ATTACHMENT A

REID ENVIRONMENTAL (2015)
CHIPPENDALE LEAKY DRAINS
SUSTAINABILITY INVESTIGATION

ATTACHMENT A

RESEARCH
ENVIRONMENT
INNOVATION
DESIGN

CHIPPENDALE LEAKY DRAINS

FEASIBILITY INVESTIGATION

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INTRODUCTION

Council received notification from a Chippendale resident that some 20 leaky drains had been installed in the Chippendale area. Leaky drains are perforated pipes that allow water from roofs to drain into the soil of the nature strip between the footpath and the road, where that is present. The notification states that approximately 50 million litres per year of stormwater runoff could be diverted in this way to reduce the pressure on downstream stormwater systems and provide additional water to irrigate the plants in the nature strips. The outcome of the notification is a proposal to install further leaky pipes throughout Chippendale as a trial for other suburbs.

It was resolved that the City investigate the implementation of a leaky drains project across the suburb of Chippendale.

This report assesses the feasibility of extending the leaky drains concept throughout Chippendale and discusses the various pros and cons, costs and benefits of doing so. A review of other methods and locations, possibly more suited to infiltration systems is presented and a recommendation for Council proposed.

WHAT IS A LEAKY DRAIN?

Rainwater drains from rooftops through a downpipe and across the footpath and nature strip and discharges into the kerb of the street. A Chippendale leaky drain replaces the solid pipe in the nature strip with a perforated pipe (known as ag pipe), which drains into the surrounding soil. The first tranche of these systems were installed during a Sustainable Chippendale Open Day in 2007 and inspected on January 6, 2015 as part of this evaluation.

There is no visual evidence of the presence of a leaky drain in the nature strip due to the build up of mulch in the nature strips. There is also not a discernably higher growth rate in the vegetation near leaky drains. The initial systems were terminated in the garden bed as shown below, which provides no overflow or inspection point. As well as being prone to blockage, these can potentially erode the nature strip by overflowing into the soil and causing holes to develop.

Figure 1: Photo showing approximate location of leaky drain in Myrtle St Chippendale

The method proposed for the trial was confirmed during a meeting with Michael Mobbs and is described in his book Sustainable Food (2012). A solid piece of PVC pipe connecting the house downpipe to the kerb would have holes drilled into the bottom, and gravel and a piece of geotextile fabric surrounding it.

