MacGregor GEOTECHNICAL

SITE INVESTIGATION REPORT

3 February 2017

PROPOSED DEVELOPMENT - DUE DILIGENCE

LOT 504-530, BALLAN ROAD, WYNDHAM

JOB NUMBER: **2170236**

REPORT prepared for

Atma Environmental
56 William Street,
Abbotsford, VIC 3067.

CONTENT

1. INTRODUCTION

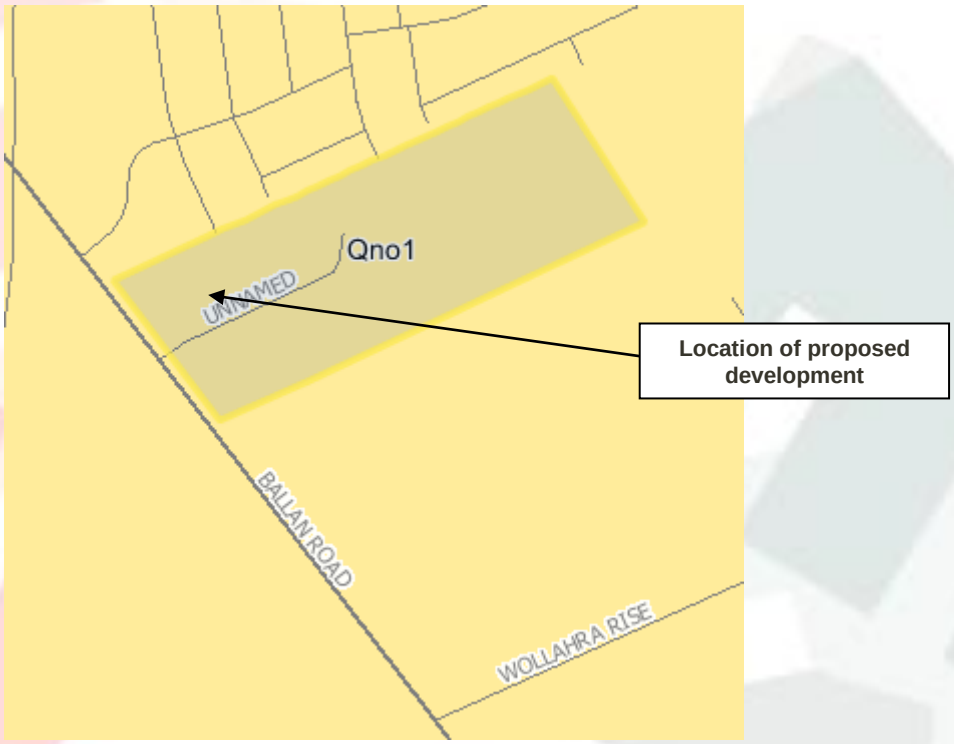
We are pleased to report on investigations carried out at the above site with the object of determining the ground conditions so that recommendations could be made on suitable foundation types and design parameters for the proposed development.

2. FIELDWORK

10 Boreholes were drilled. The Engineering Logs are attached and form part of this report. The location of the boreholes placed is described on the Borehole Location Plan.

3. SITE GEOLOGY

The site is located in an area of Quaternary Basalts.



4. SOIL CONDITIONS

The soil profile and condition in each borehole is described on the Engineering Logs attached.

5. SITE CLASSIFICATION

The site is classified as **CLASS P** in accordance with AS2870-2011. A characteristic surface movement (y_s) in the range of 60mm to 75mm has been estimated for this site.

The site has been classified **P** due to abnormal moisture conditions caused by existing trees on this site.

The underlying natural soil has been classified as **MODIFIED CLASS H2**.

6. FOOTING RECOMMENDATIONS

6.1 Timber Floor System

There are no recommendations for a strip and/or pad footing system at this site.

6.2 Concrete Slab Floor System

Slabs should be proportioned on the basis of a Modified Class H2 classification. A slab freeboard (height to top of slab from surrounding ground level) of 150mm is recommended. Edge beams should be taken through any filling and founded at least 100mm into the natural clays and should be at least 700mm thick in total, from bottom of trench to top of slab. An allowable bearing capacity of at least 50kPa will exist beneath these edge beams at the depths recommended below.

Borehole	Minimum Founding Depth For Edge Beams (mm)	Founding Material
1	350	natural soils
2	300	natural soils
3	300	natural soils
4	300	natural soils
5	200	natural soils
6	300	natural soils
7	400	natural soils
8	200	natural soils
9	400	natural soils
10	300	natural soils

The depth of beams may be reduced if continuous basalt rock is encountered.

