsed which had led to a rapid drawdown of flood levels upstream of the bridge works. The consultant concluded that there may well have been a significant difference in flood levels either side of the scaffolding during the time that the scaffolding had acted as a debris dam. However it was also concluded that at the time of the flood peak the resultant increase in levels due to the obstruction was only 0.1 metres.

The report determined that some localised filling placed in the vicinity of the freeway viaduct had no significant impact on local flood levels.

The report determined that some form of stream clearing and/or channelisation of the Mangrove-lined reach of lower Duck Creek would achieve a substantial reduction in flood levels at and upstream of the confluence of Duck Creek and A'Becketts Creek. In any future assessment of such works it was recognised that the environment effects (of disturbing the mangroves) would need to be assessed.

The 20year and 100year flood levels at the confluence of A'Becketts Creek and Duck Creek were calculated to be RL 5.3m and 5.6m AHD respectively.

3.5 THE 1990 A'BECKETTS CREEK CATCHMENT MANAGEMENT STUDY (Reference 1)

This study examined drainage and flood issues throughout the A'Becketts Creek catchment area. (The Study catchment boundary corresponded to the downstream limit of channelisation , that is adjacent to James Ruse Drive, see **Figure 2**). The study consultant found that the lower part of the catchment was by far the worst flood-affected part of the catchment and that there had been significant overbank flooding on five occasions since August 1986, including two occasions within one week in February 1990.

A review of historical (and previous design 20 year and 100 year) flood profiles confirmed that local flood levels were principally due to high coincident levels downstream of the study boundary - that is, at and downstream of the confluence with Duck Creek. As **Reference 4** the study consultant found that these high levels resulted from the existing Mangrove-dominated earthen channel downstream of the confluence with Duck Creek. The mangroves in this reach were found to reduce the channel capacity and have a significant impact on upstream flood levels.

Table 1 (Source: Reference 1) lists the historical extent of lower catchment house and property inundation based on questionnaire responses and summarises an estimate of house and property inundation for the 100 year ARI flood event.

TABLE 1: FLOODED PROPERTIES - LOWER A'BECKETTS CREEK

Flood Event	Residences		Offices		Commercial/ Industrial	
	AFL	BFL	AFL	BFL	AFL	BFL
August 1986	20	95	2	1	4	0
April 1974	5	85	2	1	3	0
November 1986	5	75	0	3	2	2
10 Feb 1990	5	75	0	3	2	2
April 1988	5	75	0	3	2	2
7 Feb 1990	1	40	0	3	1	3
100yr ARI	100-110	70-80	3	0	4	1

AFL = Above floor level flooding inundation
BFL = Below floor level flooding inundation

For this study the client had required that the RAFTS Catchment model be used in preference to a RORB model (which had been used in earlier A'Becketts Creek studies, **References 3 and 4**). The study consultant experienced similar difficulties to the earlier studies in attempting to calibrate the hydrological model. With the input of standardised design storm temporal patterns, etc. the RAFTS model was found to generate catchment flood peak flows somewhat larger than the earlier RORB models (**References 3 and 4**). Following a review of this difference (which could not be resolved in a satisfactory manner) the study consultant adopted the RAFTS model flows. This decision necessitated an upwards revision of the downstream flood peak (as generated by the combined Duck Creek and A'Becketts Creek catchments) which inevitably led to a significant increase in design flood levels at the confluence of those two creeks. Those levels were determined to be approximately 5.9m and 6.1m AHD for the 20 year and 100 year events respectively.

The study determined that the conditions along the downstream Mangrove lined reach of Duck Creek had a direct bearing on flood levels at and upstream of the confluence of Duck Creek and A'Becketts Creek. Relatively crude hydraulic modelling (undertaken to determine approximate design flood levels at the confluence) indicated that some form of stream clearing/channelisation along the mangrove-lined reach would lower upstream flood levels by approximately a metre.

Hence the study recommended (with a "high priority" rating) that an Environmental Impact Statement study (EIS) and associated investigation be undertaken to determine the appropriate extent of channel widening and/or Mangrove removal in the lower reach of Duck Creek. Given the frequency of recent flooding in lower A'Beckett's creek (and the gradual encroachment of the Mangroves in lower Duck Creek) the consultant recommended that prior to the EIS study some urgent works (consisting of some pruning and selective clearing of the mangroves) be undertaken under the guidance of a recognised expert.

