PROPOSED SUBDIVISION - RIVERSIDE ESTATE PROJECT APPLICATION AND MASTER PLAN AREA, TEA GARDENS

Tattersall Surveyors Pty Ltd

GEOTSGTE20248AA-AF
4 July 2008

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
19 Warabrook Boulevard Warabrook NSW 2304 Australia

4 July 2008

Tattersall Surveyors Pty Ltd
PO Box 54
RAYMOND TERRACE NSW 2324

Attention: Bob Lander

Dear Bob

RE: PROPOSED SUBDIVISION

RIVERSIDE ESTATE PROJECT APPLICATION AND MASTER PLAN AREA, TEA GARDENS

GEOTECHNICAL AND ACID SULFATE SOILS ASSESSMENT

Please find enclosed a report describing geotechnical studies carried out on the above site.

The purpose of the assessment was to provide comments and recommendations on acid sulfate soils within the proposed development area. A generic Acid Sulfate Soils (ASS) Management Plan has been provided for the Riverside Estate Project Application and subsequent stages.

The assessment also provides preliminary geotechnical information for the design and construction of road pavements and residential footings. On site soils have been assessed and preliminary site classifications in accordance with AS2870-1996 are provided.

Further advice on the uses and limitations of this report is presented in the attached document, *'Important Information about your Coffey Report'.*

If you have any questions regarding this matter please contact Robert Pearce or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd.

Arthur Love

Principal Geotechnical Engineer

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
19 Warabrook Boulevard Warabrook NSW 2304 Australia
T (+61) (2) 4016 2300 F (+61) (2) 4016 2380 www.coffey.com

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1 INTRODUCTION

This report presents the results of a geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) on behalf of Tattersall Surveyors Pty Ltd for the proposed Riverside Estate Project Application and Master Plan area, Tea Gardens.

The work was commissioned by Bob Lander of Tattersall Surveyors Pty Ltd on behalf of Crighton Properties Pty Ltd by way of two faxed Authorisation to Proceed forms dated 16 March and 5 April 2007. A master plan of the proposed subdivision was provided by the client.

The proposed Riverside Estate Project Application is understood to involve the subdivision of the site into a total of 390 dwellings, including dual occupancy dwellings and small lot / medium density development and construction of associated subdivision roads. The proposed Riverside Estate Master Plan area is located to the north and north east of the Riverside Estate Project Application and is understood to involve the subdivision of the site.

The scope of work for the geotechnical assessment included providing recommendations on:

- Site preparation;
- Excavation conditions;
- The suitability of the site soils for use as fill and on fill construction procedures;
- Acid sulfate soil conditions and requirements for an acid sulfate soils management plan;
- Preliminary site classification to AS2870–1996;
- Preliminary pavement design and construction;
- Special requirements for construction procedures and or site drainage.

The following report presents the results of field investigations and laboratory testing and provides discussion and recommendations relevant to the above scope of work.

2 FIELD WORK

Field work was carried out between from 4 April to 5 June 2007 and consisted of:

- Excavation of 40 test pits (TP1 to TP34 and TP39 to TP44) across the site using a rubber tyred backhoe to depths of up to 2.5m. Disturbed samples of representative materials were taken for acid sulfate soils testing;
- Drilling of six boreholes (BH35 to BH38 and BH45 and BH46) at the site using a 4WD mounted drilling rig to depths of up to 10.45m;
- Site observations and mapping of relevant site features.

All field work was carried out in the full time presence of an Engineering Geologist who located the test pits and boreholes, carried out the sampling and testing and produced engineering logs of the test pits and boreholes. Engineering logs of the test pits and boreholes are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation.

The test pit and borehole locations were pegged by the client prior to the investigation. Test pit and borehole locations are shown on Figure 1.

3 SITE CONDITIONS

3.1 Surface Conditions

The site is bounded by Toonang Drive and an existing residential subdivision to the north, Myall Street to the west, undeveloped low lying land adjoining the Myall River to the east and the recently constructed Myall Quays Estate to the south.

Topographically the site is located within an area of low lying coastal sand plains. The site is flat to slightly sloping and is subject to prolonged water logging during periods of wet weather.

Surface elevations across the site range from about RL0.75m AHD in the south eastern corner of the site, to between about RL5m across the north eastern portion.