Where pipes connect to the slab, flexible joints are to be incorporated to accommodate a total range of differential movement of 75mm in any direction. Allowance should also be made for differential movement by sleeving or taping pipes with foam to allow 40mm radial clearance.

Correct drainage and site maintenance is particularly important at this site. Refer to the "General Construction and Site Maintenance Requirements" section of this report and to sections 5 and 6 of AS2870-2011.

Surface drainage must be considered in the design of this footing system in accordance with Clause 5.6.3 of AS2870-2011. Surface drainage must be controlled from the start of construction and must be completed by the finish of construction. Subsurface drains to remove groundwater shall not be used within 1.5 metres of the building unless designed in accordance with engineering principles.

These details are to be used as a guide only and this footing system must be designed by an engineer familiar with this form of construction.

6.3 Levelling Filling Under Slabs

After clearing any surface rubbish and removing any topsoil containing grass roots, organic matter and vegetation from below the slab area, the building area may be levelled by spreading filling under the slab panel areas.

As a guide, the depth of *controlled* filling should not exceed 800mm for sand material and 400mm for other material; and the depth of *uncontrolled* filling should not exceed 600mm for sand material and 300mm for other material.

Controlled fill is material that has been placed and compacted within a defined moisture range in layers by compaction equipment to a defined density requirement. Uncontrolled or rolled fill consists of material compacted in layers by repeated rolling by an excavator, usually the same excavator used to place the fill.

Load-bearing edge beams and any load-bearing internal beams are to be taken down through this new levelling material. Slab panels and non load-bearing internal beams or ribs may be founded directly on this new levelling material.

Where the filling depths given above are exceeded, then the site should be reinspected and an appropriate slab system should be designed.

6.4 Waffle Raft Slab Floor System

The use of a Modified Class H2 waffle raft slab is recommended. Edge beams should be taken through any filling and founded directly onto the underlying natural soils. An allowable bearing capacity of at least 50kPa will exist beneath these edge beams at the depths recommended below.

Borehole	Minimum Founding Depth For Edge Beams (mm)	Founding Material
1	250	natural soils
2	200	natural soils
3	200	natural soils
4	200	natural soils
5	100	natural soils
6	200	natural soils
7	300	natural soils
8	100	natural soils
9	300	natural soils
10	200	natural soils

Any material that is not classified as filling is considered to be natural soil.

This recommendation assumes that the depth of fill, including existing fill, will be less than 300mm and be compacted in accordance with the requirements of AS2870-2011, Clause 6.4.2(a).

Once the site has been scraped and all vegetation, organic topsoil, roots and loose surface fill have been removed, an allowable bearing capacity of 50kPa will exist at the surface.

Where the depth of fill is less than 300mm and is not compacted in accordance with the requirements of AS2870-2011, Clause 6.4.2(a), all edge beams and internal beams shall be founded directly onto the natural soil where a bearing capacity of at least 50kPa will exist.

Where the depth of existing fill or levelling fill exceeds 300mm, then the waffle raft slab will require to be designed as suspended and supported on piers.

Where pipes connect to the waffle raft slab, flexible joints are to be incorporated to accommodate a total range of differential movement of 75mm in any direction. Allowance should also be made for differential movement by sleeving or taping pipes with foam to allow 40mm radial clearance.

Correct drainage and site maintenance is particularly important at this site. Refer to the "General Construction and Site Maintenance Requirements" section of this report and to sections 5 and 6 of AS2870-2011.

Surface drainage must be considered in the design of this footing system in accordance with Clause 5.6.3 of AS2870-2011. Surface drainage must be controlled from the start of construction and must be completed by the finish of construction. Subsurface drains to remove groundwater shall not be used within 1.5 metres of the building unless designed in accordance with engineering principles.

These details are to be used as a guide only and this footing system must be designed by an engineer familiar with this form of construction.

6.5 Bored Piers

Bored piers could be adopted. Piers should be taken minimum 300mm into the underlying clay. The following design parameters are recommended:

Soil Type	Allowable End-Bearing Capacity (kPa)	Allowable Side Friction Capacity (kPa)
filling	0	0
silt	0	0
clay	150	30
basalt bedrock / boulder	200	30

The bases of all excavations for piers should be well cleaned out prior to the pouring of concrete. Also, the above side friction parameters do not allow for gross smearing of the sides of holes by clay/mud. If this occurs during construction, then either the sides of the holes should be `roughened' or a reduction in side friction capacity made.

The construction of bored piers may prove difficult due to possible collapse of the sides of excavations or ground water ingress.

