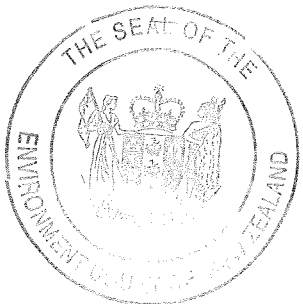
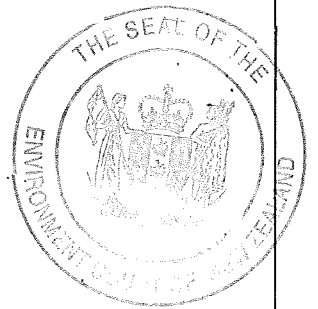


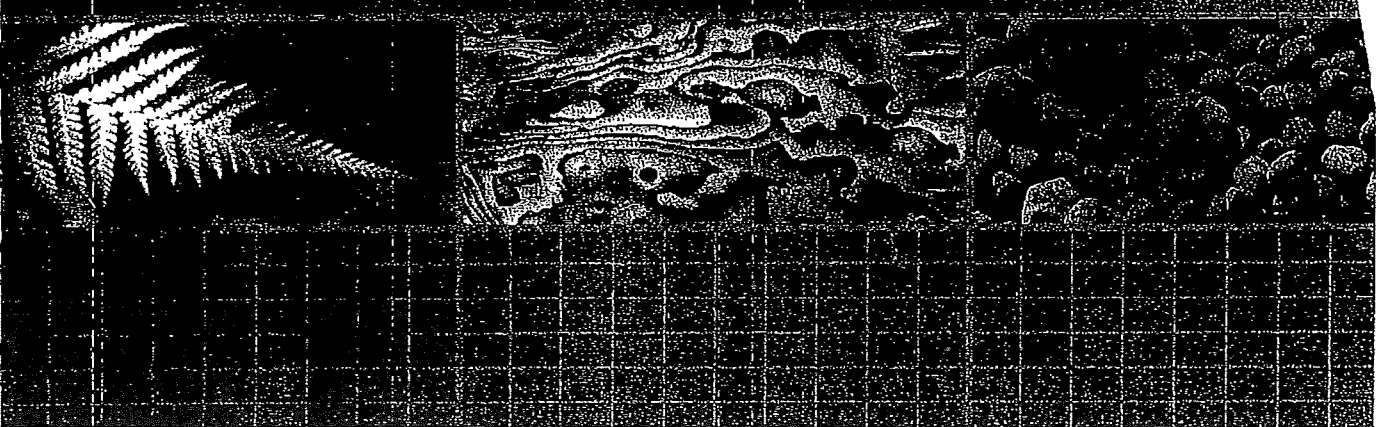
# I336 Sylvia Park Precinct Appendix





**Tonkin & Taylor**

ENVIRONMENTAL AND ENGINEERING CONSULTANTS



# REPORT

**SINCLAIR KNIGHT MERTZ**

**Sylvia Park Business Centre, Mt  
Wellington  
Geotechnical Completion Report  
for Earthworks**

**Report prepared for:  
SINCLAIR KNIGHT MERTZ**

**Report prepared by:  
TONKIN & TAYLOR LTD**

**Distribution:  
SYLVIA PARK BUSINESS CENTRE LTD  
SINCLAIR KNIGHT MERTZ  
TONKIN & TAYLOR LTD (FILE)**

**1 copy  
3 copies  
1 copy**

**May 2006**

**Job no: 21432.100**



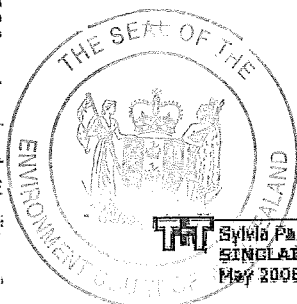


## Table of contents

1	Introduction	1
1.1	Description of site	1
2	Related reports	2
3	Earthworks operations	3
3.1	Plant	3
3.2	Earthworks sequence / programme	3
4	Compaction	5
4.1	Control criteria	5
5	Project evaluation / building design considerations	6
5.1	Bearing capacity for building foundations	6
5.2	Slope stability	6
5.3	Retaining walls	6
5.4	Settlement	6
5.5	Drainage	6
5.6	Stormwater controls	7
5.7	Road and paved area subgrades	7
6	Statement of Professional Opinion as to the suitability of land for building development	8
7	Applicability	10

Appendix A: Drawings

Appendix B: Test results



## Executive summary

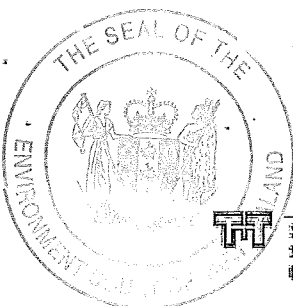
Tonkin & Taylor Ltd were engaged by Sinclair Knight Mertz Ltd on behalf of their client Sylvia Park Business Centre Ltd to monitor and provide earthworks certification for the commercial development at the Sylvia Park Business Centre, Mt Wellington Highway, Mt Wellington, Auckland.