The study included an assessment of flood hazard zones (and associated floodplain development controls) along lower A'Becketts Creek. That assessment was necessarily based on the new higher flood levels along that reach of the creek but the report stressed the fact that those new levels should be considered to be "interim" levels only pending the completion of a definitive downstream flood study (of lower Duck Creek).

3.6 THE 1990 GRANVILLE DRAINAGE STUDY (REFERENCE 5)

The study was a revision and update of the 1985 (**Reference 2**) study. A combination of RORB (hydrologic) and MIKE-11 models (hydraulic) were used to define flood profiles along Duck Creek (and little Duck Creek) and the 100 year flood level at the confluence with A'Becketts Creek was found to be similar to the **Reference 4** value.

3.7 THE 1991 DUCK CREEK CATCHMENT MANAGEMENT STUDY (REFERENCE 6)

This study was similar to the **Reference 1** study of A'Becketts Creek in its coverage of drainage and flood issues throughout the Duck Creek catchment. Similar to the A'Becketts Creek catchment study the downstream limit for this study was the end of the concrete channelised reach which is located upstream of the confluence of Duck Creek and A'Becketts Creek. However similar to **Reference 1** the study consultant assessed the impact of undertaking channelisation works along lower Duck Creek (below the confluence with a'Becketts Creek). It is understood that the draft report confirmed the findings of **Reference 1** in that it was considered that such works would achieve a potential drop in upstream flood levels of the order of one metre. Also similar to the **Reference 1** study it is understood that the draft report recommended an EIS study of such channelisation works.

As in the **Reference 5** report the study consultant adopted RORB and MIKE-11 models and concluded that the 100 year flood level (at the confluence with A'Becketts Creek) was not dissimilar to the level adopted in **Reference 4**.

4. FLOODPLAIN MANAGEMENT DIFFICULTIES

Today the 100 year flood levels for lower A'Becketts Creek have yet to be "finalised" and a commitment to works to reduce potential flood levels has yet to be made.

For a number of reasons this represents a unfortunate state of affairs:

(a) Socio-economically the lower A'Becketts Creek area is generally depressed (**Reference 1**). Quality of housing is generally quite poor and scenically the area is dominated by the expressway viaduct (and the extensive barren lands beneath and adjacent to the viaduct). This scenario is compounded by the fact that the residents have experienced a series of flood events (1986-1990) in which there has been significant property inundation including above flood level flooding.

(b) Many of the residents are (understandably) upset over the number of times they have been interview/questionnaired on their historical flood problems and that there is (still) no solution to reduce their substantial (and frequent) flood problems.

(c) Due to the variations in published flood levels the local council finds it very difficult to assess applications for house extensions, property redevelopment etc. in potentially flood prone areas.

(d) Local residents find that their property values have dropped significantly following the ongoing historical flood problems and the addition of flood notations on planning certificates (under Section 149 of the NSW EP & A Act).

5. WHAT DOES THE FUTURE HOLD?

The above case study of lower A'Becketts Creek demonstrates that unless a single authority is responsible for urban catchment drainage there will continue to be non-efficient catchment planning. If such an authority was responsible for the whole catchment of Duck Creek (if not Duck River) then there would not have been a succession of studies, nor a scenario of variable design flood levels and there would be an overall plan in place to resolve site-specific and catchment-wide problems.

The structure of such an the authority could take one of two forms:

1. Exist within a state government department or authority e.g. the Water Board.

2. Creation of a catchment trust made up of representatives from the local government authorities and relevant state government departments e.g. similar to the Upper Parramatta River Catchment Trust.

Given the complexities of setting up individual catchment trusts say for each tributary catchment to the Parramatta, Hawkesbury-Nepean and Georges River Systems it would seem to be far more logical and efficient for one state government department to have the responsibility for overall planning (and allocation of resources) and with local government authorities playing a role in construction and maintenance of certain areas/systems.