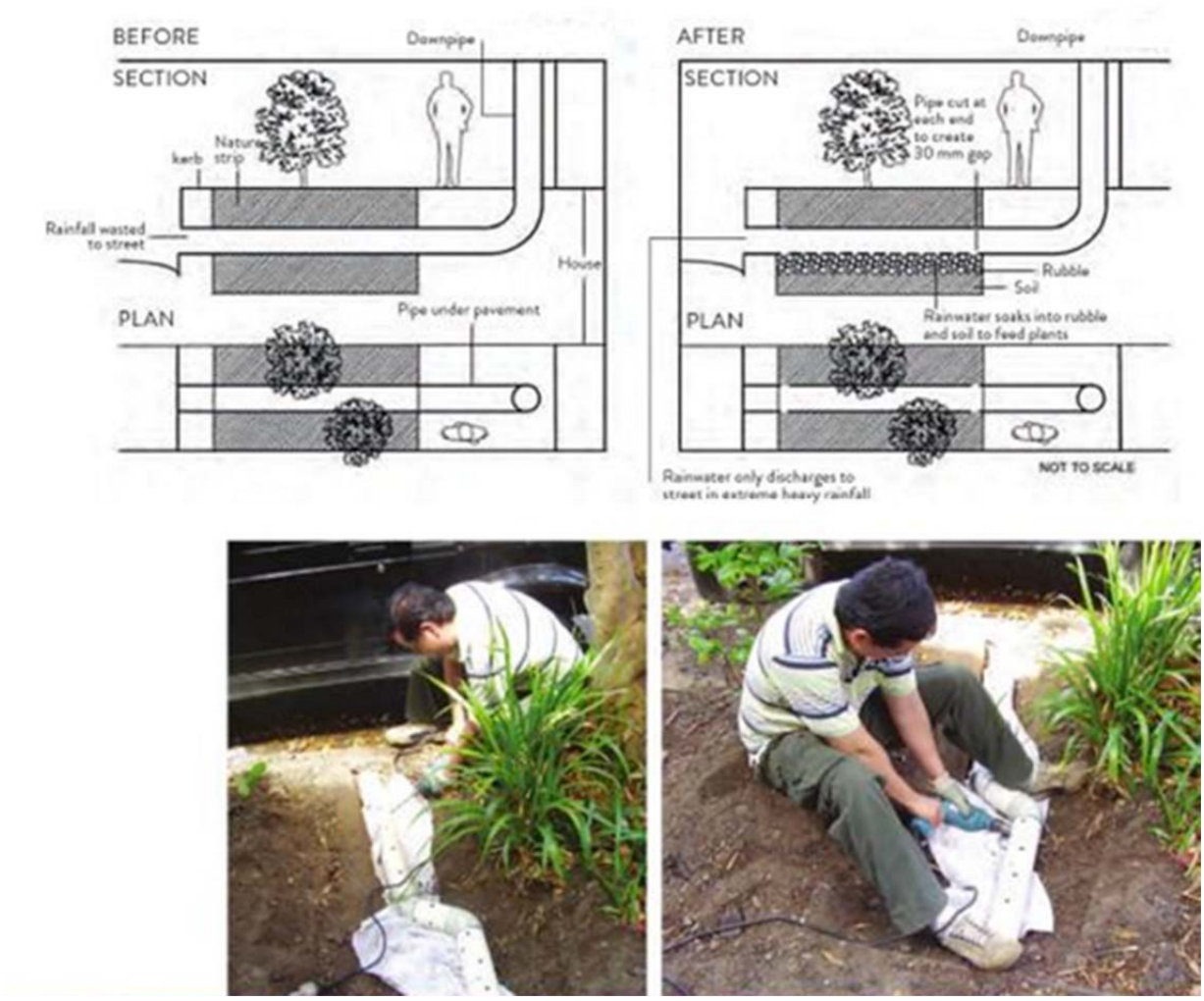

Figure 2: Design drawings and installation of leaky pipes. Source: Sustainable Food (2012)

Council has also installed systems that encourage water infiltration such as unlined raingardens, tree pits and infiltration systems in locations where infiltration is suitable: i.e. wide footpaths and sandy soils.

Managing stormwater at the source is an effective solution to reducing downstream impacts and in my opinion, involving the community is an effective and sustainable method to ensure long-term maintenance of measures such as these.

Council's own leaky pipe designs have included a small, leaky junction pit in the nature strip to act as an inspection and maintenance point and also provides greater volume for infiltration (as shown below). These systems have been installed in Harris St, Ultimo and Elizabeth St, Waterloo.