The majority of the site has been cleared, with vegetation comprising an established cover of medium to tall grasses and scattered medium sized eucalypts.

3.2 Subsurface Conditions

With reference to the Newcastle 1:250,000 Geological Series Sheet SI 56-2, the site is judged to be underlain by Quaternary aged deposits comprising gravel, sand, silt and clay.

The typical soil types encountered at test pit and borehole locations during the field investigations have been divided into geotechnical units as summarised in Table 1.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES AT TEST LOCATIONS

GEOTECHNICAL UNIT	SOIL TYPE	DESCRIPTION
1	Topsoil	Typically Silty Clayey SAND and Silty SAND, fine to medium grained and Sandy Silty CLAY / Silty Sandy CLAY, dark brown and dark grey, root affected to depths of between 0.15m to 0.45m.
2	Clay	Sandy CLAY and CLAY, medium to high plasticity, dark brown, dark grey and grey brown mottled orange of stiff consistency and Clay SAND, fine to medium grained, typically pale brown, pale grey and grey brown.
3	Sand	SAND, fine to medium grained, pale grey to white, pale grey brown, grey brown and dark brown, moist to wet and medium dense to very dense.
4	Possible Indurated / Indurated Sand	Clayey SAND and Silty SAND, fine to medium grained, dark brown, pale brown and orange brown, dense to very dense, with cemented sand nodules.

Table 2 provides a summary of the distribution of the above geotechnical units at each test location.

TABLE 2 – SUMMARY OF DISTRIBUTION OF GEOTECHNICAL UNITS AT TEST LOCATIONS

TEST LOCATION	UNIT 1	UNIT 2	UNIT 3	UNIT 4	GROUNDWATER INFLOW / WATERTABLE
	DEPTH (m)				
TP 1	0.0 - 0.3	0.3 - 0.6	0.6 - > 1.9	-	1.9
TP 2	0.0 - 0.4	0.4 - 1.5	1.5 - > 1.9	-	1.5
TP 3	0.0 - 0.5	0.5 – 0.8	0.8 - > 1.8	-	1.7
TP 4	0.0 - 0.4	0.4 - 2.0	2.0 - > 2.1	-	2.0
TP 5	0.0 – 0.4	0.4 – 0.75	0.75 - > 1.9	-	1.4
TP6	0.0 - 0.6	-	1.1 - > 2.1	0.6 - > 1.1	2.0
TP7	-	0.0 - > 1.0	-	-	0.9
TP8	-	0.0 - > 0.6	-	-	-
TP9	0.0 - 0.6	-	1.1 - > 2.0	0.6 – 1.1	1.8
TP10	0.0 - 0.45	-	0.8 - > 1.9	0.45 – 0.8	-
TP11	0.0 - 0.2	0.2 – 0.45	1.0 - > 1.9	0.45 – 1.0	1.8
TP12	0.0 - 0.4	0.4 - 1.0	1.0 - > 2.0	-	2.0
TP13	0.0 - 0.6	-	-	0.4 - > 2.0	1.9
TP14	0.0 - 0.4	0.4 - > 1.8	-	-	-
TP15	0.0 – 0.5	-	0.5 - > 1.7	-	-
TP16	0.0 - 0.25	-	0.25 – 1.7	1.7 - > 1.8	1.7
TP17	0.0 – 0.5	-	1.1 - > 2.0	0.5 – 1.1	1.7
TP18	0.0 – 0.4	0.4 – 0.8	0.8 - > 1.9	-	1.3
TP19	0.0 – 0.35	0.35 – 1.2	1.2 - > 1.8	-	1.6