This report contains information required for Completion Reporting, as well as outlining design issues that need to be considered for subsequent building design and construction.

Previous geotechnical investigation work was undertaken by several consultants and most recently by Tonkin & Taylor Ltd in November 2004, our Ref 21432. Multiplex are the managing Contractor for the enabling and building works. Civil / survey design was undertaken by Sinclair Knight Mertz and structural design by Murray Jacobs Ltd, Buller George Ltd, Stiffe Hooker Ltd and Holmes Consulting Ltd.

Current works commenced on the site in November 2004 with the majority of cut and fill completed by April 2005. Ground improvement works consisted of demolition of a number of one storey buildings, cut and fill earthworks and the placing of pavement materials.

The Business Centre site is considered to have building platform areas suitable for commercial and retail development in accordance with this report.



# 1 Introduction

Tonkin & Taylor Ltd (T&T) were engaged by Sinclair Knight Mertz (SKM) for their client Sylvia Park Business Centre Ltd (SPBL) to undertake earthworks compaction control and provide geotechnical earthworks certification for the Sylvia Park Business Centre, Mt Wellington Highway, Mt Wellington.

Sylvia Park Business Centre is a multipurpose shopping centre proposed to contain reinforced concrete buildings consisting of shopping malls, supermarkets and entertainment venues with at grade and underground carparks.

Our proposal letter dated 29 October 2004 sets out our conditions of engagement and scope of works. Confirmation was received in a Letter of Engagement, dated 2 November 2004. The scope of work covered by this report includes:

- i. review of geotechnical investigation reporting for the site prepared in August 2004 by T&T along with review of aerial photographs and our geotechnical database for the area,
- ii. observation, inspection and testing for the earthworks,
- iii. additional post earthworks investigation of some areas of ground to determine foundation design conditions for piled foundations, and
- iv. certification for commercial development are in terms of this report.

Tonkin & Taylor Ltd has also undertaken observation of foundations for the project.

## 1.1 Description of site

This report is applicable to the Sylvia Park Business and Shopping Centre.

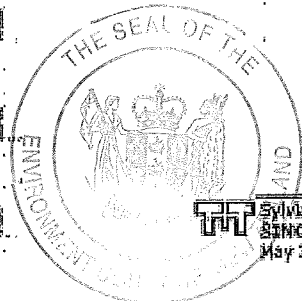
The Sylvia Park Business Centre covers over 20Ha and is bounded by Mt Wellington Highway to the west, residential properties on Lynton Road to the north, North Island Trunk Railway to the east and State Highway 1 to the south. An access road links to Carbine Road to the east.

Stage 1 of the development is located in the southern half of the site while Stage 2 is north of the south eastern Highway which runs through the centre of the site.

It involves the development of 1 commercial building with associated roads and underground services.

As can be seen on the Earthworks As-Built plan (SKM AN00667-OA-CB-230, SK-247 and 248 attached in Appendix A), all of this stage has been affected by earthworks. The depth of cut was generally less than 1 m (apart from the underground carpark, services excavations and excavation of the toe of the Mt Wellington Interchange on-ramp) and the maximum depth of fill was approximately 1.5 m.

The footprints of the buildings occupy a strip running north south across the site while carparking covers the rest. The current level is essentially flat with only minor variation for the drainage and for the roading, carparking and landscaping as shown on the SKM As-Built drawings in Appendix A.



## 2 Related reports

Previous geotechnical investigation reporting has been carried out for the site by Tonkin & Taylor Ltd in August 2004, ref 21432.

Other relevant investigation reports include:

Stormwater Trench Retention Investigations	18 April 2005
Proof Drilling of Foundations, Stage 1	3 May 2005
Rail Over Bridge Pile Length Drilling Investigations	27 May 2005
Foodtown Pile Capacity Investigations	27 June 2005
Northern Precinct Supplementary Investigations	4 July 2005

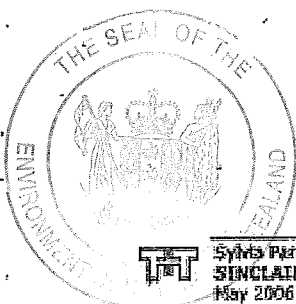
The T&T geotechnical investigation report outlines development recommendations including subsurface drainage, compaction criteria, roading and services installation and building foundation criteria. These have been incorporated into the bulk earthworks specifications prepared by SKM.