6.6 Screw In Piles

The structure could also be supported on screw-in-piles. Accurate pile lengths could be determined from electric friction-cone penetrometer tests and these could be carried out if required. Alternatively, a test screw-in should be placed in order to determine final depths and capacities.

Final pile lengths should be determined on site at the time of construction using an accepted pile driving formula, proportioned to **70kN**.

Some difficulties may be experienced with pile driving due to the presence of underground obstructions and therefore allowance should be made for relocating/redriving some piles or for pre-drilling pile locations.

7. STRENGTH AND DEPTH OF SOILS/ROCK

Borehole	Fill	Silt/Sand	Clay	Basalt Rock/Boulder
1	Depth – 0 - 250mm Bearing – 0kPa	Not encountered	Depth – 250 - 2700mm Bearing – 150kPa	Depth – 2700mm Bearing – 200kPa
2	Depth – 0 - 200mm Bearing – 0kPa	Not encountered	Depth – 200 - 500mm Bearing – 150kPa	Depth – 500mm Bearing – 200kPa
3	Depth – 0 - 200mm Bearing – 0kPa	Depth – 200 - 400mm Bearing – 50kPa	Depth – 400 - 500mm Bearing – 150kPa	Depth – 500mm Bearing – 200kPa
4	Depth – 0 - 200mm Bearing – 0kPa	Depth – 200 - 300mm Bearing – 50kPa	Depth – 300 -1200mm Bearing – 150kPa	Depth – 1200mm Bearing – 200kPa
5	Depth – 0 - 100mm Bearing – 0kPa	Depth – 100 - 300mm Bearing – 50kPa	Depth – 300 - 800mm Bearing – 150kPa	Depth – 800mm Bearing – 200kPa
6	Depth – 0 - 200mm Bearing – 0kPa	Depth – 200 - 300mm Bearing – 50kPa	Depth – 300 - 3000mm Bearing – 150kPa	Not encountered
7	Depth – 0 - 300mm Bearing – 0kPa	Not encountered	Depth – 300 - 2200mm Bearing – 150kPa	Depth – 2200mm Bearing – 200kPa
8	Depth – 0 - 100mm Bearing – 0kPa	Depth – 100 - 300mm Bearing – 50kPa	Depth – 300 - 2000mm Bearing – 150kPa	Depth – 2000mm Bearing – 200kPa
9	Depth – 0 - 300mm Bearing – 0kPa	Not encountered	Depth – 300 - 1100mm Bearing – 150kPa	Depth – 1100mm Bearing – 200kPa
10	Depth – 0 - 200mm Bearing – 0kPa	Depth – 200 - 400mm Bearing – 50kPa	Depth – 400 - 2700mm Bearing – 150kPa	Depth – 2700mm Bearing – 200kPa

8. FILLING

If existing levels require lifting, it is recommended that filling works be undertaken under Level 1 Supervision, in accordance with AS3798-2007 – Guidelines on Earthworks for Commercial and Residential Development.

If filling is required, this company can be contacted for a detailed earthworks specification.

9. GENERAL INFORMATION

Since the depth and thickness of the soil layers may vary across the site, the depths given above are only guides. Provided footings are at least the minimum size and are constructed on the recommended founding material given above, then the footings will have fulfilled the requirements of this report.

There is no technical reason to found all footing trenches at the same level or to make them constant in size.

Any earthworks carried out over the site will change the founding depths given above. If the site is levelled by cut, then the founding depths may be reduced to the minimum values specified. If levelling fill is placed on the site, then the founding depths will increase accordingly.

10. GENERAL CONSTRUCTION AND SITE MAINTENANCE REQUIREMENTS

10.1 General

The satisfactory performance of the footings detailed in this report assumes that the notes detailed below are followed.

10.2 Drainage

The surface drainage should be considered in the design of the footing system and care shall be taken with surface drainage of the site from the start of construction. The drainage system should be completed by the finish of construction of the building.

The drainage shall be designed and constructed to avoid the possibility of water ponding near or adjacent to buildings. The ground in the immediate vicinity of buildings should be graded to slope 100mm away from buildings over a distance of 2m from buildings. Any paving should also be suitably sloped.

Particular attention should be given to ensuring that plumbing trenches do not introduce water to or near the foundation system. Specifically, the trenches should be sloped away from buildings and should be backfilled with clay in the top 300mm within 2m of buildings. Where the pipes pass under slabs, the trench should be backfilled with clay or concrete to prevent the ingress of water beneath the slab.