TEST LOCATION	UNIT 1	UNIT 2	UNIT 3	UNIT 4	GROUNDWATER INFLOW / WATERTABLE
	DEPTH (m)				
TP20	0.0 – 0.2	0.2 - > 1.7	-	-	1.7
TP21	0.0 – 0.35	-	0.6 - > 2.0	0.35 – 0.6	1.7
TP22	0.0 – 0.5	0.5 – 0.8	1.2 - > 1.9	0.8 – 1.2	1.8
TP23	0.0 – 0.3	0.3 – 0.8	0.8 - > 2.0	-	-
TP24	0.0 – 0.4	0.4 – 0.7	0.7 - > 2.0	-	1.4
TP25	0.0 – 0.5	-	-	0.5 – > 2.0	1.9
TP26	0.0 – 0.3	-	0.3 - > 1.5	-	1.5
TP27	0.0 – 0.6	-	0.8 - > 1.8	0.6 - 0.8	1.7
TP28	0.0 – 0.6	-	1.2 - > 1.8	0.6 – 1.2	1.7
TP29	0.0 – 0.5	0.5 – 1.4	1.4 - > 1.7	-	1.7
TP30	0.0 – 0.3	-	0.3 - > 1.7	-	0.3
TP31	0.0 – 0.1	0.1 – 1.1	1.1 - > 1.8		0.7 & 1.1
TP32	0.0 – 0.3	0.3 - > 1.7	-	-	0.3 & 0.8
TP33	0.0 – 0.25	0.25 – 1.9	-	1.9 - > 2.0	0.75
TP34	0.0 – 0.25	0.25 – 1.9	1.9 - > 2.0	-	0.55
BH35	-	-	0.0 - > 4.0	-	0.3
BH36	-	-	0.0 - > 4.0	4.0 - > 7.0	0.7
BH37	-	-	0.0 – 3.8	3.8 - > 7.0	0.8
BH38	0.0 – 0.1	0.1 – 2.2	2.2 - > 7.0	-	1.8
TP39	0.0 – 0.15	0.15 – 1.4	1.4 - >1.7	-	1.45
TP40	0.0 – 0.2	0.2 – 1.1	1.1 - >1.7	-	1.5

TEST LOCATION	UNIT 1	UNIT 2	UNIT 3	UNIT 4	GROUNDWATER INFLOW / WATERTABLE
	DEPTH (m)				
TP41	0.0 – 0.3	0.3 – 1.5	1.5 - >2.5	-	2.2
TP42	0.0 – 0.3	0.3 – 1.1	1.1 - >1.7	-	1.7
TP43	0.0 – 0.15	-	0.15 - >1.85	-	1.7
TP44	0.0 – 0.3	-	0.3 - >1.8	-	-
BH45	-	-	0.0 - >10.45	-	2.3
BH46	0.0 – 0.25	-	0.25 - >7.45	-	0.9

4 ACID SULFATE SOILS (ASS) ASSESSMENT

4.1 Formation of Acid Sulfate Soils

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of pyrite which, in the presence of sufficient moisture, oxidises when exposed to oxygen, resulting in the generation of sulfuric acid.

Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs and sulfuric acids are generated, the soils are said to be actual ASS.

Pyritic soils typically form as waterlogged, saline sediments rich in iron and sulfate. Typically, the environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (ie: 10,000 years ago) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (ie: >10,000 years ago) would already have oxidised and leached during periods of low sea level during ice ages, which exposed pyritic coastal sediments to oxygen.

4.2 Significance of Acid Sulfate Soils

Disturbance or poorly managed development and use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters can have a detrimental effect on aquatic ecosystems.

4.3 Acid Sulfate Soils Risk Map

Reference to the Acid Sulfate Soils Risk Map for Port Stephens indicates that the site is located in an area where there is a low probability of occurrence of acid sulfate soil materials between 1m and 3m below the ground surface. The map also indicates that ASS materials, if present, are sporadic and may be buried by alluvium or windblown sediments.

The map indicates the north eastern portion of the site adjacent to the Myall River is located in an area where there is a low to high probability of acid sulfate soil materials at or near the ground surface.

4.4 Screening Tests

Samples obtained during the field investigation were screened for the presence of actual and potential acid sulfate soils using methods 21Af and 21Bf of the 1998 ASSMAC Guidelines. The results of screening tests are presented in Appendix B and are summarised below:

- pH values in 1:5 soil to distilled water mix ranged from 4.09 to 7.68. A pH of <4 in this test can indicate the presence of actual ASS;
- pH values of soil in 30% H_2O_2 were between 1.43 to 5.77. A pH of <3 in this test can indicate the presence of potential ASS;
- A maximum pH change of 4.99 after oxidation with H_2O_2 was recorded. Significant pH changes (>2) after oxidation with H_2O_2 can indicate potential ASS. pH changes >2 were recorded in 19 of the 105 samples screened for ASS;
- Slight to moderate effervescence was observed in 29 of the 105 samples tested. Vigorous effervescent reactions with oxidation in 30% H_2O_2 can indicate potential ASS;
- An odour was released upon oxidation with H_2O_2 in 18 of the 105 samples tested. A sulphurous odour is often associated with oxidising potential ASS;
- Temperatures of 19.5° to 33° were recorded in all H_2O_2 oxidation screening tests. Generally the oxidation of significant quantities of pyrite in this test will generate temperatures to >60°C.