Minor previous earthworks were undertaken as part of a previous development during the 1940's (World War 2) for the US Armed Forces. Some underground services were installed during and after this development.

A general specification for the earthworks as included in the geotechnical report, and provided initial guidelines for the control of the earthworks.

A series of building specific investigation boreholes have been carried out as part of detailed design of the buildings, as well as some proof drilling during construction. These have been reported in a series of letter reports.

The recommendations contained in the above reports have been incorporated into our control of the works and, where applicable, incorporated into this completion reporting for this Stage. In particular, T&T handauger borelogs and proof drilling have been used to help set foundation design criteria.



## 3 Earthworks operations

### 3.1 Plant

Earthworks (Bulk / final) were contracted to Ross Reid Contractors Ltd for all / the majority of earthworks on all stages. The main items of plant used were a tractor drawn scraper, several excavators and one self propelled compactor. This plant generally carried out all construction works, roading and earthworks. Specialist roading plant was brought on site for pavement construction.

### 3.2 Earthworks sequence / programme

Earthworks operations for the site commenced in November 2004. They consisted of the removal of old pavements, organic material stockpiles of fill and the rubble from demolition of numerous one storey light weight timber framed buildings. The concrete slabs forming the foundations and floors were removed to stockpiles for crushing and reuse on site.

Initial operations were to remove soft / weak / disturbed material generally from below the foundations slabs. These areas were backfilled to the original level and the site tested. Initially trafficking by the plant was determined to be causing excessive remoulding of the materials and operations were modified to limit this effect. The strength of the existing ground required some undercutting and backfilling with improved material, approximately 50% of the area. The site was then filled with 0.3 m to 1.2 m material generally to the level of the underside of the floor slab. To aid construction, a temporary coating of seal was applied. The fill consisted principally of material cut from the eastern side of the site but some imported material was required during the later stages of the works. At May 2005, the majority of the earthworks operations for the overall site was complete.

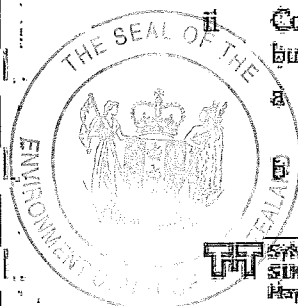
Installation of services and drainage as shown on the current As-Built drawings took place in conjunction with the earthworks operations. Roading and parking for Stage 2A was also largely completed.

The maximum depth of fill was 1.2 m and the maximum depth of cut was 3.0 m as shown on the earthwork drawings in Appendix A.

The approximate volume of earthworks to July 2005 is 59,000 cubic metres cut and 38,000 m<sup>3</sup> fill principally using material from on site.

The compaction requirements for engineered fill material has been recommended as follows:

- i Cohesive material such as bulk fill:
  - a Average vane strength over 10 consecutive readings shall not be less than 125 kPa with no individual reading less than 110 kPa
  - b The air voids shall not exceed 10%.
- ii Cohesion material within 500 mm of finished subgrade under pavements or buildings:
  - a Average vane strength over 10 consecutive readings shall not be less than 150 kPa with no individual reading less than 130 kPa
  - b The air voids shall not exceed 8%.





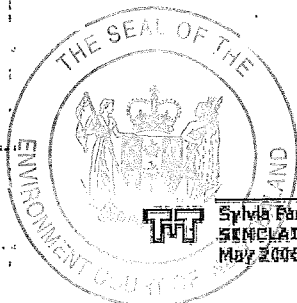
4

iii

Cohesionless material such as hard fill shall be placed in uniform layers not greater than 150 mm loose thickness.

Compaction on each layer of fill materials so placed shall be sufficient to obtain the following standards:

- a The in-situ dry density shall be not less than 75% of the maximum relative density, as determined by Test 4.2, NZS 4402
- b The number of blows to drive the Scaas penetrometer from a depth of 50 to 200 mm below the fill surface shall be not less than 11.



## 4 Compaction

### 4.1 Control criteria

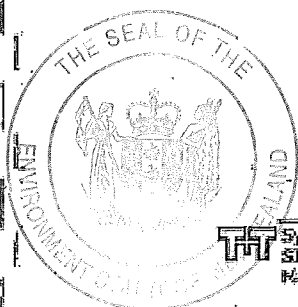
The majority of the bulk earthworks was cut to fill from within the site. However, there was also a range of other materials including crushed concrete for hardfill as well as imported granular fill.