Sub-surface drains should be avoided near footings as they can introduce water to the foundation if they become blocked.

Penetrations of slab beams and footings should be avoided if possible, but where necessary, these should be sleeved to allow for movement using 60mm thick closed cell polythene or similar material.

Connection of storm water and waste drains should include flexible connections. Plumbing and drainage under the slabs should be avoided where practical.

10.3 Vegetation

Trees and large shrubs should not be planted or allowed to exist closer to the building than 1.0 times their expected mature height. Closer planting may be possible by the correct use of tree root barriers or equivalent.

10.4 Plumbing and Drainage

Roof gutters, downpipes, stormwater and sewerage drainage should be regularly maintained to prevent leaks or overflows. Any leakages should be repaired or replaced as soon as possible. Service trenches located alongside any building should be offset at a lateral distance at least equal to their depth.

10.5 Existing Services and Footings

The presence of services on this and adjacent sites should be determined and their effect on the proposed footings considered. The depth of any adjacent building footings should be considered in the proposed footing design and construction.

10.6 Masonry Articulation

All brickwork should be well articulated by the provision of full-height joints at a maximum continuous spacing of 5m. Brickwork control joints should be provided at or near changes in foundation soil/rock type.

Articulation is also recommended to control temperature and shrinkage/growth effects.

10.7 Shrinkage Cracking For Concrete Slabs

Surface cracking for concrete slabs is to be expected as the concrete cures. This problem is of no structural significance and will not affect the performance of the slab. However, this shrinkage cracking may transmit through brittle floor tiles causing them to crack. Therefore the placement of floor tiles should be delayed as long as possible and a flexible adhesive and a weak grout should be used.

10.8 Inspections

All excavations should be carefully inspected to ensure that a suitable founding material has been reached and to check for the presence and variations in depth of filling. This office should be contacted if any doubt exists.

10.9 Filling

Care has been taken to identify any filling on this site. A check should however be made with all relevant authorities eg Local Council, to locate possible former dams, creeks, etc. If any doubt exists at the time of construction regarding identification of filling, then this office should be contacted for further advice.

11. CONSTRUCTION DIFFICULTIES AND SPECIAL SITE FEATURES

The presence of groundwater within the surface soils may lead to construction difficulties especially during wet Winter and Spring months.

The sides of excavations through the surface filling and natural sands may collapse.

It is recommended that a feature survey be carried out by a licensed surveyor prior to footing design in order to: locate all trees, easement pipes and adjoining structures etc... The relevant engineer should then take into account all those features at the time of design.

Under conditions of full saturation, the clays may not possess sufficient strength to carry loadings from conventional earth-moving and compaction equipment. Thus either over-excavation/replacement or lime/cement stabilisation will be necessary if construction is carried out when the ground is wet.

The presence of many boulders within proposed excavation depths should be anticipated and this may lead to some construction difficulties and additional expense eg. overbreak in footing excavations, difficulties in excavating trenches for services etc.

Excavation of weathered rock will be difficult and may require the use of an excavator with a rock breaking attachment

Existing trees and large shrubs are located too close to proposed footings (refer above). Therefore, vegetation should either be removed or root barriers designed and constructed. Alternatively, footings may be deepened to 2000mm or founded directly onto bedrock if encountered at shallower depths than 2000mm.

The presence of variable filling on this site should be anticipated, eg. footings from previous structures, service trenches, backfill from tree removal, etc. Allowance should be made for deeper founding depths and/or suspended slab panels if required.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12. BOREHOLE LOCATION PLAN

