Oxford Falls Grammar School

martens consulting engineers

Preliminary Site Investigation,

Propposed carpark at 1078 Oxford Falls Road, Oxford Falls, NSW.

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1907548JR01V04
March 2021

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All enquiries regarding this project are to be directed to the Project Manager.

Contents

Attachments

Tables

General Abbreviations

AASS	Actual acid sulfate soil
ABC	Ambient background concentrations
ACM	Asbestos containing material
AEC	Area of environmental concern
AF	Asbestos fines
AMP	Asbestos Management Plan
ANZECC	Australia and New Zealand Environment Conservation Council
ANZG	Australian and New Zealand Governments
ASC NEPM	National Environmental Protection (Assessment of Site Contamination) Measure (2013)
ASS	Acid sulfate soil
ASSMAC	Acid Sulfate Soils Management Advisory Committee
AST	Above ground storage tank
BGL	Below ground level
BH	Borehole
BTEXN	Benzene, toluene, ethylbenzene, xylene, naphthalene
CEMP	Construction Environmental Management Plan
COC	Chain of custody
COPC	Contaminants of potential concern
DA	Development application
DBT	Dibutyltin
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DNAPL	Dense non aqueous phase liquid
DP	Deposited Plan
DPI	NSW Department of Primary Industry
DPIW	NSW Department of Primary Industry – Water
DQI	Data quality indicators
DQO	Data quality objectives
DSI	Detailed Site Investigation
EAC	Ecological assessment criteria
EIL	Ecological investigation level
EMP	Environmental Management Plan
EPA	NSW Environmental Protection Authority
EQL	Estimated quantitation limit (Interchangeable with PQL and LOR)
ESA	Environmental Site Assessment
ESL	Ecological screening level
FA	Fibrous asbestos
GIL	Groundwater investigation level
HIL	Health investigation level
HM	Heavy metals
HSL	Health screening level
IA	Investigation area
ISQG	Interim Sediment Quality Guideline
ITP	Inspection Testing Plan
LGA	Local government area
LNAPL	Light non aqueous phase liquid
LOR	Limit of reporting (Interchangeable with EQL and PQL)
MA	Martens & Associates Pty Ltd
mAHD	Metres, Australian Height Datum
mbgl	Metres below ground level

MBT	Monobutyltin
MNA	Monitored natural attenuation
MPE	Multi phase extraction
NAPL	Non aqueous phase liquid
NATA	National Association of Testing Authorities
ND	No data
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
OCP	Organochloride pesticides
OEH	NSW Office of Environment and Heritage
OPP	Organophosphorus pesticides
PACM	Potential asbestos containing material
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soil
PCB	Polychlorinated biphenyl
PCEMP	Post Construction Environmental Management Plan
PESA	Preliminary Environmental Site Assessment
PFAS	Per- and polyfluoroalkyl substances
PID	Photoionisation detector
ppb	Parts per billion
ppm	Parts per million
PQL	Practical quantitative limit (Interchangeable with EQL and LOR)
PSI	Preliminary Site Investigation
QA/QC	Quality assurance / quality control
RAC	Remediation acceptance criteria
RAP	Remedial Action Plan
HHRA	Human Health Risk Assessment
RPD	Relative percentage difference
SAC	Site assessment criteria
SAQP	Sampling and Analysis Quality Plan
SEPP	State Environmental Planning Policy
SIL	Soil investigation level
SOP	Standard operating procedure
SWL	Standing water level
SWMS	Safe Work Method Statement
TB	Trip blank
TBT	Tributyl tin
TCLP	Toxicity characteristics leaching procedure
TEQ	Toxic equivalency factor
TP	Test pit
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
TS	Trip spike
UCL	Upper confidence limit
UPSS	Underground petroleum storage system
UST	Underground storage tank
VHC	Volatile halogenated compounds
VOC	Volatile organic compounds
WHS	Work health and safety
WHSP	Work Health and Safety Plan

1 Introduction

1.1 Overview

This report, prepared by Martens and Associates (MA), documents a Preliminary Site Investigation (PSI) of potentially contaminating activities, to support a Review of Environmental Factors (REF) for construction of a carpark (the Project) for Oxford Falls Grammar School at 1075 Oxford Falls Road, Oxford Falls, NSW ('the site').

The investigation area (IA) for this PSI is limited to the southeast portion of the school site, as shown in Attachment A.

1.2 Previous Assessments

JK Environmental previously undertook a Stage 1 Environmental Site Assessment (report reference E30807Brpt Rev2) for a proposed kiosk in the southwest portion of the school site [November 2019] (JK, 2019).

JK Geotechnics previously provided a geotechnical investigation (report reference 30807SYrpt) for the proposed sporting facility, car park and playing field in the southern portion of the site [October 2017] (JK, 2017).

Environmental Investigation Services (EIS) undertook a Waste Classification Assessment and Soil Suitability Analysis (report reference E30807KMlet-WC_rev1) for the playing field in the southwest portion of the site [November, 2017] (EIS, 2017). The testing undertaken as part of EIS (2017) covers the IA for this PSI. EIS's (2017) results and findings are summarised in Section 3.8, with a copy of their assessment provided in Attachment D.

1.3 Proposed Development

The proposed site development involves the construction of an at grade car park as documented in the plans provided by AJC (2021).

The proposed development plans are provided in Attachment C.

1.4 Objectives

Investigation objectives include:

- Identification of historic and current potentially contaminating site activities.
- Evaluation of areas of environmental concern (AEC) and associated contaminants of potential concern (COPC) within the IA.

- Assess identified AEC and associated COPC.

- Provide comment on the suitability of the IA for the future carpark use, and where required, provide recommendations for additional investigations.

1.5 Project Scope

The scope of works includes:

- Walkover inspection to review current land use, potential contaminating activities and neighbouring land use.

- Site history review using aerial photographs and available historic records.

- Review of previous investigations on the site related to contamination.

- Review of NSW EPA notices under the Contaminated Land Management Act (1997).

- Preparation of a report in general accordance with the relevant sections of NSW EPA (2020) and ASC NEPM (2013) and EPA (2017).

1.6 Guideline Reference Documents

- ASC NEPC (1999, amended 2013) National Environmental Protection (Assessment of Site Contamination) Measure. Referred to as ASC NEPM (2013).

- NSW EPA (2017) 3rd Ed. Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme.

- NSW EPA (2020) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.

2 Site Description

2.1 Site Details

Site information is summarised in Table 1, and site location and general surrounds shown in Attachment A.

Table 1: Site background information.

Item	Description / Detail
Site address	1078 Oxford Falls Road, Oxford Falls, NSW.
Legal Identifier	Lot 100 DP 1240806
Approximate site area	4.2 ha (Sixmaps, 2019)
Approximate IA area	0.5 ha (Sixmaps, 2019)
Local Government Area	Northern Beaches Council
Current zoning and land use	Zoned RE1 – Public Recreation (Planning Portal, 2019). Site is currently used for as a primary and secondary school.
Site description	Oxford Falls Grammar School at the north and southeast portion of the site, and a sports field at the southwest portion of the site.
Surrounding land uses	Church to the west of the site. Low density residential dwellings east and south.
Topography	The site is relatively flat with grades < 5%. Site elevation ranges between approximately 79 mAHD in the north eastern portion and 73 mAHD in the western portion of the site (Google Earth Pro. 2019).
Expected geology	The *Sydney 1:100,000 Geological Sheet 9030* describes site geology as Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses. The NSW Environment and Heritage eSPADE website identifies the northeast portion of the site as having soils of the Hawkesbury landscape comprising of shallow discontinuous lithosols / siliceous sands associated with rock outcrops; earth sands, yellow earths and some yellow podzolic soils on inside of benches and along joints and fractures; localised yellow and red podzolic soils associated with shale lenses; siliceous sands and secondary yellow earths along drainage lines. The remainder of the site have soils of the Oxford Falls landscape having moderately deep to deep earthy sands, yellow earths, siliceous sands on slopes; deep leaches sands, podzols and grey earths on valley floors.
Surface hydrology	Drainage of the site is via overland flow northwest, to an unnamed tributary of Middle Creek (which bisects the school site). The unnamed tributary is located along the northeast boundary of the IA.

2.2 Hydrogeology

Review of WaterNSW Real-time Water Database, indicated two groundwater bores within 500 m of the site, as summarised in Table 2.

Table 2: Available hydrogeological information.

Bore Identification	Record Date	Intended Use	Standing Water Level (mbgl)	First Water Bearing Zone (mbgl) and Substrate	Distance and Direction from IA
GW108250	2007	Recreation	21.0	Sandstone	350 m southwest
GW032798	1970	Domestic	4.8	Sandstone	450 m northwest

Groundwater inflow was encountered during a geotechnical investigation by JK (2017) between 3 – 5 mbgl, with standing water levels between 2.8 – 4.5 mbgl.

No springs were listed within 500 m of the site in the NSW Government Hydrography Spatial Data (SEED, 2019).

Should further information on permanent site groundwater conditions be required, an additional assessment would need to be carried out (i.e. installation of groundwater monitoring bores / ongoing groundwater monitoring).

3 Site Contamination Assessment

3.1 Council Historical Site Records (JK, 2019)

One historic development record was held by Council for the site. Details are summarised in Table 3 and records can be found in JK (2019).

Table 3: Available Council records.

Lot ID	Year	Record Number	Description
Lot 100 DP 1240806	1979	3675/P1 079-1080	Erection of stages of a primary and infants school comprising twelve classrooms, library, hall and administration office, playing field, carpark and associated landscaping. The enclosed pool and caretaker's cottage were to be retained. Proposed playing field involved site filling for flat surface.

3.2 NSW EPA Records

No sites within 500 m of the IA were identified on the list of NSW contaminated sites notified to the EPA as required by the Contaminated Land Management Act (1997) and the Environmentally Hazardous Chemicals Act (1985).

One site within 500 m of the IA was listed on the EPA public register required under section 308 of the Protection of the Environment Operations Act 1997 (the POEO Act), which lists licences, notices penalty notices and convictions, is summarised in Table 4.

Table 4: Potentially contaminating activities.

Licence Number	Site Name	Approximate Distance from Site Boundary	Direction from Site	Gradient from Site
4584	Numeve Pty Ltd	290 m	Northeast	Up gradient

The licenced activities include the recovery of general waste, waste storage and application of herbicides to waterways.

Due to the distance and proximinity from the site, the above location is not expected to have impacted near surface soils or groundwater within the IA.

Due to the above site being downstream of the IA, the above activity is also unlikely to have impacted surface water at the IA.

3.3 External Potentially Contaminating Activities

No potentially contaminating activities, such as service stations, mechanics and dry cleaners, were identified within 500 m of the site.

3.4 Aerial Photograph Review

Aerial photographs taken of the site during between 1956 and 2019, were reviewed to investigate historic site land uses (Table 4). Copies of aerial photographs from 1956 to 2009 are provided in JK (2019), and are reproduced as shown in Attachment B along with a recent site aerial from Nearmap 2019.

The aerials indicated that the IA was cleared prior to 1956, and a large shed constructed between 1961 and 1965. The large shed was demolished between 1982 and 1991, and the current site conditions were constructed between 1991 and 2005.

Table 5: Aerial photograph observations from 1956 to 2019.