4.5 Laboratory Analysis

Laboratory test results for samples sent for SPOCAS / SCR Suite analysis are summarised in Table 3.

TABLE 3 – SUMMARY OF ASS TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	SCREENING TEST RESULT		S_{POS} / S_{CR} (%)	TPA / NET ACIDITY (mol H+ / tonne)	LIMING RATE (kg / tonne)
		pH_F	pH_{FOX}			
TP6	2.0 – 2.1	4.94	4.06	0.02	16	-
TP14	0.6 – 0.7	5.20	3.26	**0.14**	**84**	**6**
TP19	0.5 – 0.6	4.96	3.70	0.08	49	4
TP25	1.9 – 2.0	4.36	3.26	**0.12**	**76**	**6**
TP26	1.5 – 1.6	4.71	2.60	< 0.02	< 10	-
TP27	1.1 – 1.2	4.47	3.35	0.03	**21**	**2**
TP28	0.6 – 0.7	4.95	3.55	**0.08**	**53**	**4**
TP30	1.5 – 1.6	5.25	2.81	**0.09**	**58**	**4**
TP32	1.6 – 1.7	6.40	1.43	**0.13**	**84**	**6**
TP33	1.1 – 1.2	6.34	1.45	**0.12**	**77**	**6**
TP34	1.0 – 1.1	6.35	1.36	**0.19**	**117**	**9**
BH36	0.5 – 1.0	5.03	4.24	**0.04**	**26**	**2**
BH36	3.5 – 4.0	5.75	3.26	< 0.02	11	-
BH37	0.5 – 1.0	5.85	4.67	0.02	14	**-**
BH37	2.0 – 2.5	5.55	3.92	**0.07**	**44**	**3**
BH37	5.0 – 5.5	5.83	3.27	**0.15**	**93**	**7**
BH37	6.5 – 7.0	5.73	3.07	**0.17**	**104**	**8**
BH38	0.5 – 1.0	5.19	4.20	**0.24**	**147**	**11**
BH38	6.5 – 7.0	5.63	4.26	< 0.02	11	-
TP39	1.0 – 1.1	6.75	3.86	0.006	**56**	**5**

LOCATION	**SAMPLE DEPTH (m)**	**SCREENING TEST RESULT**		**S_{POS} / S_{CR} (%)**	**TPA / NET ACIDITY (mol H+ / tonne)**	**LIMING RATE (kg / tonne)**
		pH_F	pH_{FOX}			
TP40	1.5 – 1.6	5.90	4.73	<0.005	9	1
TP41	0.5 – 0.6	5.20	3.86	<0.005	**39**	**5**
TP42	1.0 – 1.1	5.25	4.19	0.007	**37**	**3**
TP43	1.7 – 1.8	5.83	5.18	<0.005	7	1
BH45	5.5 – 5.9	6.17	4.80	0.011	**22**	**3**
BH46	1.0 – 1.1	6.57	2.28	0.028	**20**	**2**
BH46	2.5 – 3.0	6.70	4.38	0.016	**18**	**2**
BH46	5.5 – 6.0	7.68	5.33	0.013	10	1
ASSMAC Action Criteria	-	-	-	0.1* 0.03**	62* 18**	-
Levels of Concern for Screening Test	-	4	3	-	-	-

NOTE:

** Action criteria shown are those for fine textured soils (ie clays) and management of excavations involving disturbance of less than 1000 tonnes of soil;*

*** Action criteria shown are those for course textured soils (ie sands) and management of excavations involving disturbance of more than 1000 tonnes of soil;*

S_{POS} – Percentage of oxidisable Sulfur;

S_{CR} – Percentage of chromium reducible Sulfur;

TPA – Total Potential Acidity.

Results of SPOCAS and SCR Suite analysis indicate nineteen out of the twenty eight samples tested exceeded the Acid Sulfate Soil Management Advisory Committee (ASSMAC) action criteria. Works involving disturbance of soils that exceed these action criteria must prepare an Acid Sulfate Soils Management Plan.