PROPOSED DEVELOPMENT - DUE DILIGENCE
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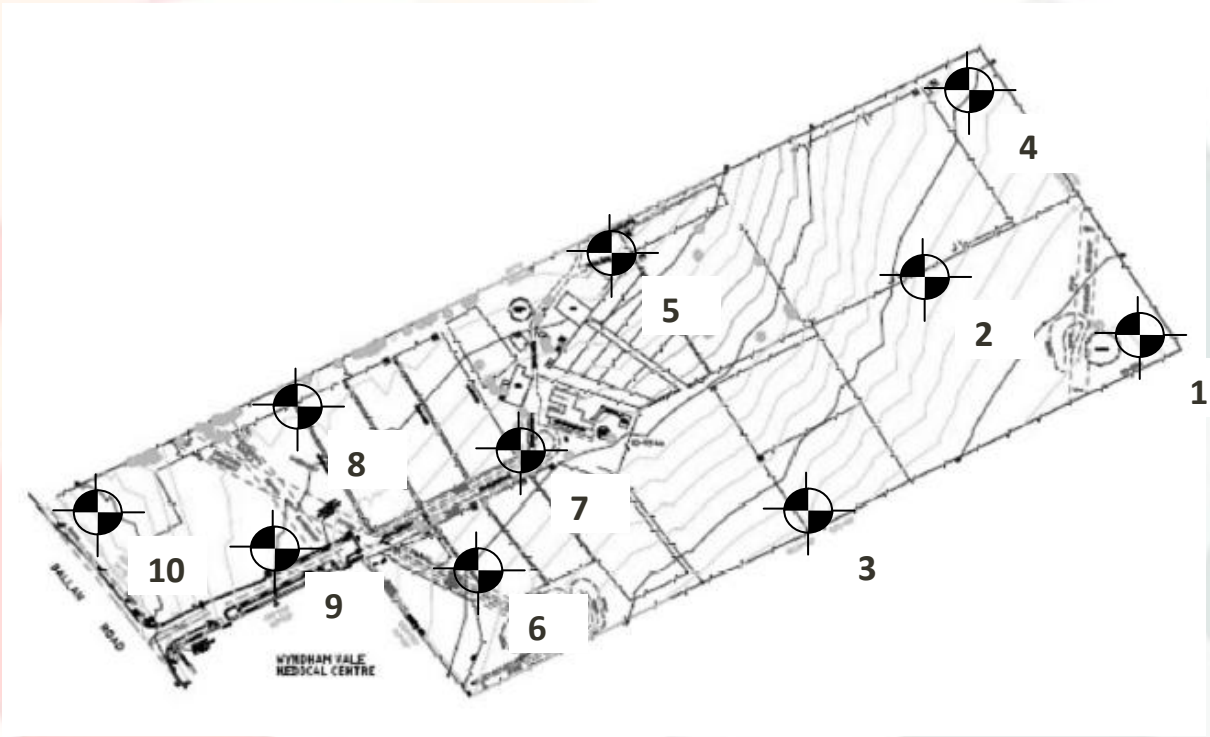
prepared for **Atma Environmental**



CONSULTING GEOTECHNICAL ENGINEERS level 1, 25-27 railway road, blackburn vic 3130 **E** contact@enrik.com.au **J**ob no. **2170236**

13. ENGINEERING LOG

PROPOSED DEVELOPMENT - DUE DILIGENCE
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prepared for **Atma Environmental**

Borehole No. 1. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0				
250	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
	Stiff brown and grey sandy clay - containing calcium carbonates - becoming grey silty clay - becoming gravelly below 2500mm	CLAY	moist	
2700	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 2. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0				
200	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
	Stiff brown and grey sandy clay	CLAY	moist	
500	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 3. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0				
200	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
	Loose brown and grey silty sand - containing gravel	SAND	dry	
400	Stiff brown and grey sandy clay	CLAY	moist	
500	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 4. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0				
200	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
	Loose brown and grey silty sand - containing gravel	SAND	dry	
300	Stiff brown and grey sandy clay - containing calcium carbonates - containing sand zones	CLAY	moist	
1200	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 5. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
100	Loose brown and grey silty sand - containing gravel	SAND	dry	
300	Stiff brown and grey sandy clay - containing calcium carbonates - containing sand zones	CLAY	moist	
800	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 6. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
200	Loose brown and grey silty sand	SAND	dry	
300	Stiff brown and grey sandy clay - containing calcium carbonates - containing sand zones - becoming grey	CLAY	moist	
3000	Terminated			

Borehole No. 7. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
300	Stiff brown and grey sandy clay - containing calcium carbonates - containing sand seams - becoming grey silty clay	CLAY	moist	
2200	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 8. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
100	Loose brown and grey silty sand	SAND	dry	
300	Stiff brown and grey sandy clay - containing calcium carbonates - containing sand seams	CLAY	moist	
2000	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 9. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
300	Stiff brown and grey sandy clay - containing calcium carbonates - becoming grey silty clay	CLAY	moist	
1100	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Borehole No. 10. **Refer to site plan**

Depth (mm)	Description	Soil Type	Moisture Condition	Comments
0	Loose sand, silt and clay fill	FILL	dry	Borehole dry on completion
200	Loose brown and grey silty sand	SAND	dry	
400	Stiff brown and grey sandy clay - containing calcium carbonates - becoming gravelly	CLAY	moist	
2700	**Refusal to steel tungsten on moderately weathered basalt or boulder**			

Drill Make: Mac Type: A3 Supervisor: tj Date: 31/01/17 Logged: tj Checked: