Loxford Precinct 1 Stages 1, 2, 3 & 4 Subdivision 464 Cessnock Road, Gillieston Heights, NSW

Prepared for: McCloy Group C/- KCE Pty Ltd
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EP RISK

Loxford Precinct 1 Stages 1, 2, 3 & 4 Subdivision 464 Cessnock Road, Gillieston Heights, NSW

[Subject]

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19 February 2025

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LIMITATIONS

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It is not possible in a Loxford Precinct 1 Stages 1, 2, 3 & 4 Subdivision 464 Cessnock Road, Gillieston Heights, NSW to present all data, which could be of interest to all readers of this report. Readers are referred to any referenced investigation reports for further data.

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1 Introduction

This report presents the results of geotechnical inspection and testing undertaken by EP Risk Management Pty Ltd (EP Risk) and Coffey Testing Pty Ltd (Coffey) during the development of Precinct 1 Stages 1,2,3 and 4 of the Loxford Residential Subdivision at 464 Cessnock Road, Gillieston Heights NSW. The work was undertaken at the request of James Lowe of McCloy Group.

The report details the findings of the geotechnical investigation, including a description of surface and subsurface conditions encountered on Site, and a statement regarding the Preliminary Site Classification in accordance with Standards Australia AS 2870-2011, Residentials Slabs and Footings (AS 2870-2011) for lots 101 to 152 (Stage 1), 201 to 214 (Stage 2), 301 to 322 (Stage 3), and 401 to 432 (Stage 4) of the Loxford Precinct Stage 1 to 4 Subdivision Development. The early site classifications were required by the developer to supplier early design by builders.

The Preliminary Site Classifications provided herein are in accordance with AS 2870-2011 and are applicable to lots 101 to 152 (Stage 1), 201 to 214 (Stage 2), 301 to 322 (Stage 3), and 401 to 432 (Stage 4) of the Loxford Precinct Stage 1 to 4 Subdivision Development in their existing condition at the time of fieldwork and in the absence of abnormal moisture condition. At the request of the client additional investigation was undertaken on Lots 107, 108, 109 and 413.

For the purpose of the investigation, combined sets of civil drawings (240289 1A1 – BEW-001 to 105 Rev B, dated 22/02/2024) for Loxford Precinct Stages 1 to 4 by ADW Johnson Pty Ltd were provided and are attached as **Appendix A – Site Plans Extract**.

An excerpt from MetroMap showing the indicative Site location is presented in Figure 1.

Figure 1 - Indicative Site Location

2 Site Location and Description

The Site, identified as Loxford Precinct 1, Stage 1 to 4 Proposed Subdivision, previously Lot 1 – DP 1206034, Lot 1 and 2 of D.P.456946, and Lot 54,70 and 71 of D.P.975994 at 464 Cessnock Road, Gillieston Heights, comprises of an irregular shape allotment, located west of Cessnock Road, Gillieston Heights. Based on plans provided by ADW Johnson the proposed development comprises creation of one hundred twenty (120) new residential allotments:

- Fifty-two (52) lots 101 to 152 in Stage 1.
- Fourteen (14) lots 201 to 214 in Stage 2.
- Twenty-two (22) lots 301 to 322 in Stage 3.
- Thirty-two (32) lots 401 to 432 in Stage 4.

The topography of the Site is gentle sloping (1-8°) to the south and south-west. Drainage across the Site is expected to comprise of surface flows following the gradient of the slopes towards the south and south-west to the newly constructed basins and ultimately to the tributaries of Swamp Creek.

New detention basins have or are currently being constructed in the southeastern and southwestern part of the site adjacent to Road MC08.

At the time of fieldwork, bulk earthwork for Stages 1 to 4 of the subdivision was nearing completion, with topsoil being applied to lots. The road bulk earthworks were almost completed with retaining walls, pavements, footpaths and utilities installation still in progress or to yet to be completed. The Site was devoid of significant vegetation.

There was significant regrade across the Site to produce level allotments, predominantly comprising of fill along the Cessnock Road and along the southern and western boundary of the site and cut in the northern and central section of the site. The extent of regrade in Stages 1 to 4 is shown on ADWJ Site Regrade Plan drawings 239233(5)5 ENG-501 to 502 which are provided with drawing extracts as **Appendix A – Site Regrade Plans**.