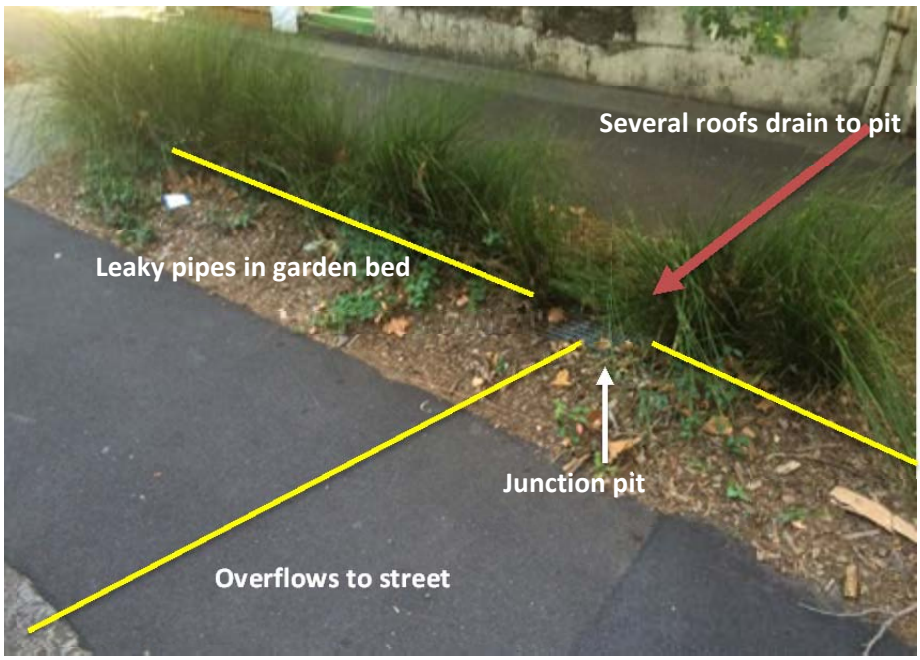

Figure 3: Nature strip with leaky drains and inspection pit in Harris St, Pyrmont

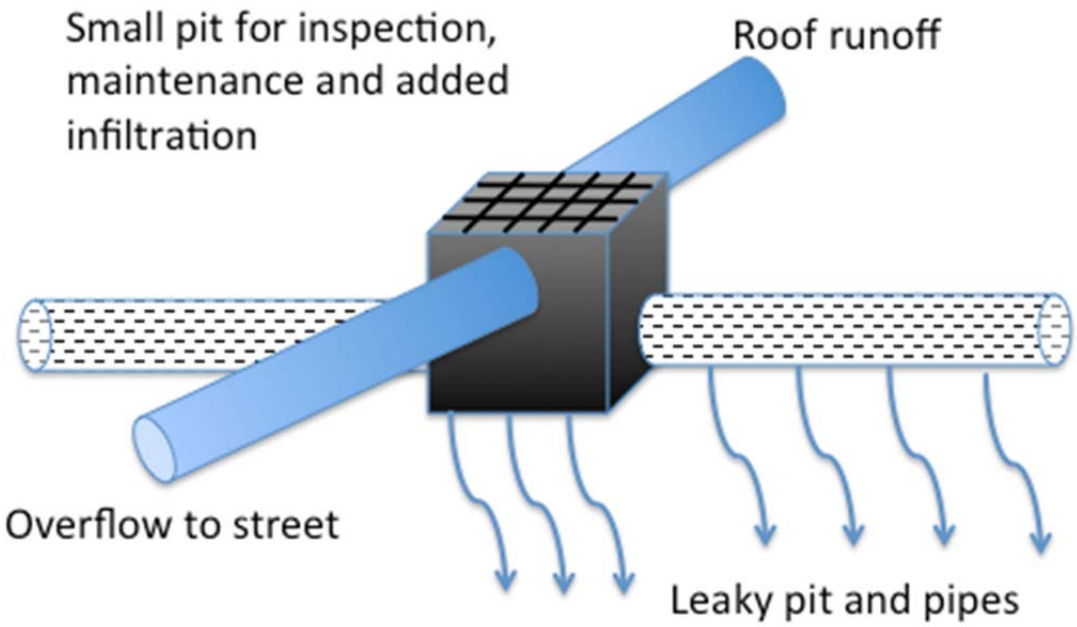

Figure 4: Diagram of the leaky pit design

Council's raingarden program is also focused on reducing the volume and pollution flowing to the Sydney Harbour and Botany Bay. Raingardens are designed to accommodate and treat the polluted first flush flowing off large catchment areas including roofs and roads during rain. These are widely acknowledged as a successful method of improving water quality and providing all the associated benefits of urban greening. To date, Council has installed more than 130 systems across the City and 20 in the Chippendale catchment alone.

