KINHILL PTY LTD

SLOPE STABILITY ASSESSMENT

ST PETERS URBAN WETLAND

A3256/1-AF

14 December 2000

Coffey

A3256/1-AF ATM:rr
14 December 2000

Kinhill Pty Ltd
186 Greenhill Road
PARKSIDE SA 5063

Attention: Mr Damien Byrne

Dear Sir,

RE: SLOPE STABILITY ASSESSMENT
ST PETERS URBAN WETLAND

Please find enclosed 3 copies of our report on our assessment of slope stability issues at St Peters Urban Wetland.

If you have any questions please do not hesitate to contact Alan Moon or the undersigned.

For and on behalf of
COFFEY GEOSCIENCES PTY LTD

ROGER GROUNDS

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1. INTRODUCTION

The Torrens Catchment Water Management Board is proposing to create an urban wetland in the St Peters River Park next to Eighth Avenue, St Peters. There is an existing billabong (known as the Billabong) at the site. The purpose of the project is to increase the flows from Second Creek into the wetland to treat a greater volume of water prior to discharge to the River Torrens.

Coffey Geosciences Pty Ltd (Coffey) has carried out a slope stability assessment at the site of the proposed St Peters Urban Wetland. The assessment was commissioned by Ms Bernie Foley of Kinhill Pty Ltd (Kinhill) in a letter dated 1 March 2000. A proposal for the assessment (Coffey letter dated 15 February 2000, Reference A3256/1 - AB was prepared in response to a brief from Kinhill (facsimile dated 11 February 2000).

The stability assessment was commissioned because of concern about the stability of steep riverbanks on the eastern side of the Billabong. The issue of the stability of these steep banks was raised in earlier reports by Coffey (for the City of Norwood, Payneham and St Peters) and by Golder Associates (for Kinhill).

The following three different operating options are being considered for the proposed wetland:

- Option 1: Billabong to remain operating as it currently does;
- Option 2: Permanent water level in Billabong to be raised 500 mm to 1000 mm with some additional fluctuations in water level;
- Option 3: Raise water level in Billabong and introduce a connection to the river resulting in high river levels being reflected in the Billabong (100 year ARI water level, 27.0 m AHD).

We understand that each option may involve some deepening of the Billabong.

The Kinhill brief asked for an assessment of appropriate slope stabilisation and/or slope risk management options for the above operating options.

In a meeting at the City of Norwood, Payneham and St Peters on 30 March 2000 we discussed progress on the assessment. At that meeting it was agreed to change the scope of the assessment to include discussion of non engineering treatment options. It was also agreed that cost estimates of engineering options and sketches of proposed works were not required.

This report presents the results of the slope stability assessment and discusses slope risk management options.

2. SCOPE

The slope stability assessment has included:

- review of published geological maps of the area;
- review of two editions of the 1 to 2500 orthophotograph of the area (1972 and 1985);
- review of stereopair aerial photographs taken in 1949, 1959, 1968, 1979, 1989 and 1998;
- review of previous reports on the site by Coffey and Golder Associates;
- review of previous reports by Coffey on the stability of the banks of the Torrens River elsewhere in the vicinity;

- site mapping including observation of slopes, soil exposed in cliffs and the approximate positions of fences and buildings;
- photography;
- discussions with local residents;
- discussions with Allsurv Engineering Surveys Pty Ltd;
- laboratory testing of soil obtained from the site (Atterberg limits, particle size distribution and Emerson dispersion);
- preparation of drawings (site plan and cross sections);
- preliminary assessment of stability and slope risk management options;
- meetings to discuss progress with Kinhill, the City of Norwood, Payneham and St Peters and the Torrens Catchment Water Management Board and the City's legal advisors;
- preparation of a draft report for discussion purposes;
- preparation of a final report.

3. SITE DESCRIPTION AND SITE HISTORY

3.1 Surface conditions

Figure 1 is a plan of the site. Cross sections of the old river bank overlooking the Billabong are shown in Figures 2 and 3. Figures 4 and 5 are photographs of the soil cliffs.

On Figure 1 we have shown the approximate position of the river bank near the Billabong where it is at least 5 m high. We have shown the slope height, and average slope and those sections of slope where soil cliffs occur. The soil cliffs are up to about 4 m high, are very steep and occur near the top of the river bank. Average overall slopes of up to 55° were observed where soil cliffs occur.

No soil cliffs were observed on the southern section of the river bank (west of St Peters Street) where the slopes are made up of fill. In this southern section overall slopes vary between 35°and 40° and slopes are up to about 8 m high.

The plan and cross sections also show the approximate positions of property boundaries, fences and houses relative to the top of the cliff. The position of these features should be regarded as indicative only as they are not based on accurate survey.