6. REFERENCES

1. Bewsher Consulting (1990) A'Becketts Creek (SWC No 46) Catchment Management Study Commissioned by the Water Board

2. Sinclair Knight & Partners (1985) Granville Rezoning - Drainage and Flood Investigation May. Commissioned by Parramatta City Council

3. Sinclair Knight & Partners (1987a) The August 1986 Flood Study - A'Becketts Creek Commissioned by Parramatta City Council - August

4. Sinclair Knight & Partners (1987b) A'Becketts Creek and Duck Creek Flood Study November. Commissioned by the Water Board and the Department of Main Roads (NSW)

5. Sinclair Knight & Partners (1990) Granville Drainage Study (Draft Report) Commissioned by Parramatta City Council

6. Sinclair Knight & Partners (1991) Duck Creek Catchment Management Study (Draft Report) Commissioned by the Water Board

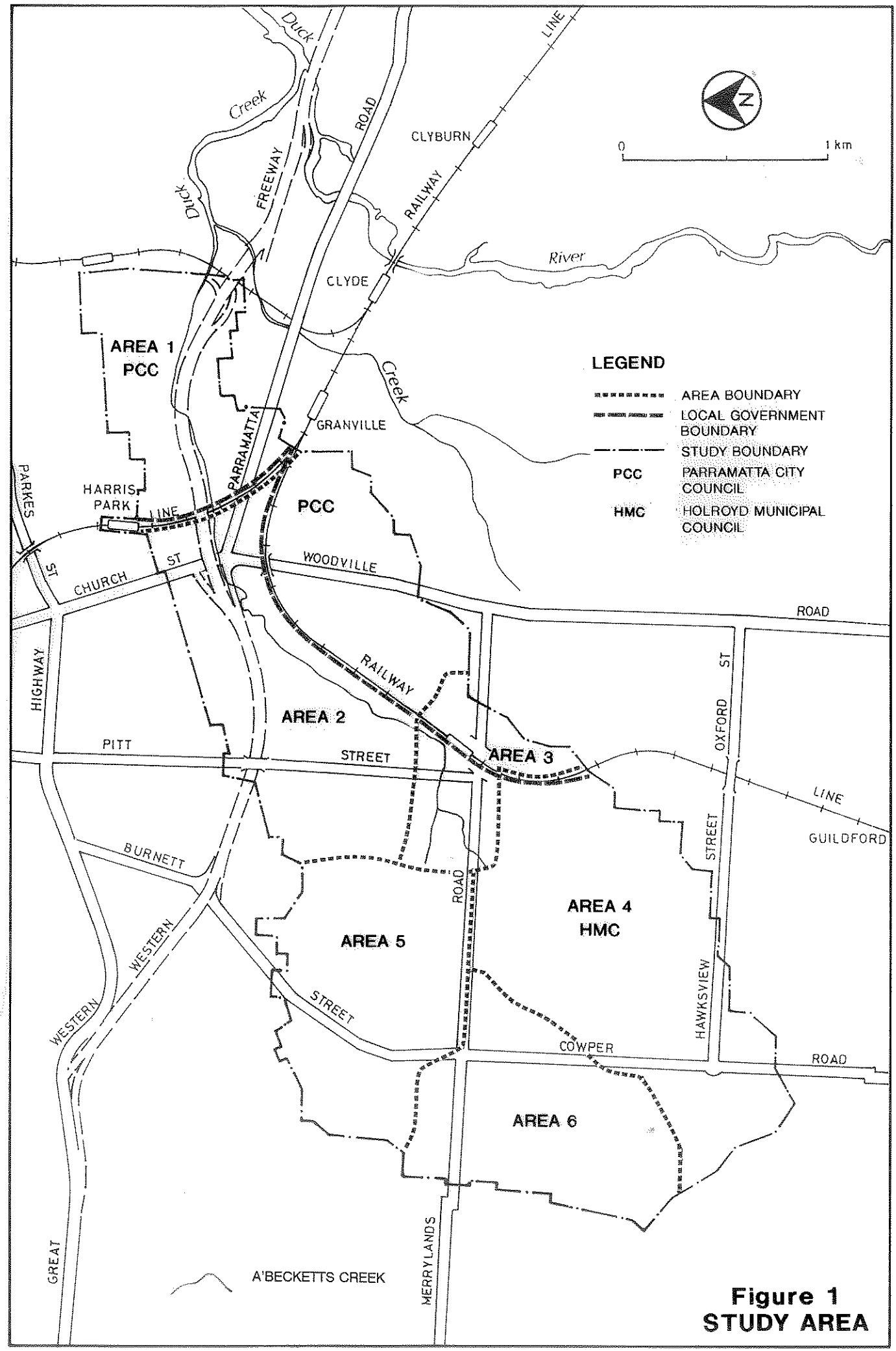

Figure 1
STUDY AREA

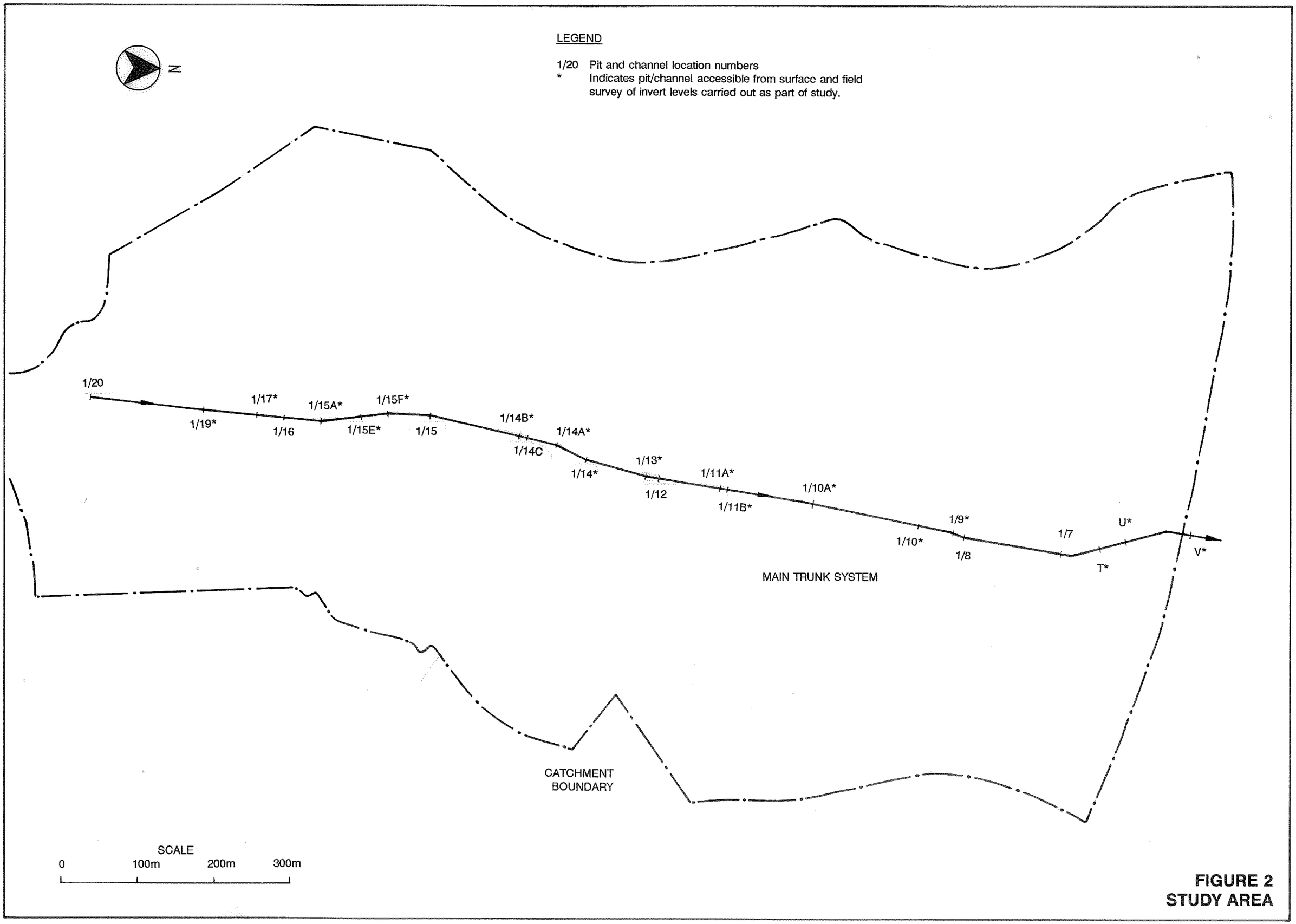

FIGURE 2
STUDY AREA