5 DISCUSSION AND RECOMMENDATIONS

5.1 Acid Sulfate Soils (ASS) Management Plan

The purpose of the plan presented in Appendix C was to provide a generic plan for management of ASS in future earthworks that occur within the Riverside Estate. It is understood that the plan is to be provided as a reference to all lot purchasers and contractors required to work on the site. It has therefore been formatted in a way that will be useable to individual land owners to assist in obtaining DA approvals and in controlling and managing ASS during the development of each lot.

5.2 Site Preparation

Site preparation and earthworks suitable for pavement and structure support should consist of:

- Prior to construction of roads and placement of any fill, the proposed fill areas should be stripped to remove all vegetation and root affected or other potentially deleterious material. Test pit logs indicate Unit 1 (Topsoil) to be present to depths of up to 0.6m, however the root affected zone is generally less than 0.3m, but up to 0.45m depth. Stripping is therefore generally expected to be required to depths of between 0.15m to 0.45m;
- Following stripping, wet areas that remain may require over excavation and backfilling with an approved select material. The exposed subgrade materials should be inspected by a geotechnical authority to assess the need for over excavation or placement of a geofabric beneath the select fill layer. The select material should be placed in a single lift. It is anticipated that this treatment could be wide spread across this site;
- It is understood that site finished levels will be up to 1m above existing surface levels across the site. The first layer of approved fill beneath roads should be placed in a single layer of 500mm loose thickness and should not be heavily compacted. Subsequent layers should not exceed 300mm loose thickness and should be compacted to a minimum density index of 70% for sands or minimum density ratio of 95% Standard Compaction for cohesive soils in accordance with AS1289 5.1.1 or equivalent. Clay subgrade fill should be placed and maintained at 60% to 90% of standard Optimum Moisture Content;
- The impact of road fill on drainage of adjacent lots needs to be considered in lot drainage design as there is a tendency for water to pond on the surface of clay soils. One option would be to provide drainage columns through the clay layer to allow surface water to drain through to the underlying sands;
- The top 300mm of natural subgrade below pavements or the final 300mm of road subgrade replaced should be compacted to a minimum density index of 80% for sands or minimum density ratio of 100% Standard Compaction for cohesive soils within the above stated moisture range;
- Residential site fill beneath structures should be compacted to a minimum density ratio of 95% Standard Compaction within ±2% of OMC;
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-1996 *‘Guidelines for Earthworks for Commercial and Residential Developments’*.

5.3 Excavation Conditions

Where excavation is required, it is anticipated that all site materials could be excavated by conventional dozer blade or excavator bucket at least to the depths indicated on the appended test pit and borehole logs. The excavator should use a ‘gummy’ bucket to avoid over-disturbance of the soils below the depth of excavation.

5.4 Reuse of Materials

The following comments are made regarding the suitability of the site materials for reuse in filled areas:

- Where site regrade is proposed vegetation, root affected or other potentially deleterious material should be removed to spoil or stockpiled for reuse as landscaping materials only. Stripping is generally expected to be required to depths of between 0.15m to 0.45m;
- Wet areas that remain after stripping may require over excavation. Unit 2 soils that are over excavated because they are over wet should also be removed to spoil;
- Very stiff to hard Unit 2 soils and Unit 3 and Unit 4 soils should be carefully excavated as necessary and stockpiled for reuse as general site fill;
- The Unit 2 soils are likely to be moderately to highly reactive (susceptible to volume changes with variation in moisture content) and if excavated and reused will need to be placed and compacted close to the specifications outlined to minimise reactive soil movements.

5.5 Preliminary Pavement Design

5.5.1 Design Traffic Loading

Design traffic loadings have been adopted in accordance with Great Lakes Council guidelines. Table 4 presents a summary of design traffic loadings adopted for subdivision roads.

TABLE 4 – DESIGN TRAFFIC LOADINGS

ROAD TYPE	**ESA’s**
Local Access	5×10^5
Collector	1×10^6

5.5.2 Preliminary Design CBR Values

Based on the results of the fieldwork, and previous experience in the adjoining Myall Quays Estate, preliminarily design subgrade California Bearing Ratio (CBR) values as outlined in Table 5 have been adopted.