On the northern side of 10A Eighth Avenue there is a 20 m long brick wall with six vertical joints (articulation joints). No cracks were observed in the wall.

3.2 Geology

According to published geological maps the area is underlain by alluvium deposited by the River Torrens. The alluvium observed in the soil cliffs is old alluvium that was deposited many thousands of years ago. It is generally stronger (denser or stiffer and cemented in places) than recent alluvium found in the present channel or deposited in recent floods. A brief description of subsurface materials observed on and near the river bank is given in Table 1.

TABLE 1: BRIEF DESCRIPTION OF SUBSURFACE MATERIALS

Material type/geological origin	Brief description	Occurrence/comments
FILL	Variable mixture of sandy clay, clayey sand, gravel, cobbles, boulders, fragments of brick and concrete.	Fill up to 8 m thick occurs south of the Billabong (east of St Peters Street). Fill also occurs on the river bank west of 3 River Street and elsewhere.
COLLUVIUM	Loose mixtures of clay, silt sand and gravel on the steep banks.	Formed by the accumulation of eroded material from higher up the slope.
TOPSOIL	Grey or grey brown sandy clay, silty clay or clayey silt. Friable.	Up to about 0.5 m thick where exposed in soil cliffs.
YOUNG ALLUVIUM	Very loose or soft mixtures of clay, silt, sand and organic material in and near the Billabong. May also include gravel in the old river channel.	Depth not known.
CALCAREOUS SOIL	Pale brown, calcareous silty clay with some gravel. Weakly to moderately cemented.	Underlain topsoil in the soil cliff. 1 m to 2 m thick. Includes irregular joints, tubes and tube casts.
VARIABLE OLD ALLUVIUM	Materials observed in the soil cliff include silty clay, sandy clay, clayey sand and clayey silt. Some of the soils are weakly cemented. Some slake (break up) in the presence of water. Drilling nearby indicates that medium dense to very dense silty sand and sand gravel mixtures may also occur.	Near vertical irregular joints observed in the soil cliff.

3.3 Site history

The most significant change to the area in the past 50 years from the stability point of view was the diversion of the River Torrens in 1976 (dated from Golder Associates report). Prior to the diversion the main channel meandered past the back of River Street and Eighth Avenue (Figure 1). The slopes which are now of concern formed the outer edge of the meander. At times of high flow erosion usually occurs on the outer edge of meanders. Early aerial photographs indicate that soil cliffs extended from about 18 River Street downstream (south) to near the end of Goss Court. These cliffs were probably formed by river erosion undercutting the base of the slopes. We understand (discussions with Andrew Thomas of the Torrens Catchment Water Management Board) that concern about erosion by the river undercutting the slopes may have been the main reason for diverting the river.

Other aspects of the site history based on review of old aerial photographs, orthophotographs and earlier reports are summarised below:

- In 1949 there were few houses in River Street. Numbers 12 to 16 Eighth Avenue had sheds at the back of their gardens close to the top of the soil cliff. Some of these sheds still exist. There appears to be fill at what is now Number 10A Eight Avenue.
- By 1959 there were houses at Numbers 1 and 5 to 21 River Street. Number 3 was vacant and fill reaching into the river had been placed at the back of the lot. Several trees still present at the top of the slope are visible on the 1959 aerial photograph.
- By 1968 Number 3 River Street was still vacant. A small landslide may have occurred on the fill slope (scar on the 1968 aerial photographs). The soil cliff between the end of St Peters Street and Goss Court had been covered by fill (Figures 1 and 3).
- By 1979 (after diversion of the river) there was a small shed on Number 3 River Street. A tree near the top of the slope behind 5 River Street visible on the 1968 aerial photograph no longer exists.
- In the 1989 aerial photograph there is bare soil at the top of the slope between St Peters Street and Goss Court probably indicating more fill has been placed in this area. In 1989 there is still no house on Number 3 River Street.
- By 1998 there is a house on Number 3 River Street. There is also an extension to Number 15 River Street closer to the top of the slope (Figures 1 and 2) and a swimming pool at Number 1 River Street (about 8 m from the top of the slope). There are trees on and near the top of the fill slope between St Peters Street and Goss Court.

At the time of the site mapping the southern corner fence post at the rear of Number 12 Eighth Avenue was located at the top of the soil cliff (Figure 5). The residents of the house reported that there used to be a path behind their fence and "about 10 years ago" children could get around the corner. Most of the recent erosion appears to have been of the friable topsoil. The underlying variably cemented calcareous soil still extends beyond the fence (Section CC' Figure 2). The residents understand that many years ago (before they lived there) there may have been a wider track behind the property with enough room for a horse and cart. Older residents in the area may have knowledge of this path or track.