Year (Source)	IA Activity	Surrounding Land Use
1956 (LIR)	The site was cleared.	Surrounding land was rural residential properties with market gardens and orchards, particularly to the west.
1961 (LIR)	Little to no change from previous.	Sheds constructed to the west, otherwise little to no change from previous.
1965 (LIR)	A large shed (possible warehouse) was constructed to the west of the IA which partly protruded into the IA.	Sheds constructed to the north, otherwise little to no change from previous.
1970 (LIR)	Little to no change from previous.	Little to no change from previous.
1982 (LIR)	Little to no change from previous, minor extension to eastern side of shed.	A number of sheds in the north in the site demolished, otherwise little to no change from previous.
1991 (LIR)	Large shed was demolished.	Sheds demolished to the west, otherwise little to no change from previous.
2005 (LIR)	The current oval was constructed.	Oxford Falls Grammar School has been constructed. The area west of the site was no longer used for agricultural purposes and a church has been constructed to the west of the site. Residential development constructed to the east.
2009 (LIR)	Little to no change from previous.	Little to no change from previous.
2019 (Nearmaps)	Little to no change from previous.	Little to no change from previous.

3.5 Site Walkover Inspection

Observations during the site walkover inspection 17 December 2019, were as follows:

- The IA was being used as a sports field with an unnamed tributary of Middle Creek flowing northwest along the northern and eastern boundary of the IA.
- The school site was bisected by the tributary of Middle Creek along a southeast to northwest transect.
- The site was bounded by Oxford Falls Road to the east, Dreadnought Road to the south, Wakehurst Parkway to the west and bush to the north.
- The IA appeared to be composed of fill to level the sports field, as observed from the raised levee banks from the unnamed tributary.
- No other obvious signs of contamination (i.e. asbestos, soil staining, odours) were noted.

3.6 Conceptual Site Model

3.6.1 Preliminary Areas of Environmental Concern/Contaminants of Potential Concern

Our assessment of site AEC and COPC (Table 6) for the IA was made on the basis of available site history, aerial photograph interpretation, site walkover and geotechnical drilling (JK, 2017).

Table 6: Preliminary areas of environmental concern and contaminants of potential concern.

AEC	Potential for Contamination	COPC
AEC A Fill	Fill from unknown sources has the potential to add contamination including hydrocarbons, heavy metals, pesticides and asbestos.	HM, TRH, BTEXN, PAH, OCP / OPP and asbestos
AEC B Former shed including 5 m curtilage	Pesticides and heavy metals may have been used underneath past shed for pest control. Building construction may include PACM, zinc treated (galvanised) metals, and lead based paints. Garage may have previously stored fuels, oils and chemicals.	HM, TRH, BTEXN, PAH, OCP / OPP and asbestos

3.6.2 Previous Assessment Results

Subsurface soil investigation by EIS (2017) to support a waste classification assessment and soil suitability analysis within the sports playing field involved the excavation of twenty one boreholes, of which ten were inside the IA for this investigation. Fill was observed up to 2.5 mbgl (BH4) and alluvium up to 5.5 mbgl (BH4).

Soil samples were sent to a NATA registered laboratory (Envirolab Services) by EIS (2017) for soil analysis, which involved:

- Fifteen samples for HM, BTEXN, PAH, TRH;
- Ten samples for asbestos;
- Five samples for OCP and OPP.

BTEXN, TRH, OCP and OPP results were all below laboratory practical quantitation limits (PQL), and all other results were below ASC NEPM (2013) site assessment criteria (SAC) for Residential A.

No asbestos was detected in samples analysed.

3.6.3 CSM Discussion

Preliminary AEC have been identified in Section 3.6.1 as areas under the former shed and also fill placed for the sports field. Given the testing completed by EIS (2017) was undertaken within the AEC areas identified and that results of laboratory testing of soils showed no signs of contamination, there appears to be no significant site source receptor pathway link.

4 Discussion and Conclusion

The review of the site history indicated that the IA was cleared prior to 1956 and a large shed constructed between 1961 and 1965. The shed was demolished between 1982 and 1991, and the current Oxford Falls Grammar school oval has been in place since.

Potential contamination sources are summarised as:

- The entire IA which appears to be filled to level the sports field.
- Former shed which occupied a small eastern portion within the IA.

Subsurface soil investigation by JK (2017) indicated fill was observed up to 2.5 mbgl (BH4) and alluvium up to 5.5 mbgl (BH4).

EIS (2017) documented a waste classification and soil suitability analysis which covered the entire IA and preliminary AEC noted in this PSI. Samples were sent to a laboratory and assessed against COPC noted in this PSI.

Soil analysis indicated all samples to be below ASC NEPM (2013) Residential A guidelines. In light of this, the fill across the entire IA and former shed AEC is not considered to pose a risk of contamination and does not require further investigation.

Overall, the IA is considered to have a low risk of broad scale or localised contamination, and will be suitable for the proposed carpark development. It should be noted, however, that past filling undertaken from unknown sources still has a risk of contamination. This risk should be managed by implementing an appropriately prepared unexpected finds protocol during construction. This document should be made available to all contractors working on the site and included as part of the site induction process.

5 Recommendations

Based on the findings of the historical analysis and EIS (2017) soil analysis results, no further investigation for contamination is warranted.

An unexpected finds protocol is to be prepared prior to works commencing on the site. If any unexpected finds (such as fibro material, odours or soil staining) are encountered during site works, the unexpected find will require assessment by MA to determine requirements for additional investigation and / or remedial action.

If any soil material is removed from site, a formal waste classification assessment shall be required in accordance with the NSW EPA Waste Classification Guidelines (2014).

6 Limitations Statement

The PSI was undertaken in line with current industry standards.

It is important, however, to note that no land contamination study can be considered to be a complete and exhaustive characterisation of a site nor can it be guaranteed that any assessment shall identify and characterise all areas of potential contamination or all past potentially contaminating land-uses. Therefore, this report should not be read as a guarantee that no contamination shall be found on the site. Should material be exposed in future which appears to be contaminated or inconsistent with natural site soils, additional testing may be required to determine the implications for the site.

Martens & Associates Pty Ltd has undertaken this assessment for the purposes of the current development proposal. No reliance on this report should be made for any other investigation or proposal. Martens & Associates Pty Ltd accepts no responsibility and provides no guarantee regarding the characteristics of areas of the site not specifically studied in this investigation.

7 References

Allen Jack + Cottier (2021), OFGS - Carpark, Project No. 18025, Drawing No. REF001 (AJC, 2021).

ASC NEPM (1999, amended 2013) *National Environmental Protection (Assessment of Site Contamination) Measure, 2013.*

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Google Earth Pro (2019).

Herbert C., 1983, Sydney 1:100 000 Geological Sheet 9130, 1st edition. Geological Survey of New South Wales, Sydney.

JK Geotechnics (2017) *Geotechnical Investigation (Proposed new sporting facility, car park and playing field at Oxford Grammar School).* Ref. 30807SYrpt (JK, 2017).

JK Environmental (2019) *Stage 1 Environmental Site Assessment (Proposed new kiosk development at Oxford Grammar School).* Ref. E30807Brpt Rev. 2 (JK, 2019). Nearmap – Aerial photographs (2019).

NSW Department of Environment & Heritage (eSPADE, NSW soil and land information), www.environment.nsw.gov.au.

NSW Department of Planning, Industry and Environment (Planning Portal, 2019) www.planningportal.nsw.gov.au/spatialviewer.

NSW EPA (2017) 3rd Ed. *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme.*

NSW EPA (2014) Waste Classification Guidelines.

NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2nd Edition

Sixmaps (2019)

State Environmental Planning Policy No. 55 – *Remediation of Contaminated Land*.

WaterNSW Real-Time Water Database, accessed 16 December 2019, https://realtimedata.waternsw.com.au/water.stm.

Attachment A: Site Overview

Project No: P1907548 Model: P1907548QGIS01 Projection: MGA Map Set: MS01-R01

0 10 20 30 40 50 m

1:1500 @ A4

Map Title / Figure:

Site Plan

Map 01	Map
1078 Oxford Falls Road, Oxford Falls, NSW	Site
Proposed Carpark	Project
Preliminary Site Investigation	Sub-Project
Oxford Falls Grammar School	Client
18/12/2019	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Attachment B: Aerial Photography

Project No: P1907548 Model: P1907548QGIS01 Projection: MGA Map Set: MS01-R01

0 30 60 90 120 150 m

1:2500 @ A4

Map Title / Figure:

2019 Aerial Image (Nearmaps, 2019)

Map 01	Map
1078 Oxford Falls Road, Oxford Falls, NSW	Site
Proposed Carpark	Project
Preliminary Site Investigation	Sub-Project
Oxford Falls Grammar School	Client
18/12/2019	Date

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Aerial Imagery 2009

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © 2019 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 56	Date: 11 September 2019

Aerial Imagery 2005

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © 2019 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 56	Date: 11 September 2019

Aerial Imagery 1991

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Metres

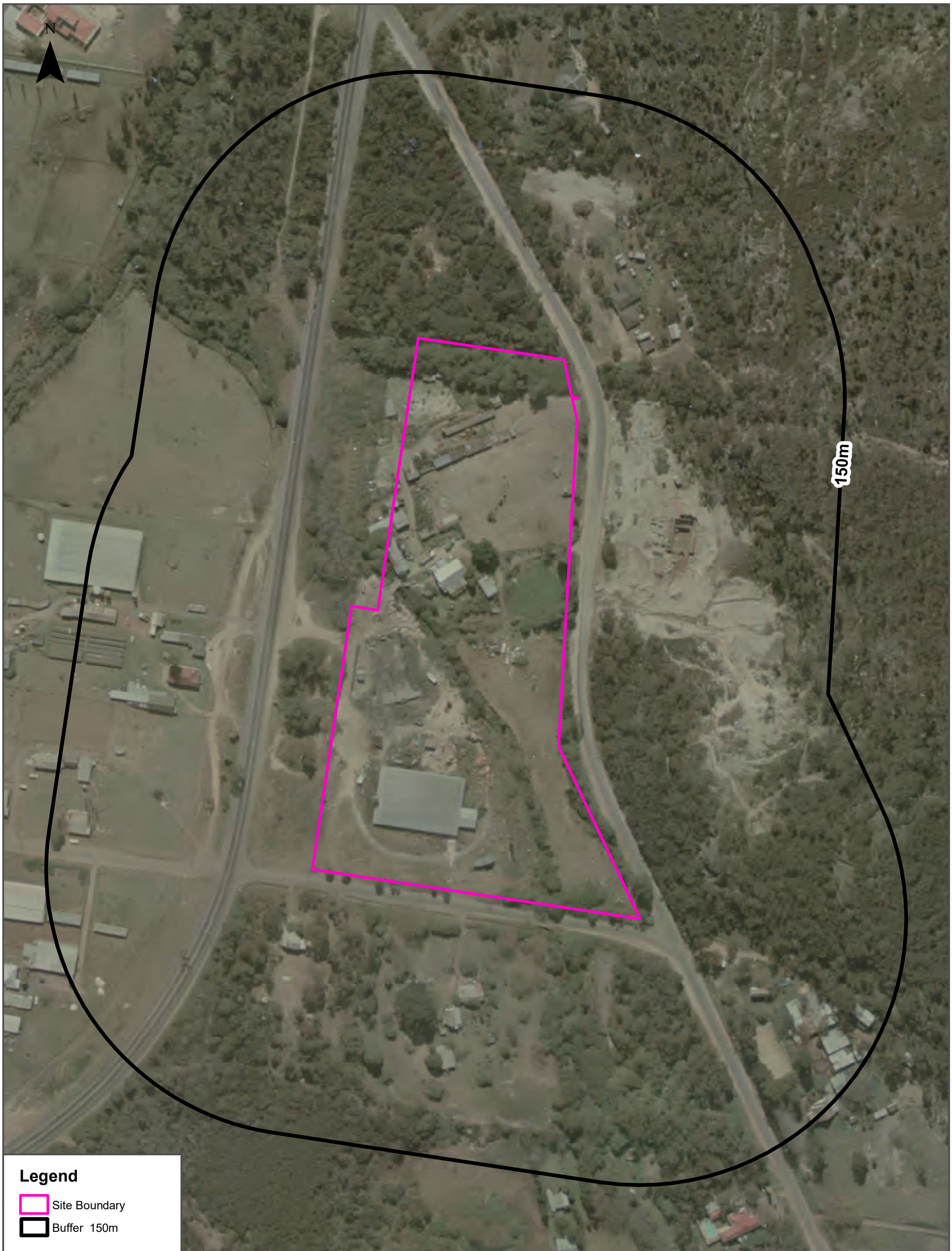
Data Sources: Aerial Imagery © Department of Finance, Services & Innovation