TABLE 5 – DESIGN CBR VALUES

MATERIAL TYPE	DESIGN CBR
Clay Soils	2 %
Sand Soils	10 %

5.5.3 Preliminary Flexible Pavement Design

Preliminary flexible pavement thickness designs have been prepared with reference to ARRB Special Report No 41, APRG Report No 21 and Austroads - Pavement Design 2004.

The recommended material, construction specification and pavement make-up are presented on the attached Pavement Thickness Design Summary (PTDS) sheet.

It is understood from discussions with Tattersall Surveyors that the design finished level of roads within the subdivision will vary from on-grade to about 1m above. At the time of the field investigation, which followed recent rain, large areas of water were observed to be ponding across the south eastern area of the site.

Subgrade moisture contents of the Unit 2 soils were judged to be generally greater than standard Optimum Moisture Content (OMC). Moisture contents are likely to remain high in these soils. It should therefore be anticipated that drying back of Unit 2 subgrade materials or over excavation and replacement will be necessary prior to the placement of site fill and / or pavement construction. The required time period to prepare the subgrade is likely to be dependant on the prevailing weather conditions at the time of construction.

If over wet subgrade conditions exist at the time of construction, these materials should be over-excavated and replaced with a minimum depth of 500mm (refer to PTDS) of well graded granular select material with a CBR of 15% or greater.

The requirement for, and extent of subgrade replacement should be confirmed by the geotechnical authority at the time of construction.

It is recommended that each construction length be boxed out to the minimum subgrade level required by the relevant pavement thickness design. Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

5.5.4 Drainage

The enclosed preliminary pavement designs assume the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. It is recommended that subsoil drains be installed along both sides of roads where Unit 2 soils are encountered at subgrade level.

5.6 Preliminary Site Classification

On the basis of the soil profiles encountered during the field investigations, results of Dynamic Cone Penetrometer testing and results of laboratory shrink / swell testing carried out in the adjoining Myall Quays Estate, lots within the proposed subdivision are currently classified in accordance with AS2870-1996 '*Residential Slabs and Footings'*, as Moderately Reactive, Class 'M'. A characteristic free surface movement of up to 40mm is estimated for the natural soil profiles encountered.

The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement. Footings for the proposed development should be designed and constructed in accordance with the requirements of AS2870.

The classification presented above assumes that:

- All footings are founded in controlled fill or in the natural soils below all root affected material and fill under slab panels meets the requirements of AS2870, in particular, the root zone must be removed prior to the placement of fill materials beneath slab floors;
- The performance expectations set out in AS2870 are acceptable;
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, *Foundation Maintenance and Footing Performance: A Homeowner's Guide*, a copy of which is attached;
- Service trenches backfilled with uncontrolled fill do not extend below a line extending out and down at 45° from the ground surface at the edge of the building;
- The constructional and architectural requirements for reactive clay sites set out in AS2870 are followed.

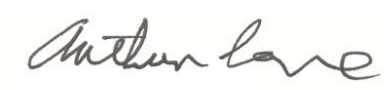
Where fill is to be placed to raise site levels, the affected allotments will require reclassification once the depth and type of placed fill are known and the level of earthworks control has been established.

6 CONSTRUCTION RISK

The extent of testing associated with this assessment is limited to discrete test pit and borehole locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

Further advice on the uses and limitations of this report is presented in the attached document, '*Important Information about your Coffey Report*'.

For and on behalf of Coffey Geotechnics Pty Ltd



Arthur Love

Principal Geotechnical Engineer

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

13 Mangrove Road, Sandgate, NSW, 2304
Ph: (02) 4967 6377 Fax (02) 4967 5402

pavement thickness design summary

client :	*TATTERSALL SURVEYORS PTY LTD*	job no :	*GEOTSGTE20248AA*
principal :	*CRIGHTON PROPERTIES PTY LTD*	laboratory :	*NEWCASTLE*
project :	*PROPOSED SUBDIVISION*	report date :	*May 09, 2007*
location :	*RIVERSIDE ESTATE, PROJECT APPLICATION, TEA GARDENS*	test report no.:	*MAY09-03/1*
council :	*GREAT LAKES COUNCIL*	designed by :	*RJP* checked by :