3 Earthworks

Earthworks and Civil Works for the development of the Subdivision were undertaken between August 2024 and December 2024 and were carried out by KCE Pty Ltd (KCE) which included development of the following:

- One hundred fifty-two (152) new residential allotments as part of Stage 1 to Stage 4.
- Bulk earthworks for Road MC12, MC13, Part Roads MC08, MC01
- Preliminary Bulk earthworks for future stage 10, 14, 15. 16 and 17
- Combined Bio-Retention/Detention Basin A2 and Detention Basin A3.

The earthworks within the development for Stage 1 to Stage 4 included regrade across of the majority of the Site, with a combination of filling along the southern, western and eastern boundary of the site and cutting in the northern and central section of the site. The extent of the regrade is shown in ADWJ site regrade plans provided as **Appendix B – Site Regrade Plans**. All material used in filling was Site won material comprising mostly of mixture of cohesive and granular soils identified as Silty, Sandy, Gravelly CLAYS and Clayey Gravelly SAND.

Compaction testing was undertaken during lot filling in accordance with Section 8 of AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Development*. The results for lot and general filling testing undertaken during development are included in Level 1 supervision and testing summary report included as **Appendix C – Level 1 Observation and Testing Summary Report**.

3.1 Material Quality

Materials encountered onsite generally comprised of Silty /Sandy / Gravelly CLAY and Clayey/Gravelly SAND (weathered bedrock). Onsite materials other than topsoil and colluvium was deemed suitable for use as general fill. Earthworks were undertaken utilising onsite materials which comprised of mixture of sands and clayey soils/weathered bedrock won from regrade activities. Colluvial soils were blended with suitable site won residual soils and used as engineered fill or stockpiled as spoil. The material description encountered in the investigation boreholes is shown in **Appendix D – Engineering Logs**.

Fill material was won from regrade activities across the site. Any unsuitable material which was excavated and replaced with suitable site won materials, with moisture reconditioning and blending as required. Anthropogenic material where encountered was removed.

3.2 Methodology

Regrade/ filling operations were undertaken by excavating the natural in-situ soils/weathered bedrock following stripping of topsoil so that the soil was free of significant organic matter and suitable for placing and use as controlled fill. Natural surfaces were inspected, and proof rolled using a compactor or wheeled construction equipment that was available at the time of inspection. Unsuitable materials were removed and replaced with select Site won material.

Fill operations were undertaken by placing layers of approximately 200 mm to 300 mm thickness and compacting to specified limits using pad foot and smooth drum rollers. Compacted fill layers were then tested for compaction in accordance with the guidelines indicated in AS 3798-2007. Table 5.1 Item 1 of AS 3798-2007 was adopted as the appropriate compaction criteria for the work with a minimum relative compaction of 95% standard relative density (SRD) required as appropriate for residential lots and 98% for fill greater than 1m depth.

Fill was tested in accordance with Table 8.1 *Frequency of Field Density Tests for Type 1 Large Scale Operations*. Placement and compaction of fill was undertaken with EP Risk and Coffey site personnel providing onsite inspections and testing services during earthworks activities.

3.3 Results of Compaction Testing

3.3.1 Lot Regrade

Results of compaction testing of regrade areas undertaken by Coffey Testing (Coffey) indicate that the filling operations have satisfied the compaction criteria for "controlled fill" as defined in Clause 1.8.13 of AS 2870-2011.

All testing has either met with or exceeded the specification adopted of 98% Standard Relative Density with compaction at moisture contents required to gain compaction at the time of placement with any failures being re-worked and retested. Compaction results indicate an average characteristic density of 103 % standard compaction achieved, with moisture contents generally within 2% of standard optimum moisture.

Geotechnical services provided during regrade comply with AS 3798-2007, with testing undertaken to the minimum frequency as indicated in Table 8.1 for Type 1 – Large Scale Operations.

Over two hundred (200) compaction tests were undertaken during regrade operations for Stage 1 to Stage 4 of approximately 100,000m^3 of cut to fill. Compaction results are shown on National Association of Testing Authorities (NATA) accredited test certificates, attached in **Appendix C - Level 1 Observation and Testing Summary Report**.