Coordinate System: GDA 1994 MGA Zone 56

Date: 12 September 2019

Aerial Imagery 1982

Wakehurst Parkway, Oxford Falls, NSW 2100



Legend

Site Boundary

Buffer 150m

Scale: 0 25 50 100 Metres	Data Sources: Aerial Imagery © Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 12 September 2019

Aerial Imagery 1970

Wakehurst Parkway, Oxford Falls, NSW 2100

Legend

Site Boundary

Buffer 150m

Scale: 0 25 50 100 Metres	Data Sources: Aerial Imagery © Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 12 September 2019

Aerial Imagery 1965

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © NSW Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 11 September 2019

Aerial Imagery 1961

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © NSW Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 11 September 2019

Aerial Imagery 1956

Wakehurst Parkway, Oxford Falls, NSW 2100

Scale: 0 25 50 100 Meters

Data Source Aerial Imagery:
© NSW Department of Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 11 September 2019

Attachment C: Proposed Development Plans

DRAWING LIST

REF101	SITE PLAN
REF201	GROUND LEVEL PLAN
REF202	LEVEL 1 PLAN TO BE CARRIED OUT AS EXEMPT DEVELOPMENT AND IS NOT PART OF THE REF
REF203	ROOF PLAN TO BE CARRIED OUT AS EXEMPT DEVELOPMENT AND IS NOT PART OF THE REF
REF311	ELEVATIONS - SHEET 1
REF312	ELEVATIONS - SHEET 2
REF321	SECTIONS
REF401	SHADOW DIAGRAMS
REF601	PERSPECTIVE VIEW 1 FROM DREADNOUGHT ROAD
REF602	PERSPECTIVE VIEW 2 FROM K - BLOCK
REF603	PERSPECTIVE VIEW 3 FROM PROPOSED FIELD

ABBREVIATIONS

A/C	AIR CONDITIONING	FIP	FIRE INDICATOR PANEL	REF	REFRIGERATOR
AFSL	ABOVE STRUCTURAL FLOOR LEVEL	FLR	FLOOR	RA	RETURN AIR
AL	ALUMINIUM	FP	FIBROUS PLASTER	RAD	RADIUS
AO	ACCESS OPENING	FRL	FIRE RESISTANCE LEVEL	RC	REINFORCED CONCRETE
AP	ACCESS PANEL	FW	FLOOR WASTE TO SEWER	RGH	RANGE HOOD
AT	ACOUSTIC TILE	GALV	GALVANISED	RH	ROBE HOOK
B	BOLLARD	GD	GRATED DRAIN	RHS	RECTANGULAR HOLLOW SECTION
BAL	BALUSTRADE	GL	GLAZING	RJ	RENDER JOINT (V-JOINT)
BDY	BOUNDARY	GND	GROUND	RL	REDUCED LEVEL
BH	BOREHOLE	GPO	GENERAL PURPOSE (POWER) OUTLET	ROW	RIGHT OF WAY
BHD	BULKHEAD	GR	GRAB RAIL	RS	ROLLER SHUTTER
BK	BRICK	GRANO	GRANOLITHIC	RW	RETAINING WALL
BLDG	BUILDING	GRC	GLASS REINFORCED CONCRETE/CEMENT	RWH	RAINWATER HEAD
BLK	BLOCKWORK	GT	GATE	RWO	RAINWATER OUTLET TO STORMWATER
BN	BULLNOSE	GTP	GREASE TRAP	RWP	RAINWATER PIPE
BOE	BRICK-ON-EDGE	HYD	HYDRANT	SA	SUPPLY AIR
BSN	BASIN	HC	HOSE COCK	SC	STEEL COLUMN
BTH	BATH	HMR	HIGH MOISTURE RESISTANT	SCR	SUNSCREEN
BWK	BRICKWORK	HR	HANDRAIL	SCT	SUSPENDED CEILING TILE
BWU	BOILING WATER UNIT	HTR	HEATER	SD	SEWER DRAIN
CB	CONCRETE BLOCK	HW	HOT WATER	SFL	STRUCTURE FINISHED LEVEL
CCTV	CLOSED CIRCUIT TELEVISION	HWD	HARDWOOD	SHB	SHOWER BATH
CD	CLOTHES DRYER	HWU	HOT WATER UNIT	SHR	SHOWER
CFC	COMPRESSED FIBROUS CEMENT	ID	INSIDE DIAMETER	SHS	SQUARE HOLLOW SECTION
CHS	CIRCULAR HOLLOW SECTION	IL	INVERT LEVEL	SK	SKIRTING
CI	CAST IRON	INCL	INCLUDE	SKL	SKYLIGHT
CIP	CAST IRON PIPE	INT	INTERNAL	SNK	SINK
CJ	CONTROL JOINT	IO	INSPECTION OPENING	SP	SEWER PIT
CL	CENTRE LINE	J	JOINERY	SPEC	SPECIFICATION
CLNR	CLEANER	JT	JOINT	SPL	SPLASHBACK
COL	COLUMN	KB	KERB	SR	SHOWER ROSE
CONC	CONCRETE	KG	KERB AND GUTTER	SS	STAINLESS STEEL
CP	CHROME-PLATED	KIT	KITCHEN	ST	STONE
CPD	CUPBOARD	L	LOUVRE	SVP	SEWER VENT PIPE
CPT	CARPET	LDY	LAUNDRY	SW	STORM WATER
CR	CEMENT RENDER	LS	LOUVRE SCREEN	SWP	STORMWATER PIT
CSK	COUNTERSINK	M	MIRROR	T	TILE
CT	COOK TOP	MC	METAL CLADDING	TEL	TELEPHONE
CTR	CENTRE	MDF	MEDIUM DENSITY FIBREBOARD	TGSI	TACTILE INDICATORS
CW	COLD WATER	MH	MANHOLE	TIMB	TIMBER
D	DOOR	MISC	MISCELLANEOUS	TOH	TOP OF HOB
DB	DISTRIBUTION BOARD	MJ	MOVEMENT JOINT	TOK	TOP OF KERB
DF	DRINKING FOUNTAIN	MLM	MELAMINE	TOW	TOP OF WALL
DG	DRIP GROOVE	MO	MICROWAVE OVEN	TP	TAP
DIA	DIAMETER	MR	MOISTURE RESISTANT	TPH	TOILET PAPER HOLDER
DIM	DIMENSION	MRS	METAL ROOF SHEETING	TR	TOWEL RAIL
DP	DOWNPIPE	MS	MILD STEEL	TRZO	TERRAZZO
DPC	DAMP-PROOF COURSE	MSB	MAIN SWITCHBOARD	TUB	LAUNDRY TUB
DPM	DAMP-PROOF MEMBRANE	MV	MECHANICAL VENT	TV	TELEVISION
DRG	DRAWING	MW	METALWORK	TYP	TYPICAL
DS	DUCTED SKIRTING	NGL	NATURAL GROUND LEVEL	U/G	UNDERGROUND
DW	DISHWASHER	NIC	NOT IN CONTRACT	U/S	UNDERSIDE
EA	EACH	NO	NUMBER	UB	UNIVERSAL BEAM
EDB	ELECTRICAL DISTRIBUTION BOARD	NOM	NOMINAL	UC	UNIVERSAL COLUMN
EJ	EXPANSION JOINT	NTS	NOT TO SCALE	UR	URINAL
EQ	EQUAL	OD	OUTSIDE DIAMETER	V	VINYL
ESB	ELECTRICAL SWITCHBOARD	OF	OVERFLOW-RAINWATER	VB	VANITY BASIN
EX	EXISTING (PRIOR TO)	OFC	OFF-FORM CONCRETE	VOS	VERIFY ON SITE
EXT	EXTERNAL	OHD	OVERHEAD DOOR	VP	VENT PIPE
F	FIXED GLAZING	OP	OPAQUE	W	WINDOW
FB	FACE BRICK	OV	OVEN	WB	WEATHERBOARD
FBL	FACE BLOCK	P	PAINT (FINISH)	WC	WATER CLOSET
FC	FIBROUS CEMENT	PAV	PAVING	WIR	WALK-IN-ROBE
FCL	FINISHED CEILING LEVEL	PB	PLASTERBOARD	WM	WASHING MACHINE
FCU	FAN COIL UNIT	PC	PRECAST CONCRETE	WO	WALL OVEN
FEN	FENCE	PEB	PEBBLE BALLAST	WP	WASTE PIPE
FFL	FINISHED FLOOR LEVEL	PFC	PARALLEL FLANGE CHANNEL	WPM	WATERPROOF MEMBRANE
FGL	FINISHED GROUND LEVEL	PLY	PLYWOOD	WR	WARDROBE
FHR	FIRE HOSE REEL	PTD	PAPER TOWEL DISPENSER	WS	WALL STIFFENER

FOR REVIEW OF ENVIRONMENTAL FACTORS

OXFORD FALLS GRAMMAR SCHOOL - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Revisions

No.	Date	Description	Checked	Approved
1	22.02.21	REVISED 50% TENDER ISSUE		
2	24.02.21	REVISED REF 50% TENDER ISSUE		
3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

N

Key

Client

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OFGS - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Proj. No. 18025