road name or type :	*LOCAL ACCESS*	*LOCAL ACCESS*	*COLLECTOR*	*COLLECTOR*
chainage interval : (m)	*Clay Subgrade*	*Sand Subgrade*	*Clay Subgrade*	*Sand Subgrade*
design traffic loading: (ESA)	5×10^5	5×10^5	1×10^6	1×10^6
wearing course thickness : (mm)	40	40	40	40
basecourse thickness: (mm)	150	150	150*	150*
sub-base thickness: (mm)	150	150	150*	150*
select thickness: (mm)	500	-	500	-
total thickness : (mm)	840	340	840	340
CBR used for design : (%)	2	10	2	10

design traffic loading : Design traffic loading is the number of equivalent standard axles (E.S.A.) in the design lane during the design period. For definitions, refer Appendix 1.1 "Pavement Design" AUSTROADS. Refer covering letter/report.

Material Quality

wearing course :	*RTA QA Specification R116*
basecourse :	*Conforming to ARRB Special Report No 41, * RTA QA Specification 3051*
sub-base:	*Conforming to ARRB Special Report No 41, * RTA QA Specification 3051*
select :	*Well graded granular material, maximum particle size 100mm, minimum CBR 15%.*

Note : Recommended material types may vary from those of job specification or statutory authority. Refer covering letter/report.

Compaction Requirements

wearing course :	*RTA QA Specification R116*
basecourse :	*98% MODIFIED*
sub-base :	*95% MODIFIED*
select :	*80% DI, 100% STD*
subgrade :	*80% DI, 100% STD*
fill below :	*70% DI, 95% STD*

Modified: Minimum required dry density ratio, AS1289 5.4.1-1993, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent, and the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.

Standard: As above, but maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.

Density Index: Minimum required Density Index AS1289 5.6.1-1998, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent, and laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent.

Note: Recommendations for compaction may vary from those of job specification or statutory authority. Refer covering letter/report.

Drainage: The design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. Refer covering letter/report.

Form Number L2.10R1 Version 6.0

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

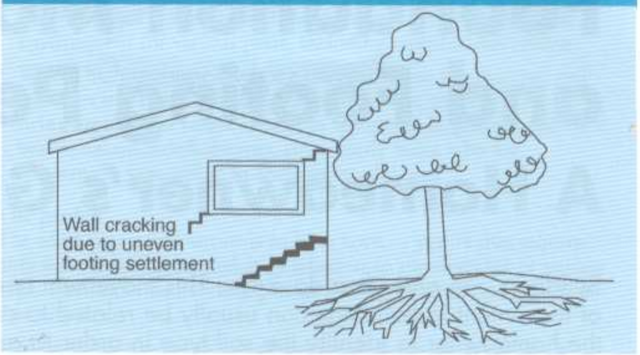
Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

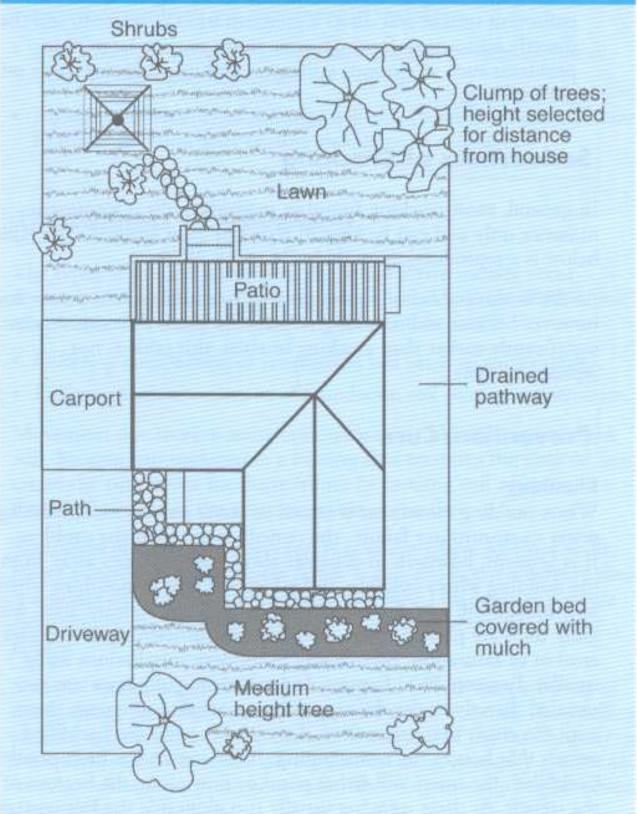
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

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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 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.