Pavement test results along with inground services testing is provided as part of the contractor's quality assurance package.

3.3.2 Basins

Basin A3 in the southern section of Stage 3 was constructed by excavation as shown on the ADW Site Regrade Plan 504 of Plan Extracts provided in **Appendix A – Site Plans Extract**. The material present in the base and walls of the basin was tested and found to be non-dispersive (Emerson Class 5). Basin A2 to the west in future staging, predominantly formed by excavation was also tested with results indicating the material to be non-dispersive. The results of testing are provided in **Appendix E – Laboratory Test Results.**

4 Investigation Methodology

Field investigation for site classification was undertaken in November and December 2024 and comprised in advancing sixty-seven (67) test bores on common boundaries and individual lot for (lots 101 to 152 in Stage 1, lot 201 to 214 in Stage 2, lot 301 to 322 in Stage 3 and lot 401 to 432 in Stage 4) using a four-wheel drive Ute mounted drill rig fitted with a 100 mm spiral auger to the target depth of 2.3 below ground level (m BGL). Majority of the test bores (53) did not reach the target depth resulting in refusal in weathered bedrock at depths varying from 0.1m to 1.9m below ground level. A test bore was drilled on the boundary of the adjacent lots or on the lot, with DCP tests conducted adjacent to and within test bores to aid in the assessment of subsurface strength conditions. Undisturbed (U50) representative soil samples from the bores were collected for subsequent laboratory testing.

Additional investigation and laboratory testing was undertaken on Lots 107, 108, 109 and 413 on xxxxxxx to provide a more specific site classification for these four (4) lots.

All fieldwork, including logging of subsurface profiles and collection of samples, was carried out by Coffey Testing on behalf of EP Risk. Test bores were located by reference to lot boundaries as shown in the Testing Location Plans for Stage 1 to Stage 4, attached as **Appendix F – Borehole Location Plans**. Subsurface conditions are summarised in Section 5.2 of this report, with detailed logs of the test bores provided in **Appendix D – Engineering Logs** of this report.

Laboratory testing on selected samples recovered during fieldwork comprised the determination of the shrink-swell index (*Iss*) carried out on undisturbed samples of the clay soils encountered at the Site to measure soil volume change over an extreme soil moisture content range.

Results of laboratory testing are detailed in the laboratory report sheets provided as **Appendix E – Laboratory Test Results** and summarised in Section 5.3.

5 Investigation Findings

5.1 Published Data

5.1.1 Site Geology

Based on geological data sourced from the NSW Department of Industry, Resources and Energy (www.minview.geoscience.nsw.gov.au) the Site is underlain by:

- Permian aged (298.9-251.9 Ma) - Greta Coal Measures of Permian Group comprising sandstone, siltstone, pellet claystone, coal, chert, sporadic conglomerate.
- Lopingian aged (272.95 - 268.8 Ma) - Branxton Formation (Pmtb) of the Maitland Group known to contain conglomerate, sandstone, siltstone.

An excerpt of the geological map is shown in Figure 2.