Drawing Title
COVER SHEET

Project Status
FOR REF

Scale

Drawing No.
REF001

Issue
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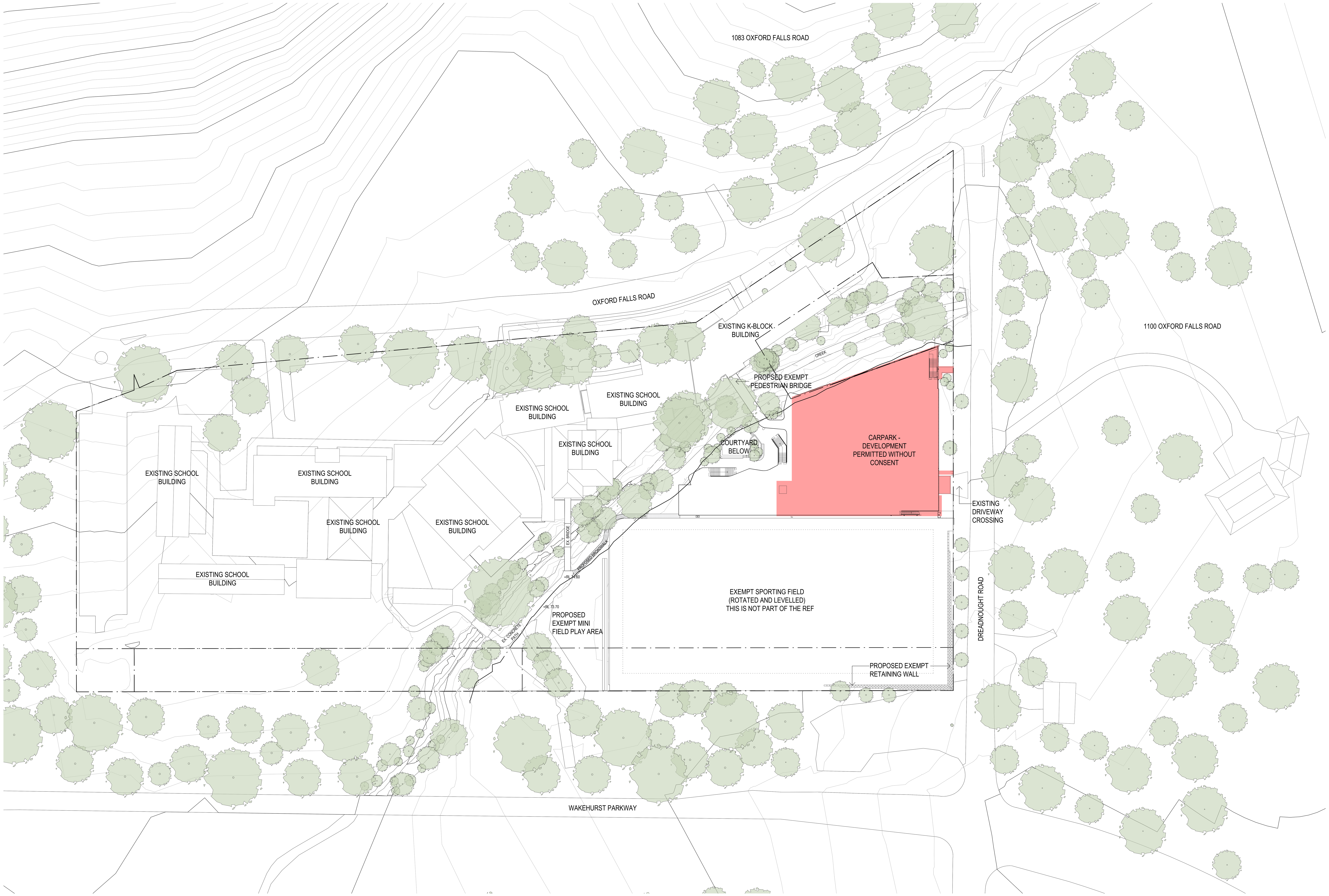

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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

N

Key

Client: OXFORD FALLS GRAMMAR SCHOOL

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Project: OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

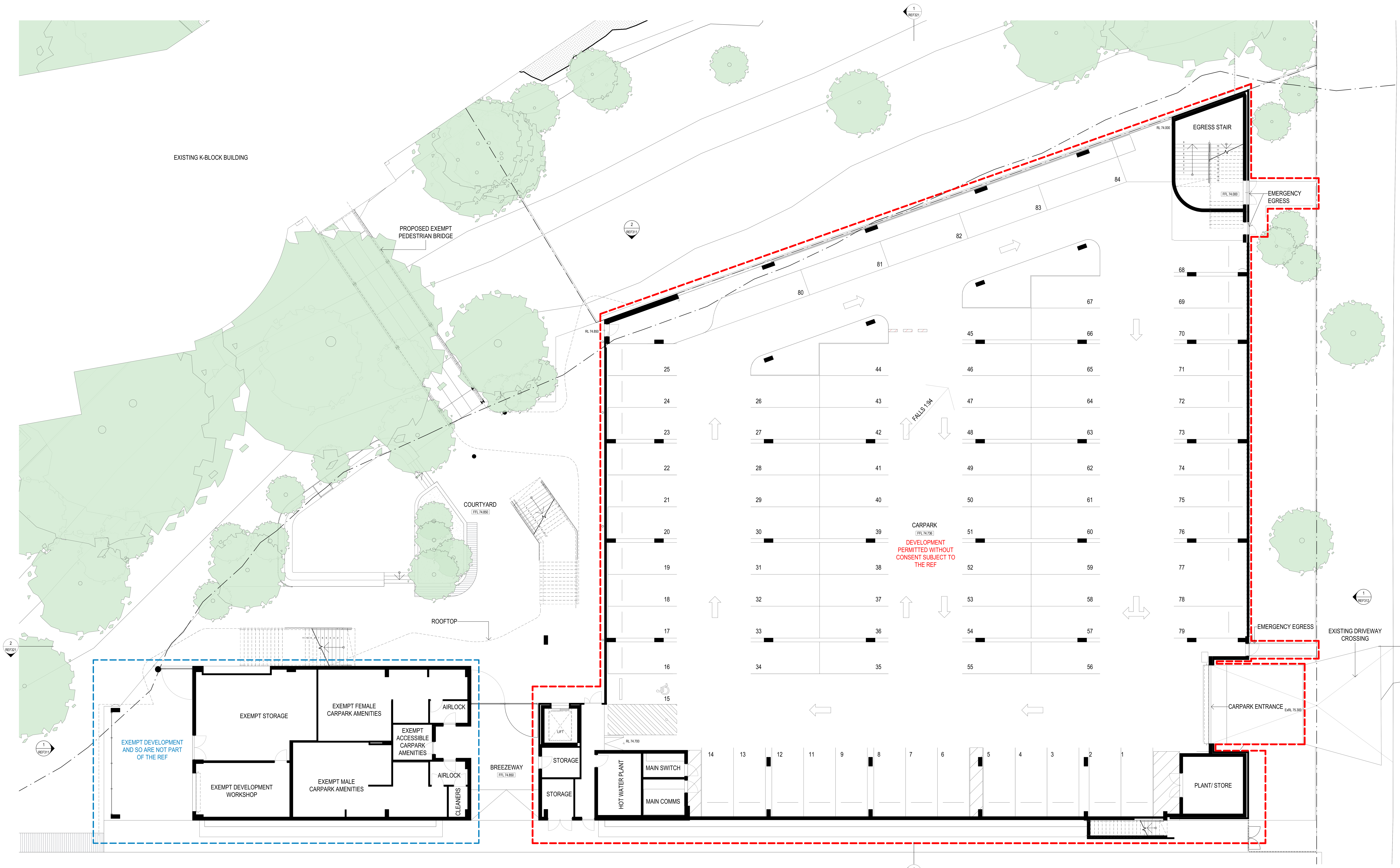
Drawing Title: SITE PLAN

Project Status: FOR REF

Scale: 1 : 500 @A0

Drawing No. REF101

Issue: 3



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Key

Client
OXFORD FALLS GRAMMAR SCHOOL

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Project
OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

Drawing Title
GROUND LEVEL PLAN

Project Status
FOR REF

Scale
1 : 100 @A0

Drawing No.
REF201

Issue
3

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Revisions

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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

Key

Client: OXFORD FALLS GRAMMAR SCHOOL

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Project: OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

Drawing Title: LEVEL 1 PLAN TO BE CARRIED OUT AS EXEMPT DEVELOPMENT AND IS NOT PART OF THE REF

Project Status: FOR REF

Scale: 1 : 100 @A0

Drawing No.: REF202

Issue: 3

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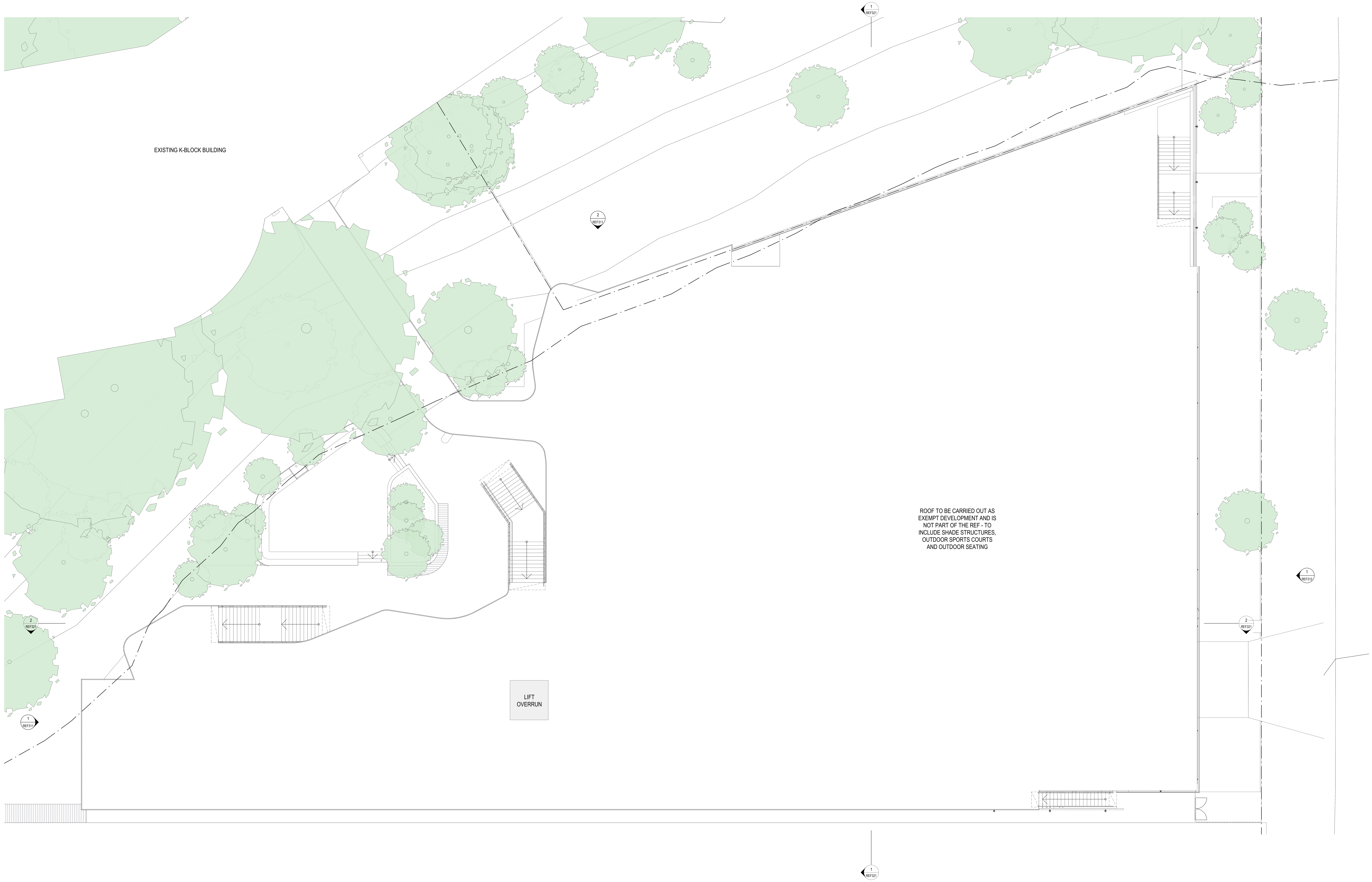

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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

Key

Client: OXFORD FALLS GRAMMAR SCHOOL

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Project: OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

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Project Status: FOR REF

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Drawing No.: REF203

Issue: 3

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1 NORTH ELEVATION
1 : 100

Revisions

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OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

Drawing Title
ELEVATIONS - SHEET 1

Project Status
FOR REF

Scale
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Drawing No.
REF311

Issue
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1 SOUTH ELEVATION
1 : 100

Revisions

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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

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Project
OFGS - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Proj. No. 18025

Drawing Title
ELEVATIONS - SHEET 2

Project Status
FOR REF

Scale
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Drawing No.
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Issue
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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

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Project
OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

Drawing Title
SECTIONS

Project Status
FOR REF

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Drawing No.
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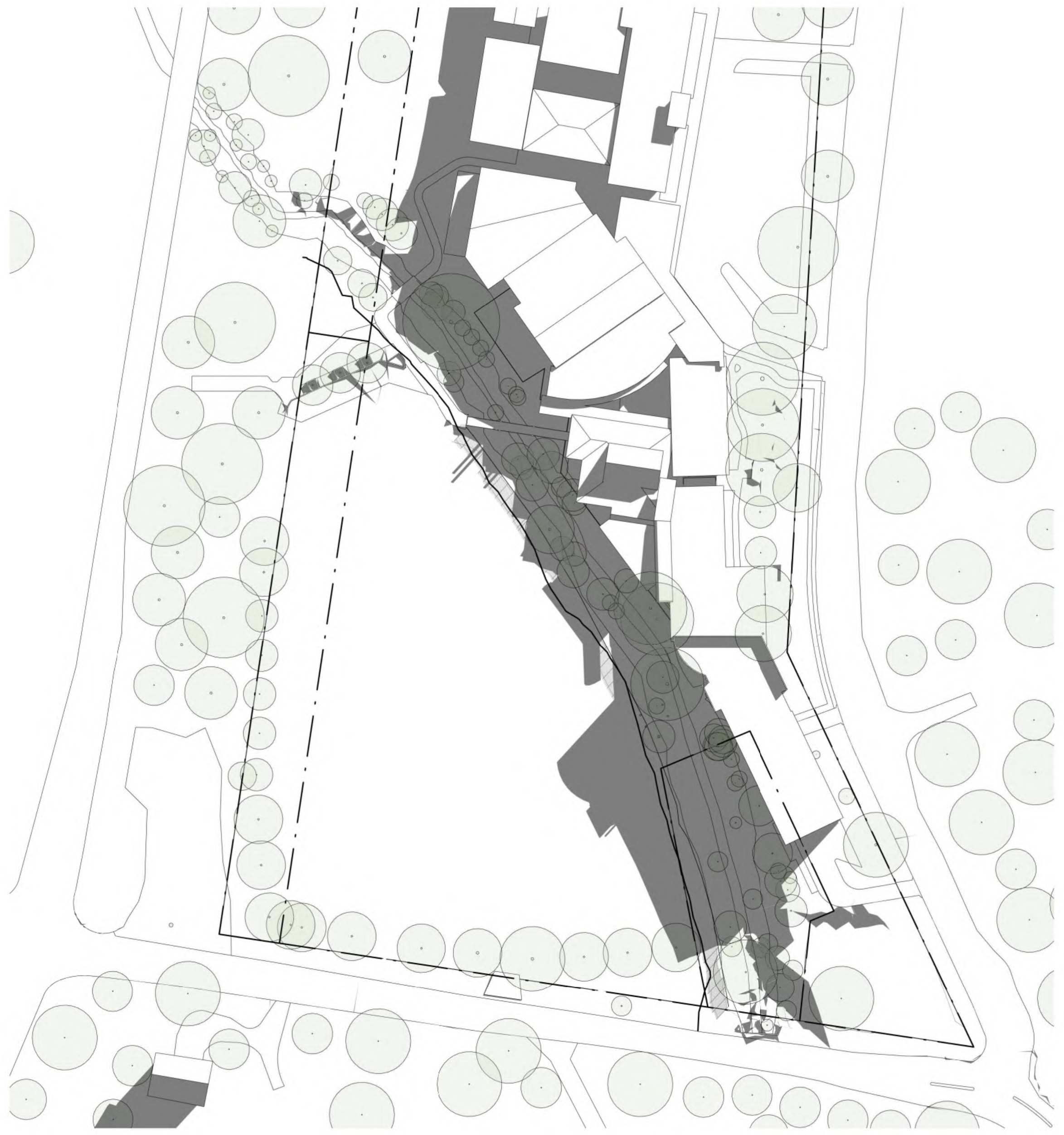

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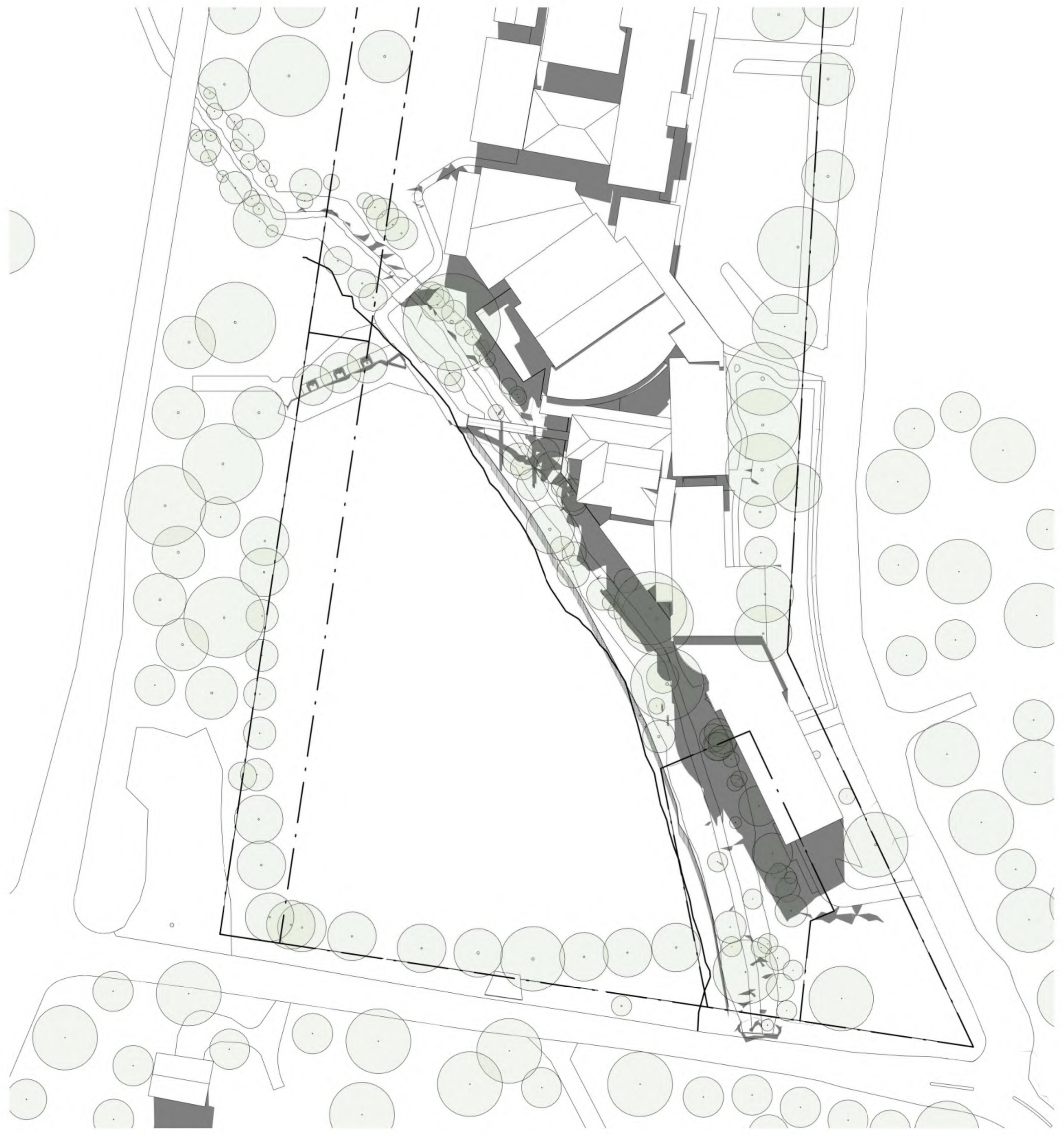

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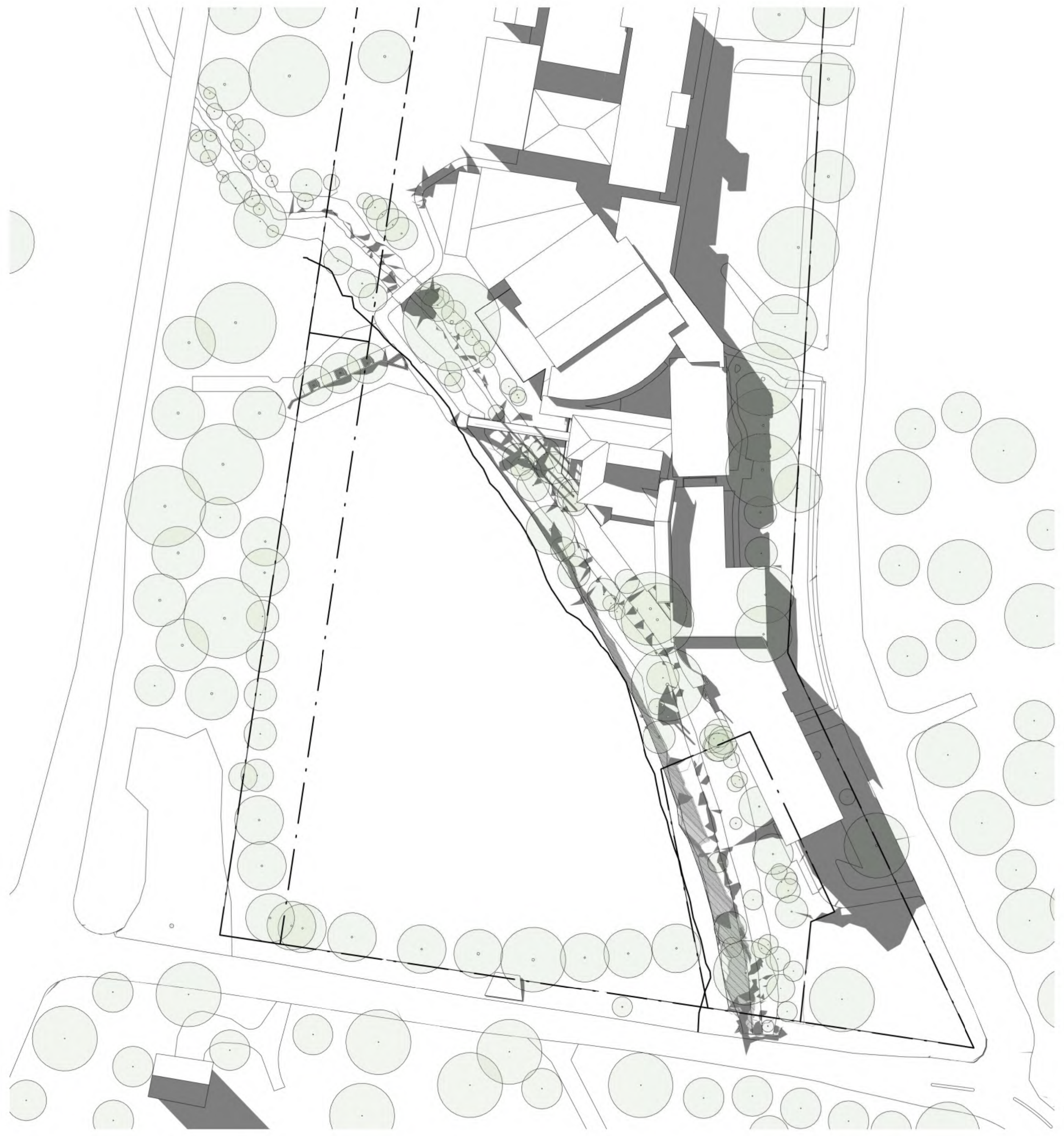