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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 incorporate 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

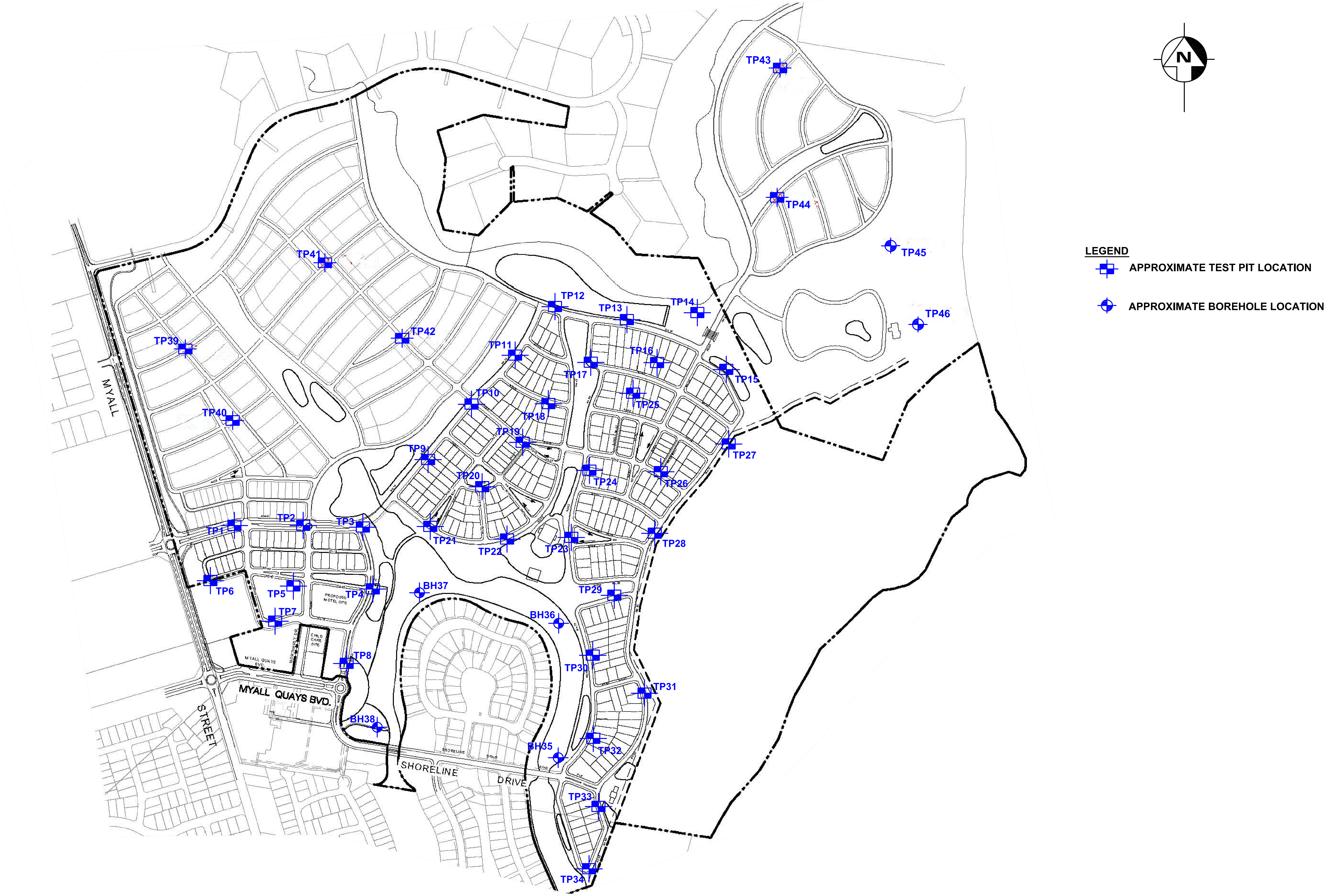
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

Figures



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title:	TESTPIT/BOREHOLE LOCATION PLAN
project no:	GEOTSGTE20248AA-AE
figure no:	FIGURE 1