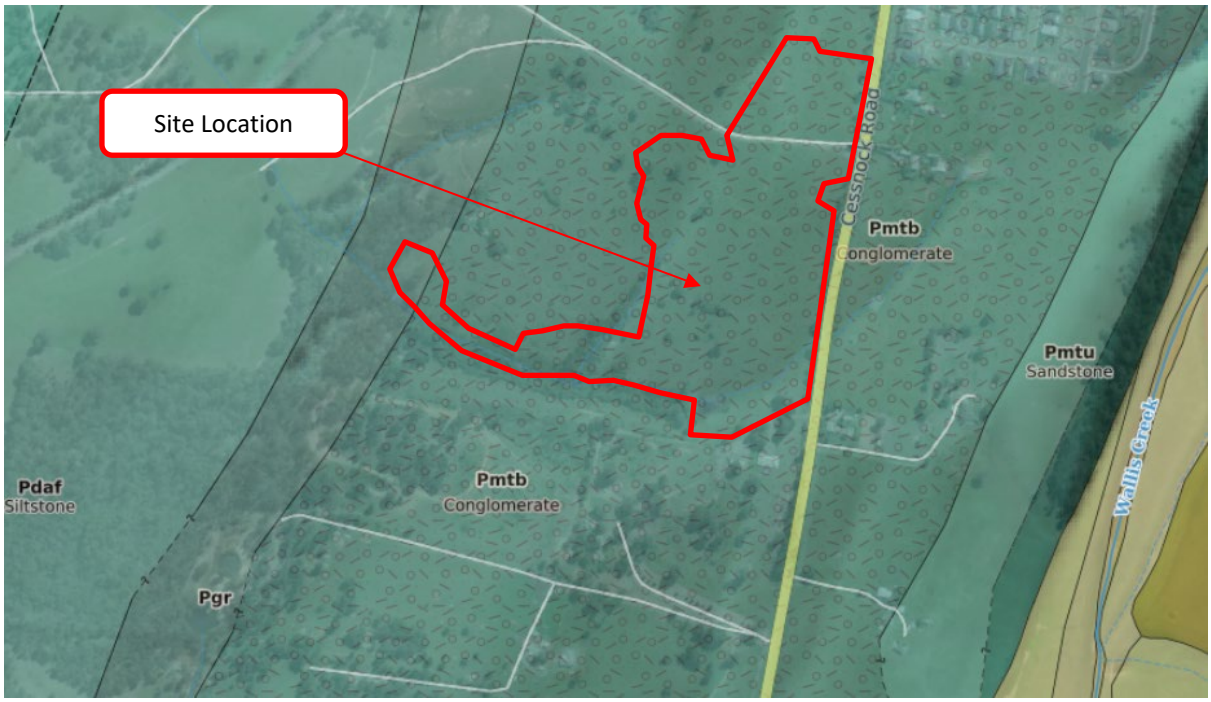

Figure 2 - Geological Map Excerpt (Pmtb - Branxton Formation, Pgr-Greta Coal Measures)

5.1.2 Soil Landscape

With reference to the NSW Department of Industry, Resources and Energy (www.environment.nsw.gov.au), onsite soil landscapes have been identified to comprise of 9232bh, Bolwarra Heights.

Landscape—rolling low hills on Permian sediments in the centre-west of the sheet in the East Maitland Hills region. Slopes are 5–20%, elevation to 100 m, local relief to 80 m. Cleared tall open-forest. Landscape Variant—bha—shallow (<55 cm) soils.

Topography— Rolling low hills. Slopes range from 5–20%. Local relief is generally 50 m, but ranging to 80 m. Elevation is 40–100 m. Crests are broad (200–500 m) with short (300–500 m), convex side slopes and narrow, incised drainage lines. Rock outcrop is localised, often occurring where Muree Sandstone is present (<2%).

Qualities and Limitations—moderate foundation hazard, water erosion hazard, high run-on (localised), seasonal waterlogging (localised), localised steep slopes with mass movement hazard.

5.1.3 Subsurface Conditions

The subsurface conditions encountered in the boreholes across the Site are detailed in the Coffey Testing borehole log sheets, attached as **Appendix D – Engineering Logs**. The subsurface profile generally comprised Clayey SAND (Topsoil), overlying Sandy and Silty CLAY, Clayey SAND, Clayey/Sandy GRAVEL (FILL), overlying Sandy/Gravelly CLAY, Clayey/Gravelly SAND and Clayey/Sandy GRAVEL.

At the time of fieldwork, the natural clays were assessed to generally range from stiff to very stiff and hard with isolated firm in surficial layers and for the granular soils from medium dense to dense and very dense.

A general summary of the subsurface conditions encountered across the site is presented below:

- Topsoil (Clayey SAND)
- Fill (Silty CLAY, Sandy CLAY, Clayey SAND, Clayey/Sandy GRAVEL)
- Residual Soil and weathered material (Sandy/Gravelly CLAY, Clayey/Gravelly SAND and Clayey/Sandy GRAVEL).

Practical refusal, at depths shallower than 2.3m – target depth, was encountered in fifty-three (53) boreholes out of sixty-seven (67) bores undertaken. DCP testing undertaken during investigation confirms suitable allowable bearing capacity within the fill and residual soil profile.

No groundwater or seepage was encountered in the boreholes at the time of fieldwork. It should be noted that groundwater levels are likely to fluctuate with variations in climatic and site conditions.