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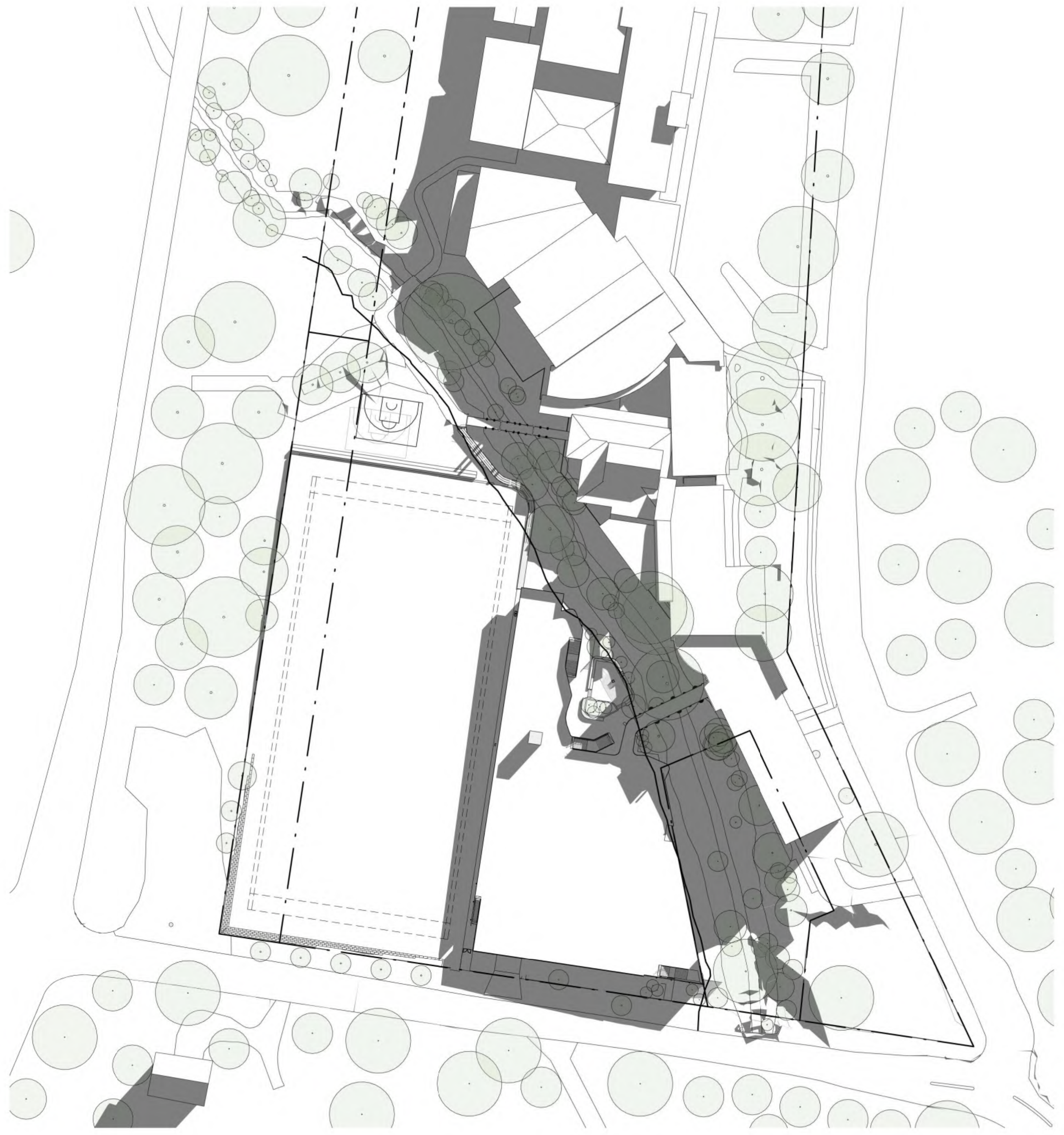

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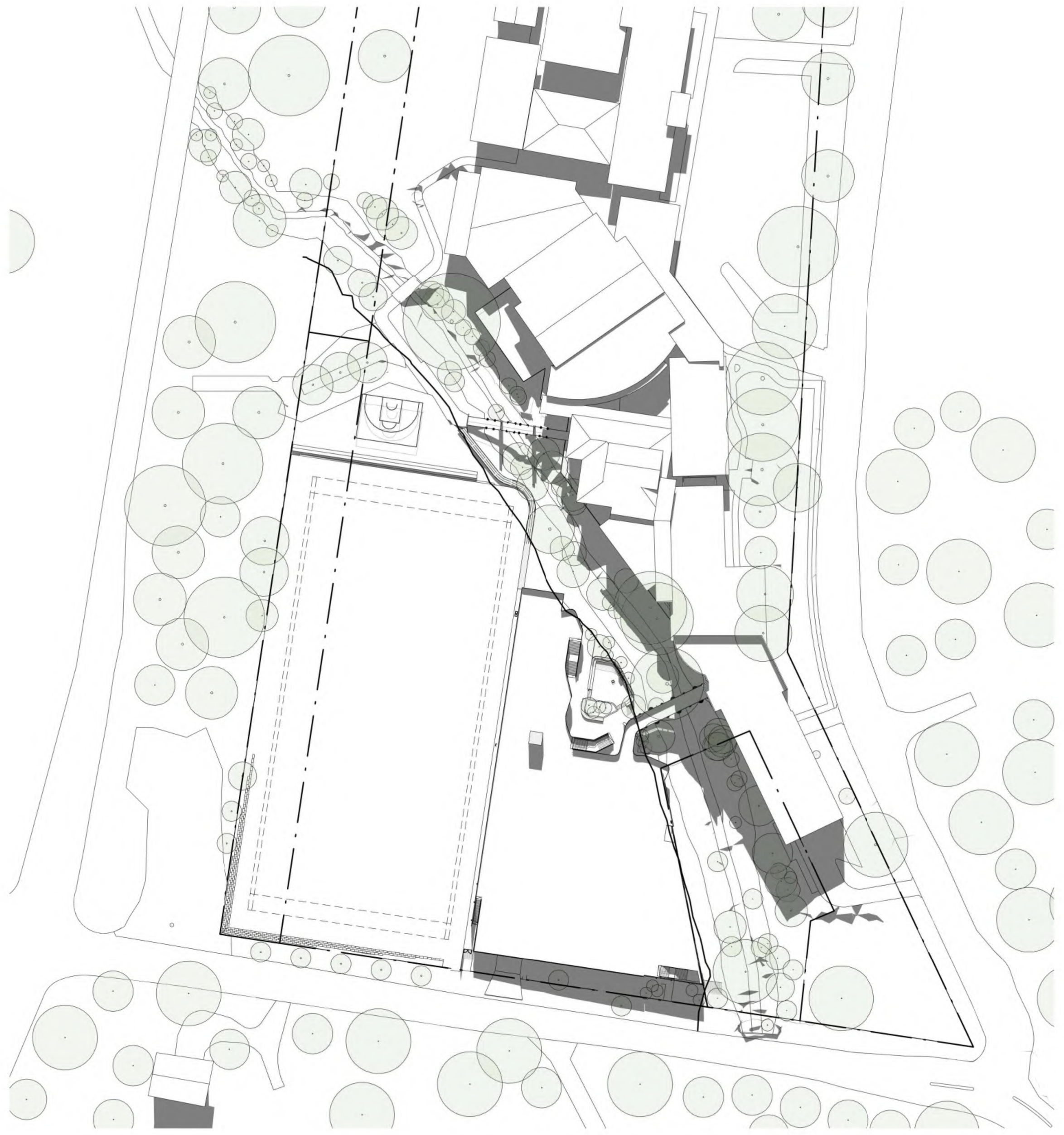

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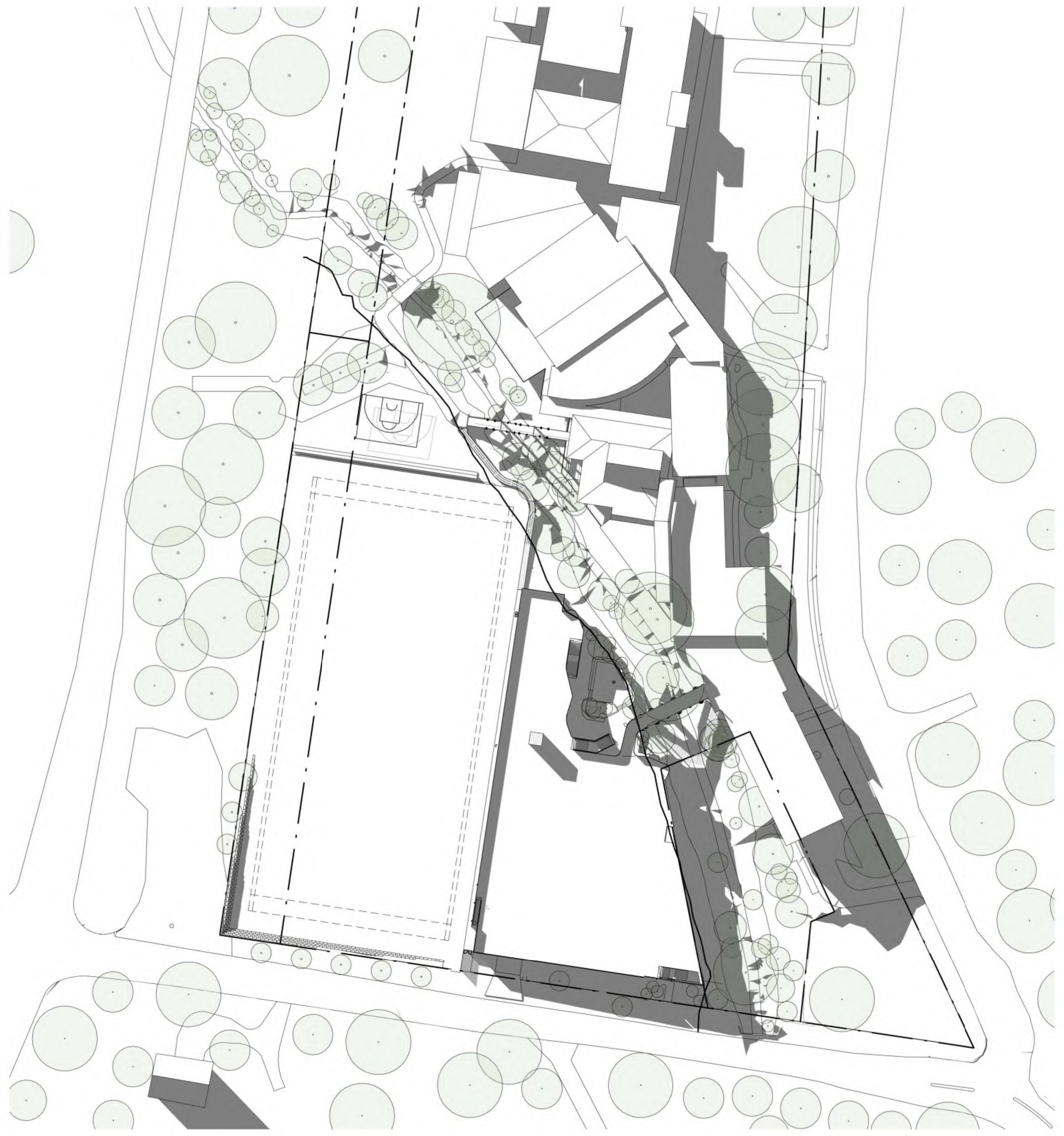