3.4 Slope failures and condition of slopes

As discussed above there has been loss of material from the soil cliffs overlooking the Billabong in recent years. This has probably been the result of erosion and small slope failures (toppling failures on near vertical joints). Erosion has probably been caused by rain, wind, animal burrowing, and the action of plants (growing roots dislodging soil). Human activity may have also contributed to the erosion (eg, disturbed topsoil on narrow footpaths or climbing across the cliff face). In places the soil cliff is undercut (Section CC' on Figure 2) and there are near vertical open joints or tension cracks. In other places the soil mass in the cliff appears to be bound together by tree roots and the cementing (particularly in the calcareous soil) contributes to the stability of the cliffs.

Loose colluvium soil occurs on the lower slopes below the soil cliffs. Loose soils were also observed on the fill slopes. Most of the fill slopes are well vegetated. Some of the trees lean down slope which may indicate shallow slope failures may have occurred in the past.

4. STABILITY ASSESSMENT AND OTHER GEOTECHNICAL ISSUES

4.1 Potential slope failure mechanisms and stability analysis

Potential slope failure mechanisms include:

- erosion and toppling failure of the soil cliffs;
- shallow failures of colluvium or fill on other slopes;
- deeper failures of colluvium or fill on other slopes;
- erosion and scour by running water (from the Torrens River or Second Creek into or out of the Billabong after direct connection to the river);
- rapid drawdown failure (when the water level drops quickly after flooding).

Uncertainties in input parameters (associated with the variability of materials, pore pressures, cementing, effects of roots etc) means that numerical slope stability analysis can confirm that the slopes are only marginally stable but can provide only limited insight into the rates and size of slope failures. Such insights are best derived from understanding failure mechanisms and understanding what has happened in the past at the Billabong and in similar situations elsewhere.

In this report, the term "overall stability" refers to the stability of the entire slope from the toe to the crest. In this project any movement of the crest of the slopes adjacent to the Billabong is particularly significant because of the nearby properties.

Rates of retreat of slopes are usually characterised by the rate of retreat of the crest of the slope. Again, as the location of the crest is particularly significant, the term "overall rate of retreat" in this report refers to the rate of retreat of the crest of the slope.

4.2 Past and current rates of slope retreat

Soil cliffs

The soil cliffs were probably formed by undercutting of the slope on the outer bend of the river. As the river no longer undercuts the slope the rate of cliff retreat has probably reduced. As discussed in Section 3.4 erosion and toppling failure is continuing to occur. The process is generally slow although it is possible that larger individual falls (with volumes of up to at least one cubic metre could occur from the higher cliffs. In our judgement the current average rate of retreat of the higher soil cliffs may be between 1 m and 3 m every 50 years.

Other slopes

Vegetation (grass, shrubs and trees) is established on most other slopes. Under present conditions the slopes above the Billabong are not subject to running water from the river. In our judgement although the slopes are vulnerable to small shallow slope failures (generally less than 0.5 m deep) large failures of the overall slopes are unlikely. Overall rates of slope retreat are judged to be less than 1 m every 50 years.

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4.3 Effect of proposed wetland and extreme conditions

In considering the effect of the three options for the proposed wetland we have assumed that there will be no deepening of the Billabong within 10 m of the base of the slope and no excessive, steep-sided deepening elsewhere. We suggest that if any excavation is carried out in the Billabong more than 10 m from the base of the slope it should be less than 1.5 m deep and side slopes should be less than 3H to 1V (horizontal to vertical). Deeper or steeper side excavations, if carried out, could initiate slope failures in the lower parts of the slope and increase the likelihood of larger slope failures.

Our assessment of the effect of the three options and extreme conditions assuming no deepening is carried out near the slopes is summarised below:

Option 1: (No change in operation of the Billabong)

If this option is adopted we would expect no change in the overall condition of the slope and rates of slope retreat.

Option 2: (Water level in the Billabong raised by 0.5 to 1 m and minor fluctuations)

If this option is adopted we would expect a minor increase in erosion and very small slope failures near the base of the slopes. We would expect negligible effect on overall stability and no effect on overall rates of retreat of the soil cliffs or overall slopes.

Increasing water levels in the Billabong by 0.5 m to 1 m and minor fluctuations in water level during operation (assumed to be less than 0.5 m) could result in a minor increase in erosion and a very small slope failures near the base of the slope, assuming that the existing vegetation cover is maintained. In our judgement:

- the individual volume of most of the very small failures is likely to be less than 1m^3;
- the effects on the slopes from the very small failures and minor erosion is likely to be limited to small scarps or local steepening (less than about 1 m high) within 1 m to 2 m of the water level at the edge of the Billabong.