Figure 5: Raingarden in Ultimo, downstream of Chippendale

CHIPPENDALE LEAKY DRAINS - EVALUATION

This evaluation reviewed various elements of the proposal including:

- Estimated runoff volumes
- Suitability of soils in Chippendale
- Impacts of infiltration
- Estimated costs
- Installation and maintenance issues.

RUNOFF VOLUMES DIVERTED

The Chippendale project states that 20 leaky drains have been installed and they have captured more than 4 million litres of stormwater. This calculation is based on the idea that the roof area draining to the leaky drain is 60m^2 and 80% of the water arrives in the garden bed (Source: Sustainable Food (2012)). This equates to around 60 kilolitres per house per year. For this volume to be achievable using these assumptions, at least 65 roofs of this size would each need to have been connected to leaky drains, more than the stated 20.

The proposal that approximately 50 million litres of water could be diverted would require more than 800 roofs of 60m^2 to be connected to leaky drains based on these calculations. Most of the houses in Chippendale have roofs draining to the street about 30m^2.

To check these figures, a simple stormwater runoff model; MUSIC, which uses average climate data to model flows and calibrated research data to determine the effectiveness of stormwater pollution removal measures, found approximately 32 kilolitres per year could flow off a 60m^2 roof. The proportion of flow able to be infiltrated was around 30%, which is conservatively high, as MUSIC is designed for larger systems than the leaky pipe, which are below the resolution of the model. Therefore a maximum of 10 kilolitres per year could be infiltrated for each average house roof, which equates to 200 kilolitres per

year rather than the stated 4 million litres from the currently installed systems in the proposal, ie one twentieth.

Based on this analysis, these small pipes will not make an impact on flooding with such small volumes infiltrated.

To achieve the stated 50 million litres per year infiltration, 5,000 roofs would need to be connected, which are not available in the suburb of Chippendale. Connecting larger roof areas would overwhelm the leaky drain by flowing straight through and require large infiltration systems that could not fit into the nature strips around Chippendale. Therefore, the assumed benefits are unachievable.

The MUSIC model also measures the potential of infiltration systems to reduce stormwater pollution, and the results indicate that leaky pipes could reduce total suspended solids by 55%. This reduction is based on runoff from a total urban catchment including roads and pavements, however the initial amount of pollution on the roofs is very low, so the treatment benefit of a leaky pipe will be minimal. Intercepting runoff from the streets through raingardens is more effective at reducing stormwater pollution.

SOIL TYPE IN CHIPPENDALE

Prior to Chippendale being developed from the 1800s, Blackwattle Creek flowed along the alignment of Buckland St, over a flat sandstone base and much of the runoff would have been surface flows. The catchment extends to Redfern and Sydney University. Chippendale is now a densely urbanised area and the major geology of the area consists of impermeable clays and fill - it is impossible to know where the water will flow.

Tests of the hydraulic conductivity (the speed at which water flows through the soil) in the area prior to installing the raingardens in Buckland St, showed a very slow rate (less than 50mm per hour), not suitable for infiltration. Therefore those raingardens were designed to drain to the stormwater system rather than infiltrate.

POTENTIAL IMPACTS OF INCREASING INFILTRATION

A major problem in urban areas is water getting under the roads and weakening the pavement, causing potholes and other structural issues to nearby building foundations. Many of the nearby apartment buildings and warehouses have deep foundations and underground rooms and carparks, which are built close to the pavement, as shown in the figures below.

The possible future impact on these buildings is not clear. While rising damp is a pre-existing issue in Chippendale due to many buildings being constructed without damp course, it is likely prudent not to contribute to the problem with further infiltration in some locations.

These clays will also expand and contract with water changes, causing buildings to crack.

An analysis of the capacity of the geology to handle the increased flows should be undertaken if the project proceeds.

Diverting 50 million litres of water each year into the ground in Chippendale may seriously impact on the foundations of the buildings in the area. While it is beneficial to encourage infiltration, the geological conditions need to be capable of accepting the flows and draining safely past existing infrastructure.

The WSUD Technical Guidelines for Western Sydney (2004) state:
“Infiltration systems are generally not suitable in the following soil or terrain conditions:

- Loose sands or heavy clays;
- Exposed bedrock or shallow soils over rock or shale;
- Unengineered fill

In medium to heavy clays, infiltration systems should have clearance from the building line of 4-5m.”

Figure 6: Showing two locations where infiltration may impact on the foundations of existing buildings.

EXISTING PIPE MATERIAL

Many old drainage pipes were made from asbestos. If any asbestos pipes are found in the proposed trial area, they should not be disturbed.

Other common drainage materials are PVC; which can be cut and re-used, and metal or clay pipes; some of which may be broken down and left in-situ for drainage.

COSTS

The submission to Council suggests the 20 current systems have been installed for a cost of $300 ($15 each). These costs may be achievable for materials only, as the materials required include 100mm PVC pipe, which costs about $5 per metre, and gravel which is about $10 for a 20kg bag or it can be sourced from the ground. The system in Figure 2 features two bends, which would increase the potential of water to infiltrate, and cost $2 each. The geotextile fabric comes in 2m wide, 20m long rolls, at around $2/m so a large amount will need to be stored and cut.

The other costs are labour to prepare the holes in the pipe and install the systems, borne by the Sustainable Chippendale members. To objectively compare this proposal with other options, a 2-hour labour requirement for a qualified tradesman is assumed, equivalent to $180.

The works also require a road-opening permit, which costs $240, applicable for the duration of the trial project.

This proposal intends to bear the costs for these and any other externalities through local business sponsorship and contributions from their volunteer members. This therefore will not be replicable in other areas, unless there is a similar community volunteer group willing to take on the project.

INSTALLATION AND MAINTENANCE

It is proposed to install these systems in a short period so that the required skills and coordination can be gathered together. Specialist equipment will be required in some locations to saw and break concrete, ensure the pipes are connected correctly and to manage public safety during the process. It is proposed to contract a builder (pro-bono) to coordinate the works and manage site safety (particularly for working near the road), obtain the road opening permit as well as providing public liability insurance cover for any volunteers and potential damage to property.

The longer-term issue with the pipes is maintenance, which is the residents' responsibility. Council has advised that it is not their policy to maintain private stormwater pipes draining across footpaths and nature strips. Systems like this will be prone to clogging with leaves and debris, tree root blockage and breakage; causing leaking and flooding.

Currently, there is no maintenance performed on the pipes crossing the nature strip and in many cases none on the downpipes themselves.

Figure 7: Downpipes in Myrtle St showing signs of neglect

At the site meeting, Michael Mobb's explained that the proposed solution to ongoing maintenance is to engage and incentivise the residents with firstly involving them in the installation and enjoy gardening in the nature strip, but also to develop a contract with Council where they must provide photographic evidence of a clear leaky drain pipe every 6 months. In return they would receive a rebate on their rates, equivalent to the $25 Sydney Water stormwater charge. It is assumed that this will ensure the residents remain committed to drain maintenance.

Recouping this fee from Sydney Water would require Council to gain approval from them and the state government. In order to achieve this, extensive lobbying and communication with the agencies will be required, and if it does happen, the administration would likely require several hours per week of a full-time Council employee to review the inspection reports, maintain an asset register of all new systems and coordinate the rate rebate each quarter.