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Key

Client
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Project
OFGS - CARPARK
1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100
Proj. No. 18025

Drawing Title
SHADOW DIAGRAMS

Project Status
FOR REF

Scale
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Drawing No.
REF401

Issue
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REF: C:\Users\dieckmann\Documents\18025_Master_Clare.Dieckmann.rvt

Revisions

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Project

OFGS - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Proj. No. 18025

Drawing Title

PERSPECTIVE VIEW 1 FROM DREADNOUGHT ROAD

Project Status

FOR REF

Scale

Drawing No.

REF601

Issue

3

PLOT DATE & TIME: 2/03/2021 3:51:00 PM PLOTTED & CHECKED BY: Author REF: C:\Users\dieckmann\Documents\18025_Master_Clare.Dieckmann.rvt

Revisions

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3	02.03.21	REVISED REF 50% ISSUED FOR APPROVAL	JG	CD

Key

Client

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Project

OFGS - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Proj. No. 18025

Drawing Title

PERSPECTIVE VIEW 2 FROM K - BLOCK

Project Status

FOR REF

Scale

1 : 1 @A0

Drawing No.

REF602

Issue

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PLOT DATE & TIME: 2/03/2021 3:51:01 PM PLOTTED & CHECKED BY: Author REF: C:\Users\dieckmann\Documents\18025_Master_Clare.Dieckmann.rvt

Revisions

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Key

Client

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Project

OFGS - CARPARK

1078 OXFORD FALLS ROAD
OXFORD FALLS, NSW 2100

Proj. No. 18025

Drawing Title

PERSPECTIVE VIEW 3 FROM PROPOSED FIELD

Project Status

FOR REF

Scale

1 : 1 @A0

Drawing No.

REF603

Issue

3

PLOT DATE & TIME: 2/03/2021 3:51:03 PM PLOTTED & CHECKED BY: Author REF: C:\Users\dieckmann\Documents\18025_Master_Clare.Dieckmann.rvt

Attachment D: EIS Waste Classification Assessment and Soil Suitability Analysis (2017)

ENVIRONMENTAL INVESTIGATION SERVICES

15/11/2017
Report Ref: E30807KMlet-WC_rev1

Oxford Falls Grammar School
1078 Oxford Falls Road
OXFORD FALLS NSW 2100

Attention: Mr Greg Morris

WASTE CLASSIFICATION ASSESSMENT AND SOIL SUITABILITY ANALYSIS
PROPOSED PLAYING FIELD DEVELOPMENT
OXFORD FALLS GRAMMAR SCHOOL

1 INTRODUCTION

Oxford Falls Grammar School ('the client') commissioned Environmental Investigation Services (EIS)[1] to assign a waste classification and conduct a soil suitability analysis of in-situ soil located at the playing fields at Oxford Falls Grammar School, 1078 Oxford Falls Road, Oxford Falls ('the site'). The site location is shown on Figure 1 and sampling for the assessment was confined to the in-situ soil in the investigation area as shown on Figure 2 attached in the appendices.

The purpose of this assessment was to:

i. provide a waste classification for the off-site disposal of the material in accordance with the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014[2]); and
ii. assess the suitability of the soil for growing grass on the oval.

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP45494KM) of 8 August 2017 and written acceptance from Oxford Falls Grammar School of 14 August 2017.

A geotechnical investigation was undertaken in conjunction with the waste classification assessment by JK Geotechnics[3] and the results are presented in a separate report (Ref. 30807SYrpt, dated 23 October 2017).

---

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

[2] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

[3] Geotechnical consulting division of J&K

1.1 Proposed Development Details

The proposed development includes:

- Construction of a sporting facility building located in the south-eastern corner of the oval adjacent to the creek. The building will have a basement car park, which may require excavation to maximum depths of approximately 3m. A new vehicular access way to the building is proposed adjacent to Dreadnought Road;
- Expansion and reorientation of the existing sports field. The new sports field will occupy the existing field and will extend further west to accommodate the sports facility building in the south-east. The new oval will be at approximately the same surface level as the existing oval. Within the footprint of the existing oval this will require some cutting into the embankment along the southern and western boundaries of the site. It is expected that maximum cut depths may be in the order of approximately 3m; and
- Footbridges are proposed over the existing creek providing pedestrian access from the main school buildings to the proposed new sports facilities and oval.

2 SITE INFORMATION

2.1 Site Identification and Description

Table 2-1: Site Identification

Site Address:	1078 Oxford Falls Road, Oxford Falls, NSW, 2100
Lot & Deposited Plan:	Part of Lot 1 DP1046451
Current Land Use:	Sports oval
Area Applicable to Waste Classification:	Approximately 10,000m^2
Geographical Location (approx.):	Latitude: -33.739114°; Longitude: 151.24546°

A site inspection was conducted during the fieldwork on 25 and 26 September 2017. The school was located within undulating topography. A creek ran through the school grounds in a north-westerly to south-easterly direction.

The site was bound by Dreadnought Road to the south and the creek to the north-east. The site comprised a sports oval which was located in the south-western corner of the school grounds. The oval was relatively flat and appeared to have been formed by a cut along the western edge and filling along the eastern side, closer to the creek. Batters were located along the western and north-western sides of the oval.

A gravel surfaced car park was located at the top of the batter on the western side of the oval. School buildings were located on the eastern side of the creek. A seating area and several small to medium sized trees were located to the north of the oval.

Wakehurst Parkway was located beyond the gravel car park on the western side of the oval. Oxford Falls Road was located on the eastern side of the school buildings to the east of the site.

2.2 Background/Historical Information

EIS has undertaken a preliminary historical assessment based on a review of the following information:

- The 1943 aerial photograph for the site provided by SIX Maps[4];
- The contaminated land records provided by the NSW EPA[5]; and
- Historical information from the school's website.

The 1943 aerial photograph indicated that the site was used for agricultural purposes at that time. The site area appeared to be divided into several fields or paddocks used for a variety of purposes. A copy of the photograph is reproduced below in Plate 1.

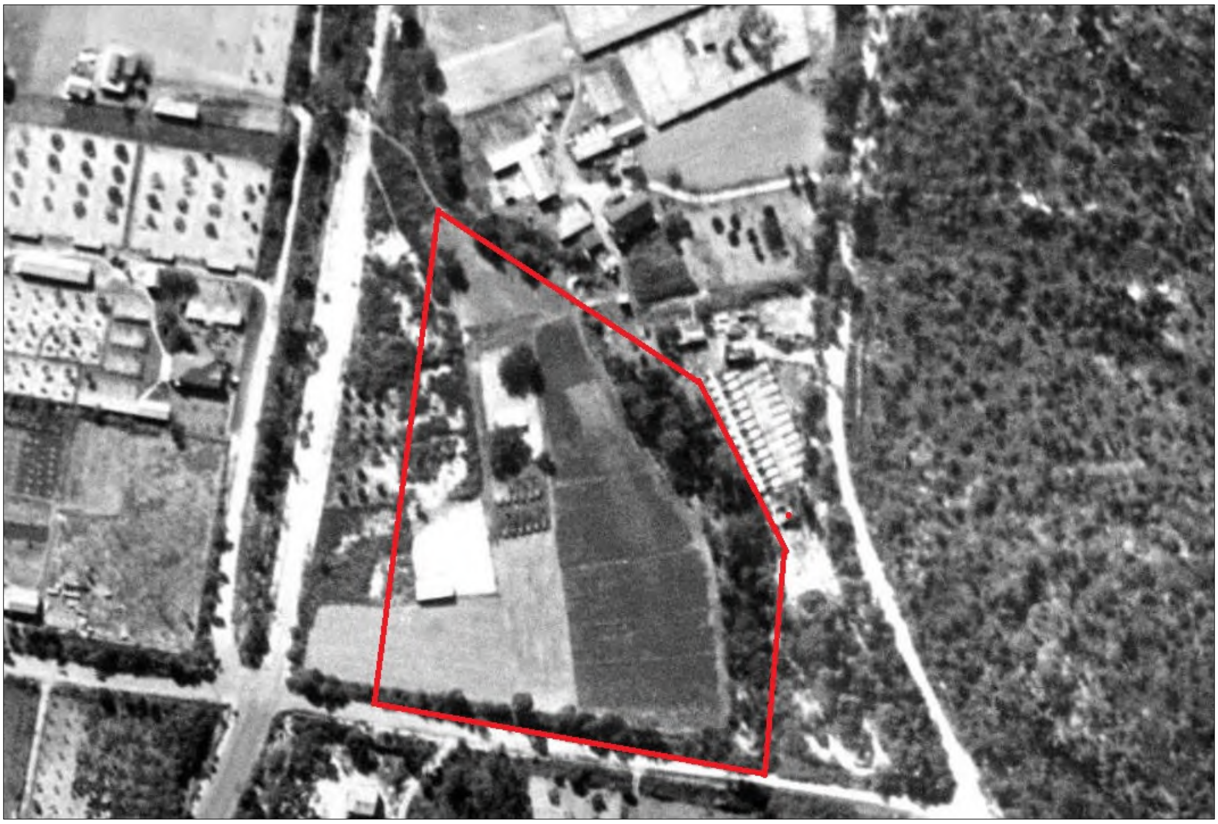

Plate 1: 1943 aerial photograph, showing the approximate location of the current school oval and assessment area outlined in red (Six Viewer - https://maps.six.nsw.gov.au, accessed on 19 October 2017)

There were no records for the site on the NSW EPA contaminated land registers.

Information from the school's website[6] indicated that the school was constructed in the early 1980s and officially opened in 1984.

[4] https://maps.six.nsw.gov.au/

[5] http://www.epa.nsw.gov.au/

[6] http://www.ofgs.nsw.edu.au/about

Considering the above information, the waste classification assessment will consider a broad suite of potential contaminants as outlined in Section 4.4.

2.3 Regional Geology

The geological map of Sydney (1983[7]) indicates the site to be underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses.

3 ASSESSMENT CRITERIA

3.1 NSW EPA Waste Classification Guidelines

Off-site disposal of fill, contaminated material, stockpiled soil, natural soil and rock excavated as part of the proposed development works is regulated by the Protection of the Environment Operations Act (1997[8]) and associated regulations and guidelines including Part 1 of the Waste Classification Guidelines.