5.1.4 Laboratory Test Results

The results of the laboratory shrink swell tests undertaken on samples of the natural and fill clay soils are detailed on the laboratory test report sheets attached in **Appendix E – Laboratory Test Results** and are summarised below in Table 1.

Table 1 – Summary of Reactivity Testing

BH ID	Soil Type	Depth (m BGL)	Shrinkage		Swell			Shrink – Swell Index (Iss%)
			Shrinkage moisture content (%)	Shrink on drying (%)	Moisture content before (%)	Moisture content after (%)	Swell on saturation (%)	
Lot 102-103	Sandy CLAY	0.6-0.9	18.3	2.3	14.5	19.5	0.8	1.5
Lot 103-104	Sandy CLAY	0.7-0.9	19.2	4.8	20.5	20.4	0.9	2.9
Lot 107-413	Sandy CLAY	1.0-1.4	24.8	5.4	28.0	30.2	0.4	3.1
Lot 142	Sandy CLAY	0.8-1.7	22.9	4.3	20.6	21.4	-0.1	2.4
Lot 203-204	Sandy CLAY	0.3-0.7	16.5	1.6	20.1	29.1	0.3	0.9
Lot 206	Sandy CLAY	0.8-1.2	11.1	3.1	14.6	18.0	1.1	2.0
Lot 209-210	Sandy CLAY	0.5-0.5	25.0	5.6	16.8	22.8	0.2	3.2
Lot 414	Sandy CLAY	0.8-1.2	23.6	4.7	22.5	25.9	0.3	2.7
Lot 415-416	Sandy CLAY	0.8-1.2	19.0	3.5	11.8	22.7	0.1	2.0
Lot 427-428	Sandy CLAY	0.3-0.6	8.4	1.0	12.5	13.5	-0.3	0.6
Lot 427-428	CLAY	0.6-1.0	13.3	0.5	12.4	14.2	-0.3	0.3
Lot 432-431	Sandy CLAY	0.4-0.6	19.1	2.4	15.9	20.1	2.1	1.9

Table 1 – Summary of Reactivity Testing

BH ID	Soil Type	Depth (m BGL)	Shrinkage		Swell			Shrink – Swell Index (Iss%)
			Shrinkage moisture content (%)	Shrink on drying (%)	Moisture content before (%)	Moisture content after (%)	Swell on saturation (%)	
Lot 107*	Silty CLAY	1.1-1.6	26.6	4.8	28.7	28.6	0.7	2.9
Lot 107*	Sandy CLAY	0.3-0.52	26.0	4.0	24.5	27.6	1.8	2.7
Lot 108*	Clayey SAND	0.5-0.7	11.5	0.3	10.3	15.3	0.9	0.4
Lot 109*	Silty CLAY	0.6-1.1	21.3	2.6	25.0	27.6	0.6	1.6
Lot 109*	Silty CLAY	1.2-1.7	14.5	1.0	16.4	21.4	1.0	0.8
Lot 413*	Silty CLAY	0.4-0.68	28.2	6.1	26.5	27.9	0.9	3.7
Lot 413*	CLAY	1.3-1.8	22.2	2.8	26.1	28.7	0.5	1.7

* additional investigation undertaken on 05/02/2025

6 Comments and Recommendations

6.1 Preliminary Site Classification

EP Risk were requested to provide Preliminary Site Classification in accordance with AS 2870-2011 for the one hundred twenty (120) residential lots within Stages 1 to Stage 4 of the Loxford Precinct Subdivision Development. Along with the sixty-seven (67) bores undertaken, twelve (12) undisturbed samples were secured from various depths within the test bores of material considered representative of the soil profile encountered during investigation to assess the preliminary site classification. The shrink-swell test results show the shrink-swell index ranging from 0.6% to 3.2%.

Australian Standard AS 2870-2011 establishes performance requirements and specific designs for common foundation conditions as well as providing guidance on the design of footing systems using engineering principles. Site classes as defined on Table 2.1 and 2.3 of AS 2870-2011 are presented in Table 2.

Table 2 – General Definition of Site Classes

Site Class	Foundation	Characteristic Surface Movement
A	Most sand and rock sites with little or no ground movement from moisture changes	
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 – 40 mm
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 – 60 mm
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	> 75 mm
A to P	Filled sites (refer to clause 2.4.6 of AS 2870-2011)	
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.	