Option 3: (Raise water levels in the Billabong and connect with River Torrens. The 100 year flow level is assumed to be RL 27m)

With this option there is likely to be erosion and small rapid drawdown failures which may increase the likelihood of overall slope failures. As shown on Figures 2 and 3 the 100 year flow level is well below the top of the slope and the soil cliffs. Unless significant undercutting occurs erosion and rapid drawdown failures are unlikely to have an effect on the rate of retreat of the soil cliff. The amount of erosion and failures that occur will be related to the rate at which water flows into and out of the Billabong.

Extreme floods (and intense rain)

The slopes will be most vulnerable during extreme floods (where the river water level rises above RL 27 m) and during intense rain. Erosion of the slopes, shallow failures of colluvium and fill including rapid drawdown failures would be expected. There may also be some deeper failures of the fill slopes. If river levels reach the soil cliff, significant erosion and toppling failures would be likely resulting in an accelerated retreat of the cliff top.

Options 1 and 2 would appear preferable to Option 3 as the likelihood and consequences of future instability are judged to be significantly lower. Any connection to the river should be regulated with a suitable control structure at the inlet.

The assessment of the future performance of slopes for Option 2 presented above is based on our judgement that, left untreated, small scars or over-steepening could result in shallow soil movement in the lower half of the slope but are unlikely to result in any slope movement in the upper half of the slopes, the soil cliffs or the crest of the slope or cliffs. As can be seen on Cross Sections AA' to FF' (Figures 2 and 3), the areas which may be affected by erosion and very small failures are well away from the crest of the slope.

We recommend a regular review of the condition of the edge of the Billabong (at least once a year and after major floods or changes to the water level). Consideration should be given to locally treating erosion and slope failures if they occur in order to prevent progressive deterioration of the slope. This strategy of on-going maintenance is considered essential to maintain the integrity of natural slopes.

We emphasise that the above opinions are based on judgement and experience. If the future condition of the slopes and banks of the Billabong differ from those anticipated above further specialist advice should be sought.

If Option 3 is selected, additional advice must be sought from Coffey as part of the design work. It is considered that some slope protection measures would be required as part of this option.

4.4 Properties at risk

The position of the property boundaries shown on Figures 1 to 3 with respect to the cliffs and the top of the slope is approximate only. Survey would be required to establish accurate relationships between property boundaries, fences, buildings, cliffs and the top of the slope.

On the basis of our assumptions of where the actual property boundaries are and our assessment of current rates of cliff and slope retreat some properties appear at risk of being affected by slope instability in the next 50 years. The most vulnerable properties are those where the back fences are closest to the top of the cliff or slope. If slope instability occurs back fences and, in some properties, small out-buildings may be at risk.

In our judgement, the existing houses are unlikely to be affected by slope instability in the next 50 years.

Properties which in our opinion are at risk of being affected by slope instability in the next 50 years are listed below:

Property	Comments
12 Eighth Avenue	Most vulnerable property. Fence at top of the soil cliff (Figures 1, 3, 4 and 5).
14 and 16 Eighth Avenue 1, 3, 5, 13 and 13A River Street	Properties with fences within about 2 m of the top of the soil cliff or slope (Figures 1, 2 and 5).
7, 9, 11, 15 and 17 River Street	Properties with fences between about 2 m and 10 m of the top of the soil cliff or slope (Figures 1 and 2).

We have not assessed the risk to properties close to the Torrens River east of Goss Street.

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4.5 Other geotechnical issues

It appears likely that part of the house at 10A Eighth Avenue is located on fill. The City of Norwood, Payneham and St Peters provided a copy of a footing construction report prepared by RM Herriot and Associates (Reference F9106-047 A, 23 March 1992) for 10 Eighth Avenue. At that time a brick wall, roof extension and paving were planned. RM Herriot recognised the existence of deep fill and recommended driven piles be used. However, there are now two new houses on the property and we are unaware of what footings were used for these structures. Depending on the type of footings the house may be vulnerable to differential settlement if the fill becomes saturated under extreme conditions (eg, a very large flood or following intense prolonged rain).

Other houses in the area are likely to be founded on natural ground (or shallow fill) and are likely to be less vulnerable to differential settlement under extreme conditions.

Part of Eight Avenue (Figure 1 and Figure 3, Section DD') may be founded on fill near an old soil cliff and may be vulnerable to differential settlement.

5. SLOPE RISK MANAGEMENT

In this section we explain the basic principles of slope risk management and list possible treatment options, to facilitate discussion of legal implications.