Table 1: Summary of Pros and Cons

PRO	CON
• Increasing water infiltration mimics previous hydrology and reduces flows in stormwater drains and reduces some of the pollution in stormwater runoff. • Diverting water into nature strips reduces the demand for irrigation, thus saving potable water. • Green strips along the footpaths in urbanised areas provide cooling and visual amenity. • The systems can be installed relatively cheaply. • The community may embrace the idea and continue to manage the drains.	• The assumed volumes of runoff diverted are overestimated and do not take into account high flows bypassing the pipes. To achieve the stated targets, over 5,000 roofs of 60m^2 need to be connected and the proposed water diversion benefits are unlikely to be achieved. • Increased water infiltration may damage underground infrastructure and exacerbate rising damp problems because the clay soils in Chippendale are not suitable for infiltration. • These systems cannot be installed where the existing pipe is made from asbestos. • Blocked pipes can cause damage to houses, the nature strip and the footpath. • The proposed costs do not include labour, permits, insurance or safety management and therefore cannot be compared with a similar proposal in another area. • The works require a road opening permit and liability insurance for working in a roadway. • The systems may cause damage to buildings and the footpath, which raises a liability issue. • Council's raingardens provide the same function with additional treatment and flow capacity and are specifically designed for their purpose and location. • The systems will need long-term maintenance by the residents. • Managing a rebate system to ensure the maintenance of the systems will cause an administrative burden to Council.

OTHER POSSIBLE SYSTEMS FOR CHIPPENDALE

In addition to the designs adopted by Council, there are other solutions which provide the same benefit as a leaky drain and may be more appropriate for the limitations of Chippendale.

It may be possible to install small rainwater tanks in the front of houses around Chippendale to collect water for irrigating the nature strip gardens. This would be a good solution where the soils, pipe material other services make it impossible to install the leaky pipe. It is also a visible unit which will encourage continual use.

There are products that enable water in the gutter to infiltrate, by drilling through the gutter and deep into the ground. These would be the responsibility of Council to install and manage. A product called Aquakerb provides this function but it was not possible to contact the company for details on costs or availability.

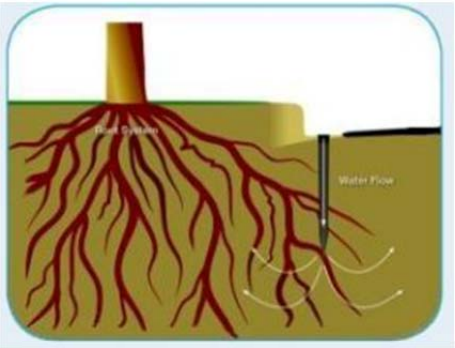

Figure 8: Aquakerb system

Above ground planter beds can be connected to the downpipes for irrigation before overflowing to the street drainage. These are essentially elevated raingardens and they avoid the issue of poor soil conditions and provide accessible maintenance points.

Figure 9: Above-ground raingarden planter (source: Melbourne Water)

CONCLUSIONS

1. The assumed volumes of water to be diverted have been modeled and found to be approximately one twentieth of the stated possible volumes.
2. These systems will cause a negligible reduction of frequent flooding.
3. Increasing water infiltration in a highly developed area and with dense clay and fill soils like Chippendale may pose risks to road and building infrastructure and should be investigated further.
4. Some existing pipes are made from asbestos and should not be cut.
5. The installation costs proposed are only achievable with purchase of supplies in bulk and labour contributed for free by the Sustainable Chippendale members and do not include the cost of road opening permits.
6. Issues such as safety, liability and maintenance need to be carefully managed and in this trial the costs of these have not been included for comparison.

RECOMMENDATION

It is not recommended to fund a Chippendale-wide implementation of leaky drains due to the risk to property and infrastructure posed by the slow rate of infiltration combined with the heavily urbanised area. The ongoing maintenance requirement and possible damage caused by these systems could cause issues for Council.

REFERENCES

City of Sydney (2012) Greening Sydney Plan

Michael Mobbs (2012) Sustainable Food, UNSW Publishing

NSW Government (2013) Botany Bay Local Environment Plan

WSUD Technical Guidelines for Western Sydney (2004) URS and UPRCT

www.wsug.org Water Sensitive Urban Design resource

http://healthywaterways.org Water Sensitive Urban Design resource