Reactive sites are sites consisting of clay soils that swell on wetting and shrink on drying, resulting in ground movements that can damage lightly loaded structures. The amount of ground movement is related to the physical properties of the clay and environmental factors such as climate, vegetation and watering. A higher probability of damage can occur on reactive sites where abnormal moisture conditions occur, as defined in AS 2870-2011, due to factors such as:

- Presence of trees on the building site or adjacent site, removal of trees prior to or after construction, and the growth of trees too close to a footing. The proximity of mature trees and their effect on foundations should be considered when determining building areas within each allotment (refer to AS 2870-2011);
- Failure to provide adequate site drainage or lack of maintenance of site drainage, failure to repair plumbing leaks and excessive or irregular watering of gardens; and
- Unusual moisture conditions caused by removal of structures, ground covers (such as pavements), drains, dams, swimming pools, tanks etc.

In regard to the performance of footings systems, AS 2870-2011 states "footing systems designed and constructed in accordance with this Standard on a normal site (see Clause 1.3.2) that is:

(a) not subject to abnormal moisture conditions; and

(b) maintained such that the original site classification remains valid and abnormal moisture conditions do not develop;

are expected to experience usually no damage, a low incidence of damage category 1 and an occasional incidence of damage category 2."

Damage categories are defined in Appendix C of AS 2870-2011, which is reproduced in CSIRO Information Sheet BTF 18*, Foundation Maintenance and Footing Performance: A Homeowner's Guide.*

The extent of Site Regrade is shown on ADW Site Regrade Plans which are provided as **Appendix B – Site Regrade Plans**. As specified in AS 2870-2011 Clause 2.5.3, the classification of sites with controlled fill of depths greater than 0.4 m (deep fill) comprising of material other than sand would be Class P. However, an alternative classification may be given to the site with consideration to controlled fill.

Based on the soil profiles encountered in the test bores, and in accordance with AS 2870-2011, the lots in their existing condition following regrade and in the absence of abnormal moisture conditions received recommended preliminary site classifications ranging from Class **A**, Stable to Class **H2**, highly reactive. The recommended Site Classifications for footing and slab design are detailed below in Table 3**.**

Table 3 – Recommended Preliminary Site Classifications

Lot Numbers	Recommended Site Classification
101, 112, 113, 114, 115, 118, 119, 120, 121, 122, 123, 126, 127, 128, 131, 132, 133, 134, 135, 136, 137, 138, 139, 143, 144, 145, 146, 149, 150, 151, 152, 201, 202, 203, 204, 209, 210, 211, 212, 213, 214, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 320, 321, 322, 401, 402, 403, 404, 405, 406, 407, 408, 417, 418, 421, 422, 429, 430, 431, 432	**Class M,** Moderately reactive
116, 117, 124, 125, 205, 206, 207, 208, 319, 411, 412, 414, 415, 416, 419, 420, 423, 424, 425, 426, 427, 428	**Class H1,** Highly Reactive
102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 129, 130, 140, 141,142, 147, 148, 207, 409, 410, 413	**Class H2,** Highly Reactive
Where founded uniformly on weathered rock or sand class S, Slightly Reactive or Class A, Stable would be appropriate:	

The above classifications assume that all foundations are founded below any topsoil, uncontrolled fill or slope wash and on natural soil profile or on engineered fill. Characteristic surface movements in the range of 10 mm to 70 mm have been calculated for the lots in their existing condition at the time of investigation taking into consideration the age and extent of regrade activities assuming the elimination of the cracked zone. Recommended preliminary site classifications based on characteristic site movement range from **Class M**, Moderately Reactive to **Class H2,** Highly Reactive unless founded uniformly on weathered rock where **Class S**, Slightly Reactive of **Class A**, Stage would be appropriate.

The Site Classification assumes that all footings (edge beams, internal beams and load support thickenings) are founded below any topsoil, slopewash, fill or other deleterious material and have been based on assumed waffle type slab construction.