Slope risk management involves answering the following questions:

- What might happen? (HAZARD IDENTIFICATION)
- How likely is it? (LIKELIHOOD)
- What damage or injury may results? (CONSEQUENCE)
- How important is it? (RISK EVALUATION)
- What can be done about it? (TREATMENT)

Hazards, likelihood and consequences have been discussed in previous sections. Risk evaluation involves value judgements by clients, owners, regulators and those affected by the risk. Treatment options by different parties depend on, among things, risk evaluation, resources available and degree of responsibility. In our earlier report to the City of Norwood, Payneham and St Peters (Reference A3214/1-AB, 22 November 1999) we identified the following engineering options to improve the stability of the steeper slopes close to existing properties:

- flattening the slope (where access permits), particularly in the near vertical sections;
- a geo-grid reinforced earthfill embankment;
- a crib wall retaining system;
- a gabion retaining wall;
- soil nailing;
- vegetation cover and erosion mats.

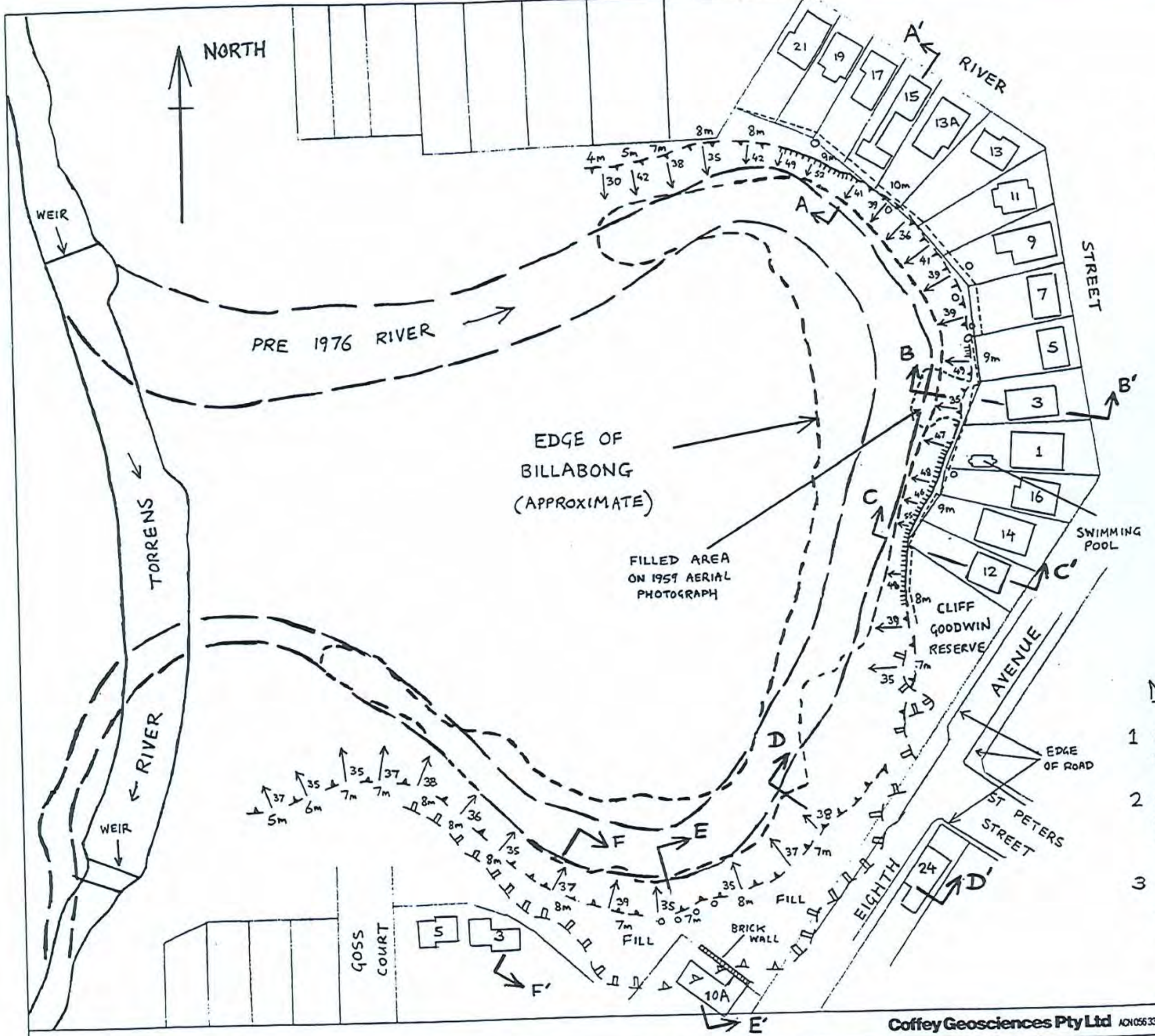
The above options are likely to be highly intrusive, difficult to construct (due to restricted site access) and expensive.