Road and paved area design was provided by SKM with geotechnical testing during construction provided by others under their instruction. Review and acceptance of the results were provided by SKM. The criteria for acceptance was based on recommendations provided by T&T in their specification Ref No. 21432.100 dated 11 August 2004, copy attached in Appendix C.

The main method used for the clay and silt type fill materials was the maximum allowable air voids and minimum allowable shear strength method.

In situ density, strength and water content tests were carried out on the filling at or in excess of the frequency recommended by NZS 4431:1989. Testing results are contained in Appendix C.

After some initial issues associated with excessive working of the material, control tests showed that the results were consistently meeting the required shear strength and air void criteria, demonstrating that the water content of placed fill was consistently at or close to optimum. To the best of our knowledge, any problems encountered were rectified by close monitoring of the selection of borrow materials, discing and remixing of the available soil types and minor reworking where required.



## 5 Project evaluation / building design considerations

### 5.1 Bearing capacity for building foundations

A combination of shallow footings and piled foundations have been utilised for the new development. All filled and natural ground within the influence of the shallow and pad type foundations as shown on the drawings in Appendix A generally has a geotechnical ultimate bearing capacity of 300 kPa. This corresponds to a factored (ultimate limit state) bearing capacity of 150 kPa and working bearing capacity of 100 kPa. For deeper foundations site specific reports have been prepared.

Where a working bearing capacity greater than 100 kPa was required, further specific site investigation and design of foundations have been undertaken.

Limits for distributed floor loadings have been provided. These are generally 15 kPa but for The Warehouse are increased to 20 kPa.

It is concluded that settlements associated with the fill placement would have been largely completed prior to application of building loads. This is based on results of the preload tests report of August 2004.

### 5.2 Slope stability

The site is generally flat as shown on the As-Built drawings in Appendix A. Local retention works were constructed adjacent to the boundary of the Mt Wellington Interchange on-ramp. Slope stability is not considered an issue for the permanent works.

### 5.3 Retaining walls

A timber pole retaining wall has been constructed along the base of a cut batter that forms the on-ramp for the Mt Wellington Interchange in the south western sector of the site. T&T provided design review and construction observation of the work.

During construction some slumping of the excavated face occurred but the ground was remediated and the earthworks associated with the final retention works are considered to have been completed in accordance with design. In particular, the soils identified during investigation and the parameters utilised for design are considered to be applicable.

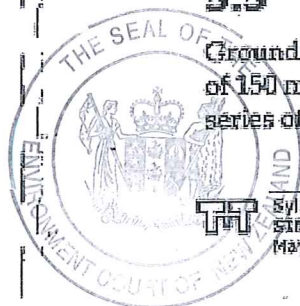
### 5.4 Settlement

Settlements have been assessed from analyses using assessed parameters for the soil types as well as from results obtained from the pre-loading trials.

Based on this information we consider that settlement of shallow footings of structures designed in accordance with the recommendations in the reports reference previously, should be within normally accepted design tolerances.

### 5.5 Drainage

Groundwater drainage was installed in the Pak N Save basement carpark. This consisted of 150 mm diameter perforated pipe (Novasflo) within a geotextile sleeve installed within a series of trenches with a graded granular drainage layer below the proposed floor slab



level as shown on As-Built drawings in Appendix A. They have outlets to the sump in the proposed adjacent Stage 2B (Basement Carpark). These drains are not expected to require maintenance during the design life of the structure.

**5.6 Stormwater controls**

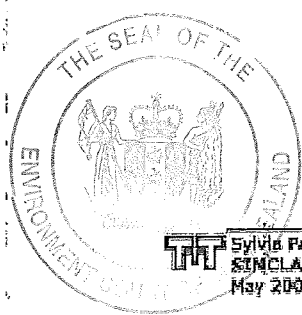
Stormwater disposal systems have been designed and constructed by others. These systems serve to collect all runoffs from roofs, decks and paved areas, together with discharges from retaining wall drains and other subsoil drains and should connect into the public stormwater drainage network.

**5.7 Road and paved area subgrades**

Road and paved area design was provided by SKM with geotechnical testing during construction provided by T&T and others under SKM instruction. Review and acceptance of the results were provided by SKM. The recommended criteria for acceptance for subgrades was provided by T&T in their letter Ref No. 21432.100 dated 11 August 2004, from which the criteria are included in Section 4.1 and have been incorporated into SKM's specifications.

Prior to placing sub-base or basecourse material, the formation was tested as described in section 4.

We are advised by SKM that the final basecourse tests undertaken by others were satisfactory. This will be certified separately by SKM.