As noted in Section 2 the Site was devoid of trees at the time of investigation except for the recent street landscaping. Clause 1.3.3 of AS 2870-2011 nominates that the presence of trees could result in abnormal moisture conditions at the Site should the trees be located within the building areas (include new planting and

street landscaping). In such situations, AS 2870-2011 nominates adoption of a Class P classification. The above Site Classifications are expected if any trees located or proposed within and surrounding building areas, as indicated in Appendix B of AS 2870-2011, are removed and sufficient time is allowed for the soil moisture to re-equilibrate or moisture reconditioning of the soil is undertaken. Earthwork for reinstatement/filling of areas following tree removal should be undertaken to meet the requirements of "controlled fill" as per AS 2870-2011 with moisture content close to the equilibrium moisture.

It should be appreciated that the Site Classifications provided above are based on test bores and laboratory testing of multiple layers over the depth of total soil suction change in the soil profile. Soil conditions are not expected to vary significantly, excluding depth to rock and fill which may vary across the Site and allotments due to the regrade undertaken. The above site classifications and footing recommendations are for the site conditions present at the time of fieldwork and consequently the site classifications may need to be reviewed with consideration of any site works that may be undertaken after the investigation and this report.

Site works may include:

- Changes to the existing soil profile by cutting and filling.
- Landscaping, including trees removed or planted in the general building area; and
- Drainage and watering systems.

Designs and design methods presented in AS 2870-2011 are based on the performance requirement that significant damage can be avoided if site conditions are properly maintained.

Performance requirements and foundation maintenance are outlined in Appendix B of AS 2870-2011. The above site classification assumes that the performance requirements as set out in Appendix B of AS 2870-2011 are acceptable and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.

Details on appropriate site and foundation maintenance practices are presented in Appendix B of AS 2870-2011 and in CSIRO Information Sheet BTF 18, *Foundation Maintenance and Footing Performance: A Homeowner's Guide*, which is attached as **Appendix G – Foundation Maintenance and Footing Performance** of this report.

Adherence to the detailing requirement outlined in Section 5 of AS 2870-2011 is essential, in particular Section 5.6 *Additional requirements for Classes M, H1 and H2 sites*, including architectural restrictions, plumbing and drainage requirements.

6.2 Footings

All foundations should be designed and constructed in accordance with AS 2870-2011, *Residential Slabs and Footings* with reference to site classifications as presented in Table 3.

All footings should be founded below any topsoil, slopewash, deleterious soils or uncontrolled fill. All footings for the same structure should be founded on strata of similar stiffness and reactivity to minimise the risk of differential movements.

Potential for differential movement should be considered due to variation in depth of filling and rock across the Site and articulation incorporated into the design.

Footings should be founded below the zone of influence of any service trenching. This may require the use of piering depending on the location and depth of inground services.

6.2.1 High Level Footings

High-level footing alternatives could be expected to comprise slabs on ground with edge beams or pad footings for the support of concentrated loads. Such footings designed in accordance with engineering principles and founded in stiff or better natural soils or controlled fill (below topsoil, slopewash, uncontrolled fill or other deleterious material) may be proportioned on an allowable bearing capacity of 100 kPa and founded in weathered bedrock for 500kPa.

Where controlled lot filling has been carried out, high-level footing types should be founded below any topsoil onto the engineered fill that is placed and compacted in accordance with AS3798-2007.

The founding conditions should be assessed by an experienced geotechnical consultant or experienced engineer to confirm suitable conditions.

6.2.2 Piered Footings

Piered footings are considered as an alternative to deep edge beams or high-level footings and provide an alternate founding solution. It is suggested that bored piered footings, founded in stiff or better natural clay could be proportioned on an end bearing pressure of 100 kPa. Bored pier footings founded in weathered sandstone/siltstone/shale could be proportioned to an end bearing allowable pressure of 500kPa.

All footings should be founded below any topsoil, slopewash, deleterious soils or uncontrolled fill. All footings for the same structure should be founded on strata of similar stiffness and reactivity to minimise the risk of differential movements.

Inspection of high level or piered footing excavations should be undertaken to confirm the founding conditions and the base should be cleared of fall-in prior to the formation of the footing.