Depending on legal advice on responsibility, legal implications and other considerations (eg, aesthetic, environmental), we suggest that non engineering treatment options including the following should be considered where private properties are close to the top of slopes:

- do nothing (cliff retreat is a natural process);
- suggest/advise some residents to move their fences away from the top of the slope;
- restrict developments (such as buildings, swimming pools and elaborate landscaping) with a prescribed distance from the crest of the river bank (say nominally 10 m);
- offer to move fences back for some residents;
- erect warning signs for the public about the danger of falling from cliffs and cliff falls;
- restrict public access;
- buy a strip of land at the back of some properties close to the top of steep slopes.

Experience elsewhere indicates that the people may be more tolerant of risks from natural slopes than from engineered slopes. Carrying out engineering works on the slopes or substantially modifying the Billabong (such as opening it up to the river) may make people less tolerant of subsequent stability problems.

For and on behalf of
COFFEY GEOSCIENCES PTY LTD



LEGEND

- APPROXIMATE PROPERTY BOUNDARY (BASED ON SURVEY DRAWING)
- APROXIMATE POSITION OF FENCE RELATIVE TO TOP OF BANK
- APPROXIMATE POSITION OF HOUSE (FROM 1998 AERIAL PHOTOGRAPH)
- TOP OF SOIL CLIFF
- TOP OF SLOPE AND SLOPE HEIGHT
- SLOPE ANGLE
- TOP OF SOIL CLIFF IN 1959 (PROBABLY EXTENDED AS FAR NORTH AS 19 RIVER STREET)
- TOP OF FILL SLOPE IN 1959
- LINE OF CROSS SECTION (SEE FIGURES 2 AND 3)
- TREE (ONLY SOME SHOWN)

NOTES

1. BASE PLAN FROM ALLSURV ENGINEERING SURVEYS PTY LTD DRAWING No. 70299D1A, 13 OCTOBER 1999.
2. PRESENT POSITION OF RIVER TORRENS FROM 1985 ORTHOPHOTOGRAPH, FORMER POSITION OF RIVER TORRENS FROM 1972 ORTHOPHOTOGRAPH (REFERENCE 1:2500, 6628-42-a).
3. PLAN IS APPROXIMATE ONLY. SURVEY WOULD BE REQUIRED TO ESTABLISH ACCURATE RELATIONSHIPS BETWEEN PROPERTY BOUNDARIES, FENCES, BUILDINGS, CLIFFS AND TOP OF SLOPE

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | Resources | Environmental | Technical | Project Management