## 6 Statement of Professional Opinion as to the suitability of land for building development

1, Mr P J Millar of Tonkin & Taylor Ltd, P O Box 5271, Wellesley St, Auckland, hereby confirm that:

6.1 I am a Chartered Professional Engineer experienced in the field of geotechnical engineering and was retained by Sylvia Park Business Centre Limited as the Geotechnical Engineer on the Sylvia Park Business Centre, Mt Wellington Highway, Mt Wellington. Inspection and observation of the works have been carried out during construction by either myself or staff acting under my direction.

6.2 The extent of investigations are described in the Tonkin & Taylor Ltd report, Ref No. 21432 dated August 2004 and other referenced reports. The conclusions and recommendations of these documents have been re-evaluated in the preparation of this report. Details of earthworks control tests performed are enclosed.

6.3 The Contractor confirms that the work undertaken has been completed in accordance with the drawings, specifications and any variations issued and is consistent with the inspections and observations carried out by Tonkin & Taylor Ltd. A completion Certificate - Construction is to be provided by the Contractor.

6.4 On the basis of our observations and inspections, together with the information supplied by others, including the Contractor's Completion Certificate, it is my professional opinion, not to be construed as a guarantee that:

6.4.1 The fills shown on the attached SKM drawing No. AN00667-OA SK247 have been generally placed in compliance with NZS 4431:1989.

6.4.2 The completed earthworks give due regard to land slope and foundation stability considerations.

### 6.5 Foundations

#### 6.5.1 Foundation design

The filled and natural ground within site boundaries is considered generally suitable for the erection thereon of commercial and retail buildings.

#### 6.5.2 Bearing capacity

##### Shallow footings

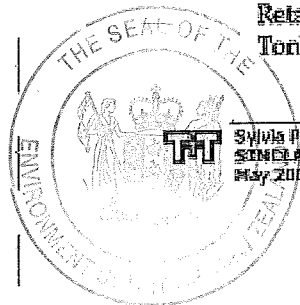
Foundation design for all building in this Stage should limit geotechnical ultimate bearing capacity to 300 kPa (factored capacity ULS) 150 kPa, working 100 kPa).

#### 6.5.3 Pile foundations

Pile foundations have been utilised for some structures where high concentrated loadings are applied. These have all been subject to specific reporting and separate certification for the foundations.

#### 6.5.4 Retaining walls

Retaining walls have been constructed on the south western perimeter of the site. Tonkin & Taylor Ltd undertook observation of the ground conditions encountered

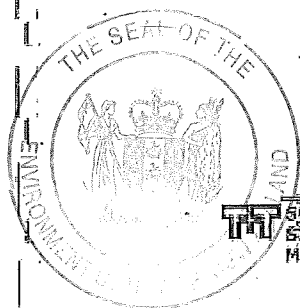




and installation of the piles. We confirm the soil conditions are consistent with soils exhibiting the parameters recommended by Tonkin & Taylor Ltd and retention works designed in accordance with these parameters should provide adequate performance.

#### 6.5.5 Unexpected ground conditions

Our assessment is based on interpolation between borehole positions, site observations and periodic earthworks control visits. Local variations in ground conditions may occur. Although highly unlikely, unfavourable ground conditions may be encountered during excavation for foundations or site benching. It is important that we be contacted in this eventuality, or in the event that any variation in subsoil conditions from those described in the report are found. Design assistance is available as required to accommodate any unforeseen ground conditions present.



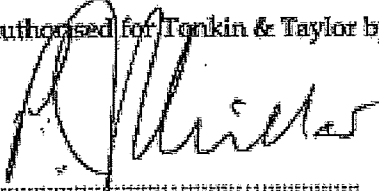
## 7 Applicability

The professional opinion contained within this report is furnished to Sylvia Park Business Centre Ltd, Multiplex Ltd, Sinclair Knight Mertz Ltd and the Auckland City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

Authorised for Tonkin & Taylor by:

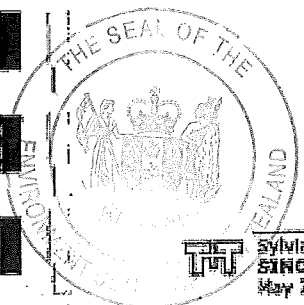


P J Millar

Project Co-ordinator

gjm:ma

PA21037A21432.1098EM1100jml20598\_GCR1\_Rep.doc



## **Appendix A: Drawings**

### **SKM Drawings**

- AN00667 - OA-SK-247 Rev A Bulk Earthworks, Cut and Fill Depths**
- OA-SK-248 Rev A Bulk Earthworks Existing Contours**
- OA-C8-230 Rev 5 Bulk Earthworks Finished Contours**