7 Conclusion

The earthworks undertaken for Stage 1 to Stage 4 of Loxford Residential Development have been undertaken in accordance with guidelines outlined in AS3798-2007. The fill was tested in accordance with Table 8.1 *Frequency of Field Density Tests for Type 1- Large Scale Operations* Australian Standard AS3798-2007. Placement and compaction of fill was observed by EP Risk and Coffey site personnel who provided onsite inspection and testing services during earthworks activities. Results of compaction testing of regrade areas undertaken by Coffey indicate that the filling operations have satisfied the compaction criteria for controlled fill as defined in AS2870-2011, with suitable allowable bearing capacity obtained for retaining walls.

Geotechnical investigation was carried out for the purpose of Site Classification of lots within the development in accordance with AS2870-2011. The subsurface profile encountered in the test bores generally comprised topsoil overlying, controlled fill, residual soils (Sandy/Gravelly CLAY and Clayey/Gravelly SAND) and weathered material. Weathered bedrock was encountered in fifty-three (53) boreholes with refusal before 2.3m depth. The depth to rock and fill will vary across allotments and the Site in general due to regrade activities undertaken. It is noted that significant regrade was undertaken in portions of the Stage 1 to Stage 4 to raise levels and to provide level lots to accommodate construction of new dwellings.

As specified in AS 2870-2011 Clause 2.5.3, the classification of sites with controlled fill of depths greater than 0.4 m (deep fill) comprising of material other than sand would be Class P. However, an alternate classification may be given to the site with consideration to controlled fill.

Recommended Preliminary Site Classifications for to be used for footing and slab design for lots in the development are shown in Table 3 and range from **Class M,** Moderately Reactive to **Class H2,** Highly Reactive for a *Hs* (design soil suction change) of 2.3 m in accordance with AS2870-2011 and in the absence of abnormal moisture conditions, which is the recommended classification to be adopted, unless footings are founded uniformly on weathered rock where a classification of Class S, or Class A would be appropriate. The Site Classifications assume that all foundations are founded below any topsoil/slopewash and on the controlled fill or the natural soil profile. Characteristic surface movement in the range of 10mm to 70mm have been calculated for the lots in their existing condition taking into consideration the extent and age of regrade undertaken. The Site Classification also takes into consideration the potential for differential movement because of the depth of fill across the Site due to regrade activities undertaken.

High-level footing alternatives could be expected to comprise slabs on ground with edge beams or pad footings for the support of concentrated loads. Such footings designed in accordance with engineering principles and uniformly founded in stiff or better natural soils or controlled fill (below topsoil, slopewash, uncontrolled fill or other deleterious material) may be proportioned on an allowable bearing capacity of 100 kPa. Piered footings are considered as an alternative to deep edge beams or high-level footings and offer a viable alternative. It is suggested that piered footings, founded in very stiff clay or better and medium dense to dense sand could be proportioned on an end bearing pressure of 100 kPa. Piered footings founded in weathered bedrock could be proportioned for an allowable bearing pressure of 500kPa.

Footings for residential type light weight structures do not necessarily need to be founded in the natural soils where fill is undertaken in accordance with AS3798-2007 and satisfies the criteria of controlled fill as per AS2870-2011.

Site Classifications to those presented in this report could be determined by other consultants and recommended site classification by EP Risk are based on detailed knowledge of site conditions and regrade activities undertaken during construction.

8 References

- Australian Standard AS1726-2017. *Geotechnical Site Investigation.* Standards Australia, 2017.
- Australian Standard AS2870-2011. *Residential Slabs and Footings.* Standards Australia, 2011.
- Australian Standard AS3798-2007**.** *Guidelines on Earthworks for Commercial and Residential Structures.* Standards Australia, 2007.
- Qualtest Report "*The Loxford Residential Subdivision – Stages 1 to 4 Preliminary Geotechnical Assessment 464 Cessnock Road, Gillieston Heights*" NEW23P-0017-AC.rev1 4 September 2023

Appendix A
SITE PLANS EXTRACT

Appendix B
SITE REGRADE PLANS

Appendix C

LEVEL 1 OBSERVATION AND TESTING SUMMARY REPORT

Appendix D
ENGINEERING LOGS

Appendix E
LABORATORY TEST RESULTS

Appendix F
BOREHOLE LOCATION PLAN

Appendix G

FOUNDATON MAINTENANCE AND FOOTING PERFORMANCE