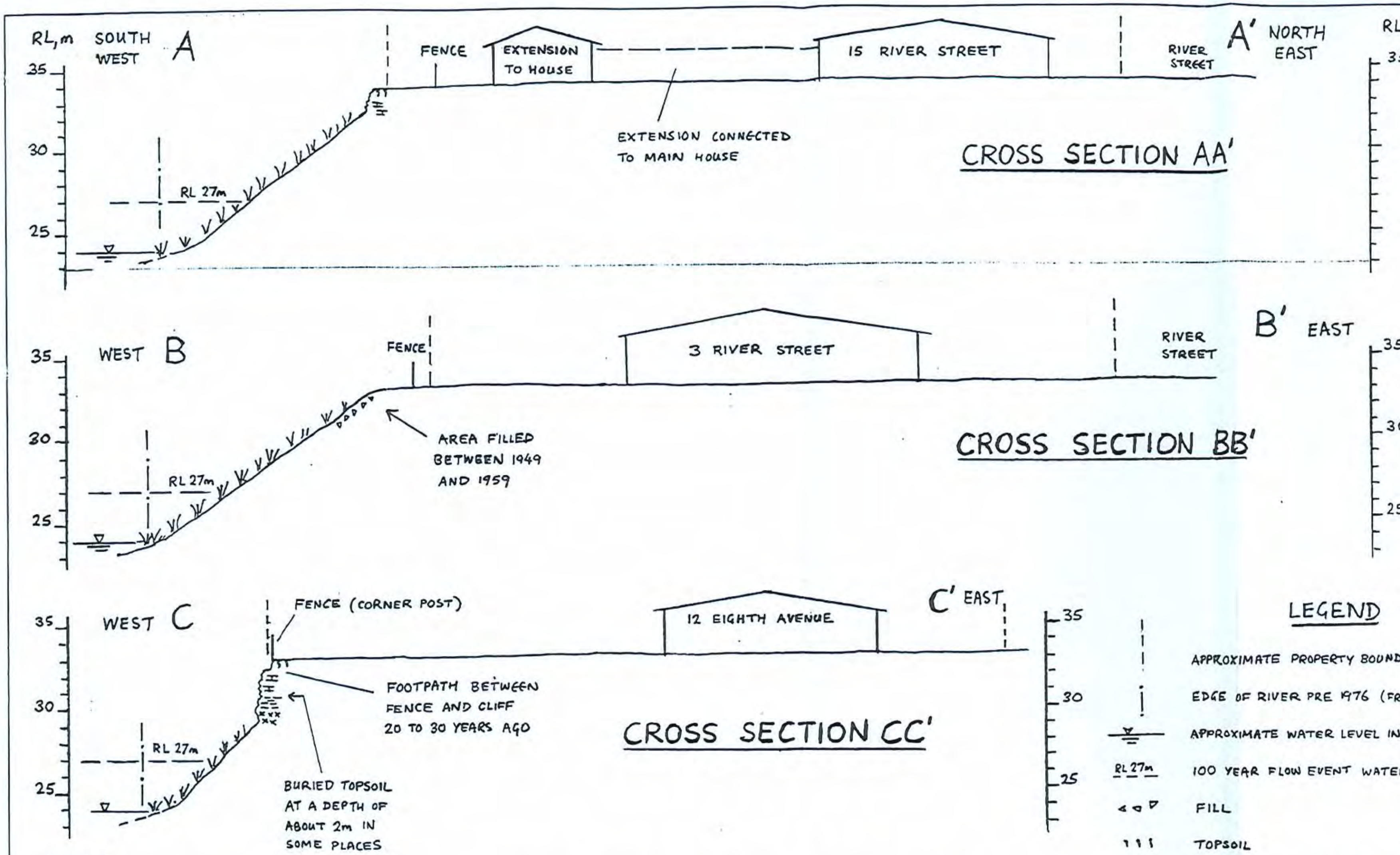
Scale (metres): 0 15 30 60 90

Revision	Description	Drawn	Approved	Date

Drawn	ATM	KINHILL PTY LTD
Checked	ATM	ST PETERS URBAN WETLAND
Date	23 June 2000	SITE PLAN

~~Drawing no:~~ Figure 1

Job no: A3256/1



LEGEND

- APPROXIMATE PROPERTY BOUNDARY (BASED ON SURVEY DRAWING)
- EDGE OF RIVER PRE 1976 (FROM 1972 ORTHOPHOTOGRAPH)
- APPROXIMATE WATER LEVEL IN BILLABONG (RL 24m)
- RL 27m — 100 YEAR FLOW EVENT WATER LEVEL
- FILL
- TOPSOIL
- CALCAREOUS SILTY CLAY, VARIABLY CEMENTED
- SILTY CLAY AND CLAYEY SILT

NOTES

1 CROSS SECTIONS ARE APPROXIMATE ONLY. PROPERTY BOUNDARIES NOT SURVEYED AND HOUSE POSITIONS BASED ON 1998 AERIAL PHOTOGRAPHS. HOUSE POSITIONS, SIZE AND SHAPE INDICATIVE ONLY

Scale (metres): 0 5 10 20

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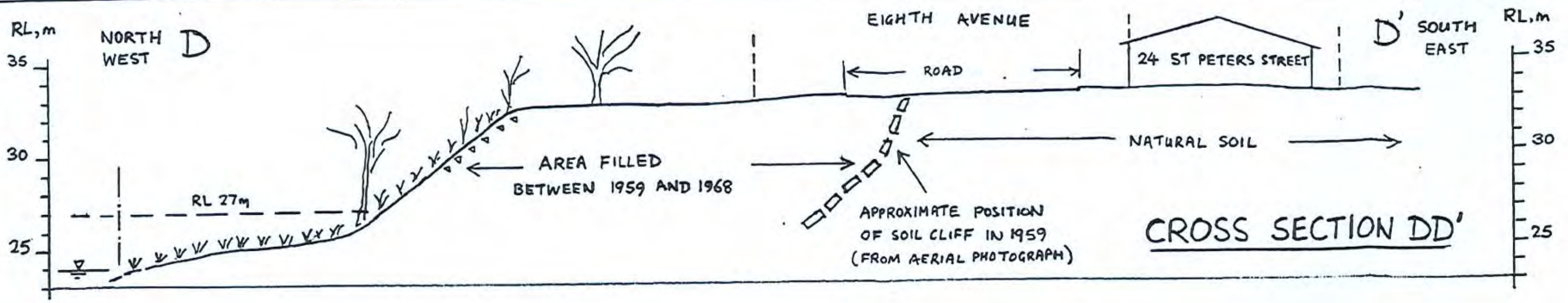
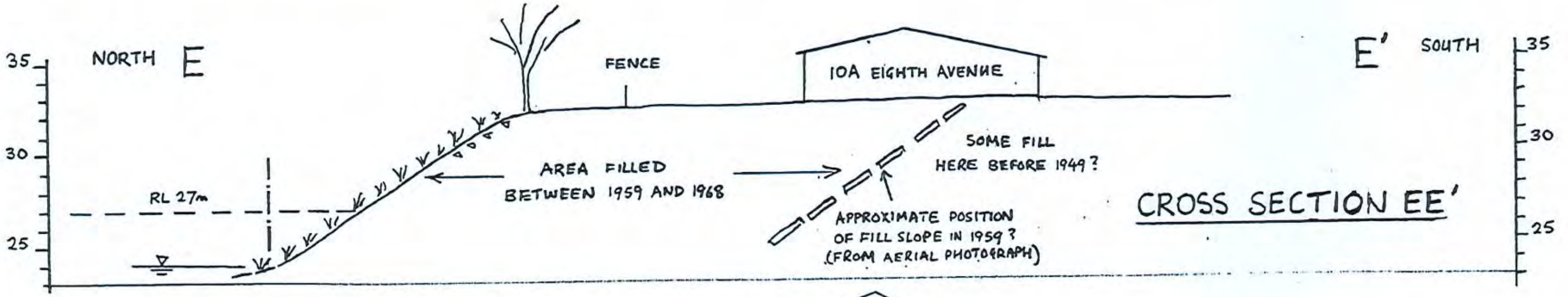
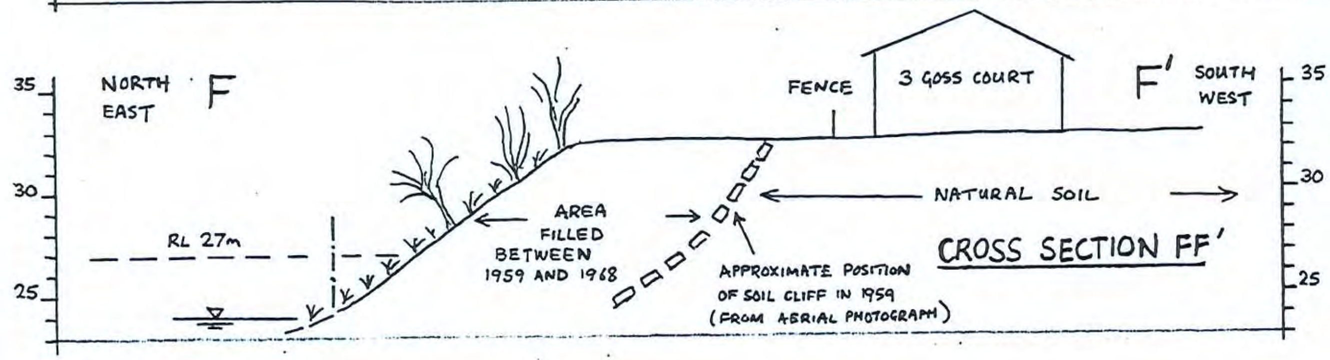
Revision	Description	Drawn	Approved	Date

Drawn	ATM	KINHILL PTY LTD	~~Drawing no:~~ Figure 2
Checked	ATM	ST PETERS URBAN WETLAND	
Date	23 Jue 2000	CROSS SECTIONS AA', BB' AND CC'	Job no: A3256/1

A15







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Scale (metres): 0 5 10 15

Revision	Description	Drawn	Approved	Date

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Geotechnical | Resources | Environmental | Technical | Project Management

Drawn	ATM	KINHILL PTY LTD ST PETERS URBAN WETLAND CROSS SECTIONS DD', EE' AND FF'	Drawing no: Figure 3
Checked	ATM		
Date	23 Jun 2000		Job no: A3256/1

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← RIVER STREET → ← EIGHTH AVENUE → ← CLIFF GOODWIN RESERVE →

No. 3 No. 1 No. 16 No. 14 No. 12

21 MARCH 2000

Coffey Geosciences Pty Ltd ACN 056 335 516 | Geotechnical | Resources | Environmental | Technical | Project Management

Scale (metres)	Revision	Description	Drawn	Approved	Date

Drawn	ATM	KINHILL PTY LTD	~~Drawing no:~~ Figure 4
Checked	ATM	ST PETERS URBAN WETLAND	
Date	23 Jun 2000	PHOTOGRAPH LOOKING NORTH EAST AT SOIL CLIFF ABOVE THE BILLABONG	Job no: A3256/1

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21 MARCH 2000

Coffey Geosciences Pty Ltd ACN 056 335 516

Geotechnical | **Resources** | Environmental | **Technical** | Project Management

Scale (metres)	Revision	Description	Drawn	Approved	Date

Drawn	ATM	KINHILL PTY LTD	Drawing no: Figure 5
Checked	ATM	ST PETERS URBAN WETLAND	
Date	23 Jun 2000	PHOTOGRAPH LOOKING NORTH AT SOIL CLIFF BELOW EAST CORNER OF No:12 EIGHTH AVENUE	Job no: A3256/1

Information

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Coffey

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design toward construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

** For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National Headquarters, Canberra, 1987.*