Soils are classed into the following categories based on the chemical contaminant criteria outlined in the guidelines:

Table 3-1: Waste Categories

Category	Description
General Solid Waste (non-putrescible) (GSW)	• If Specific Contaminant Concentration (SCC) ≤ Contaminant Threshold (CT1) then Toxicity Characteristics Leaching Procedure (TCLP) not needed to classify the soil as GSW • If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as GSW
Restricted Solid Waste (non-putrescible) (RSW)	• If SCC ≤ CT2 then TCLP not needed to classify the soil as RSW • If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as RSW
Hazardous Waste (HW)	• If SCC > CT2 then TCLP not needed to classify the soil as HW • If TCLP > TCLP2 and/or SCC > SCC2 then treat as HW

[7] *1:100,000 Geological Map of Sydney (Series 9130),* Department of Mineral Resources (1983) [now Department of Primary Industries]
[8] NSW Government, (1997). *Protection of Environment Operations Act.* (POEO Act 1997)

Category	Description
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that meet the following criteria: • That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • That does not contain sulfidic ores or other waste; and • Includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette.

4 INVESTIGATION PROCEDURE

4.1 Subsurface Investigation and Soil Sampling

Field work for this investigation was undertaken on 25 and 26 September 2017. Soil samples for the waste classification assessment were obtained from eleven of the twenty-one boreholes drilled for the JK geotechnical investigation. The borehole locations are shown on Figure 2 attached in the appendices.

The sample locations were drilled using a truck-mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

Soil samples were collected from the fill and natural profiles encountered during the investigation. All samples were recorded on the borehole logs attached in the appendices.

Samples were placed in glass jars with plastic caps and Teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date.

4.2 Screening for Volatile Organic Compounds (VOCs)

A photoionisation detector (PID) was used to screen the samples for the presence of VOCs. PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases.

The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source. The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.

4.3 Sample Preservation

Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS4482.1-2005 and AS4482.2-1999[9], as summarised in the following table:

Table 4-1: Soil Sample Preservation and Storage

Analyte	Preservation	Storage
Heavy metals	Unpreserved glass jar with Teflon lined lid	Store at <4°, analysis within 28 days (mercury and Cr[VI]) and 180 days (other metals)
Hydrocarbons, pesticides and other organics	As above	Store at <4°, analysis within 14 days
Asbestos	Sealed plastic bag	None

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA-registered laboratory for analysis under standard Chain of Custody (COC) procedures.

4.4 Laboratory Analysis for Waste Classification Assessment

Selected samples were analysed for a range of potential contaminants based on the site information presented in Section 2. EIS note that a detailed site history assessment was not undertaken, however this was compensated for by analysing the samples for a broad range of potential contaminants.

Fifteen selected in-situ soil samples were analysed for the following:

- heavy metals including: arsenic, cadmium, chromium (total), copper, lead, mercury, nickel and zinc;
- polycyclic aromatic hydrocarbons (PAHs);
- total recoverable hydrocarbons (TRH); and
- monocyclic aromatic hydrocarbons including benzene, toluene, ethylbenzene and xylene (BTEX).

Ten of the samples were also analysed for asbestos.

Five of the samples were also analysed for:

- organochlorine pesticides (OCPs);
- organophosphate pesticides (OPPs); and

[9] *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part2: Volatile Substances,* Standards Australia, 1999 (AS 1999)

- polychlorinated biphenyls (PCBs);

Samples were analysed by Envirolab Services (NATA Accreditation Number – 2901) using the analytical methods detailed in the National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013[10]). Reference should be made to the laboratory report (Ref: 176661) attached in the appendices for further information.

4.5 Laboratory Analysis for Soil Suitability Analysis

Three soil samples, collected at a variety of depths from BH1, BH4 and BH7 were analysed for a range of parameters to assess the soil's suitability for growing turf on a school oval. The analysis included:

- pH;
- electrical conductivity;
- organic matter;
- cation exchange capacity;
- nitrate;
- phosphate;
- potassium;
- sulphate;
- calcium;
- magnesium;
- iron;
- manganese;
- zinc;
- copper and
- boron.

5 RESULTS OF THE INVESTIGATION

5.1 Subsurface Conditions

A summary of the subsurface soil conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 5-1: Summary of Subsurface Conditions

Profile	Description (depth in m below ground level)
Fill	Fill material was encountered in all boreholes and extended to depths ranging from 0.1m to 3.5m. The fill typically comprised silty sand, sand and sandy clay, with sandstone gravel, cobbles and boulders. Traces of bricks, timber, plastic and string were encountered in some boreholes.

[10] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

Profile	Description (depth in m below ground level)
	Odours or staining were not observed in the fill during the investigation. Potential asbestos containing material was not observed. The attached Figure 2 shows the depth of fill material in each borehole, and a contour plan showing the approximate depth of fill across the site. The contours should be regarded as approximate only.
Natural Soil	Natural alluvial soils were encountered below the fill material, and comprised sands, clayey sands and sandy clays. Odours or staining were not observed in the natural soils during the investigation.
Bedrock	Weathered sandstone bedrock was encountered in several boreholes at depths ranging from 3.3m to 4.8m. Odours or staining were not observed in the bedrock during the investigation.
Groundwater	Groundwater seepage was encountered during drilling at depths ranging from 3.0m to 5.0m. On completion of drilling groundwater was measured at depths ranging from 2.8m to 4.5m. At the time of drilling the groundwater levels had not had time to stabilise and therefore may be artificially higher. No longer-term groundwater monitoring was carried out.

5.2 VOC Screening

PID soil sample headspace readings are presented in the COC documents attached in the appendices. All results were 0ppm equivalent isobutylene which indicates a lack of PID-detectable VOCs.

5.3 Laboratory Results – Waste Classification Assessment

The laboratory results were assessed against the criteria presented in Part 1 of the Waste Classification Guidelines. The results are summarised in Table A which is attached in the appendices. A summary of the results is presented below.

Table 5-2: Summary of Soil Laboratory Results Compared to Waste Classification Criteria

Analyte	No. of Samples Analysed	No. of Results > CT1 Criteria	No. of Results > SCC1 Criteria	Comments
Heavy Metals	15	0	0	All results were below the CT1 and SCC1 criteria.
TRH	15	0	0	All results were below the laboratory practical quantitation limits (PQLs).

Analyte	No. of Samples Analysed	No. of Results > CT1 Criteria	No. of Results > SCC1 Criteria	Comments
BTEX	15	0	0	All results were below the laboratory PQLs.
Total PAHs	15	0	0	All results were below the CT1 and SCC1 criteria.
Benzo(a)pyrene	15	0	0	All results were below the CT1 and SCC1 criteria.
OCPs & OPPs	5	0	0	All results were below the laboratory PQLs.
PCBs	5	0	0	All results were below the laboratory PQLs.
Asbestos	10	-	-	Asbestos was not detected in the samples analysed.

5.4 Statistical Analysis

95% Upper Confidence Limits (UCLs) of the mean were calculated for all analytes that were detected at concentrations above the laboratory PQLs, which included arsenic, chromium, copper, lead, nickel, zinc, total PAHs and benzo(a)pyrene. All 95% UCLs were below the corresponding CT1 criterion. The UCL calculations are included in Appendix F.

5.5 Laboratory Analysis – Soil Suitability Assessment

The analytical results of the soil suitability assessment are contained in the attached appendices. A summary of the results is presented below:

- The sample from BH1, collected from a depth of 0.0m to 0.2m, had a low effective cation exchange capacity (eCEC) indicating poor nutrient retention. It was recommended that nitrate, potassium and sulphate be boosted. Once compacted through pedestrian traffic, it was expected that the soil would become waterlogged and turf growth would fail;
- The sample from BH4, collected from a depth of 0.5m to 0.95m, had a low eCEC indicating poor nutrient retention. It was recommended that all nutrients be boosted with the exception of phosphorus. Once compacted through pedestrian traffic, it was expected that the soil would become waterlogged and turf growth would fail;
- The sample from BH7, collected from a depth of 0.0m to 0.2m, had a low eCEC indicating poor nutrient retention. It was recommended that all nutrients be boosted with the exception of phosphorus. The soil in this sample was considered to be the most suitable for growing turf.

6 CONCLUSIONS

6.1 Waste Classification of Fill

Based on the results of the assessment, and at the time of reporting, the fill material is classified as **General Solid Waste (non-putrescible)**. Surplus fill should be disposed of to a landfill that is licensed by the NSW EPA to receive this waste stream. The landfill should be contacted to obtain the required approvals prior to commencement of excavation.

6.2 Classification of Natural Soil and Bedrock

Based on the scope of work undertaken for this assessment, and at the time of reporting, EIS are of the opinion that the natural soil and bedrock at the site meets the definition of **VENM** for off-site disposal or re-use purposes. VENM is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. In accordance with Part 1 of the Waste Classification Guidelines, the VENM is pre-classified as general solid waste and can also be disposed of accordingly to a facility that is licensed to accept it.

6.3 Recommendations of the Waste Classification Assessment

Any unexpected finds encountered during the site works should be inspected by a suitably qualified environmental consultant[11]. In the event that the find has the potential to alter the waste classification documented in this report, additional testing and reporting should be undertaken.

6.4 Conclusions of the Soil Suitability Assessment

Detailed recommendations for each of the three sample locations are contained in the report attached in Appendix E. A summary of the recommendations is provided below.

It is recommended that fertiliser be added to the soil to boost nutrients. The nutrient requirements are likely to vary depending on the location of the soil.

It is recommended that the soil in the vicinity of sample locations BH1 and BH4 be capped with approximately 100mm of imported 80/20 media (a blend of 80% sand and 20% soil). Alternatively the soil from the vicinity of sample BH7 could be used as a capping material.

6.5 General Information

If disposed off-site, the fill material must be disposed of to a facility licensed by the NSW EPA to accept the waste. It is the responsibility of the receiving facility to ensure that the material meets their EPA license conditions. EIS accepts no liability whatsoever for illegal or inappropriate disposal of material.

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[11] The consultant should be from a company that is a member of the Australian Contaminated Land Consultants Association (ACLCA).

Fill and contaminated soil disposal costs are significant and may affect project viability. These costs should be assessed at an early stage of the project development to avoid significant future unexpected additional costs.

Material classed as VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted for advice.

Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. EIS accepts no liability whatsoever for the unlawful disposal of any waste from any site.

7 LIMITATIONS

The report limitations are outlined below:

- EIS accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the EIS proposal; and terms of contract between EIS and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated in the report;
- EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;

- EIS have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or land use. EIS should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa;
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report is the property of EIS. EIS has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report;
- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of EIS; and
- Any third party who seeks to rely on this report without the express written consent of EIS does so entirely at their own risk and to the fullest extent permitted by law, EIS accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

If you have any questions concerning the contents of this letter please do not hesitate to contact us.

Kind Regards

Rob Muller
Senior Environmental Scientist

Adrian Kingswell
Principal

Appendices:

Appendix A: Report Figures
Appendix B: Laboratory Summary Table
Appendix C: Borehole Logs
Appendix D: Laboratory Report & COC Documents
Appendix E: Soil Suitability Analysis Report and Recommendations
Appendix F: UCL Calculations

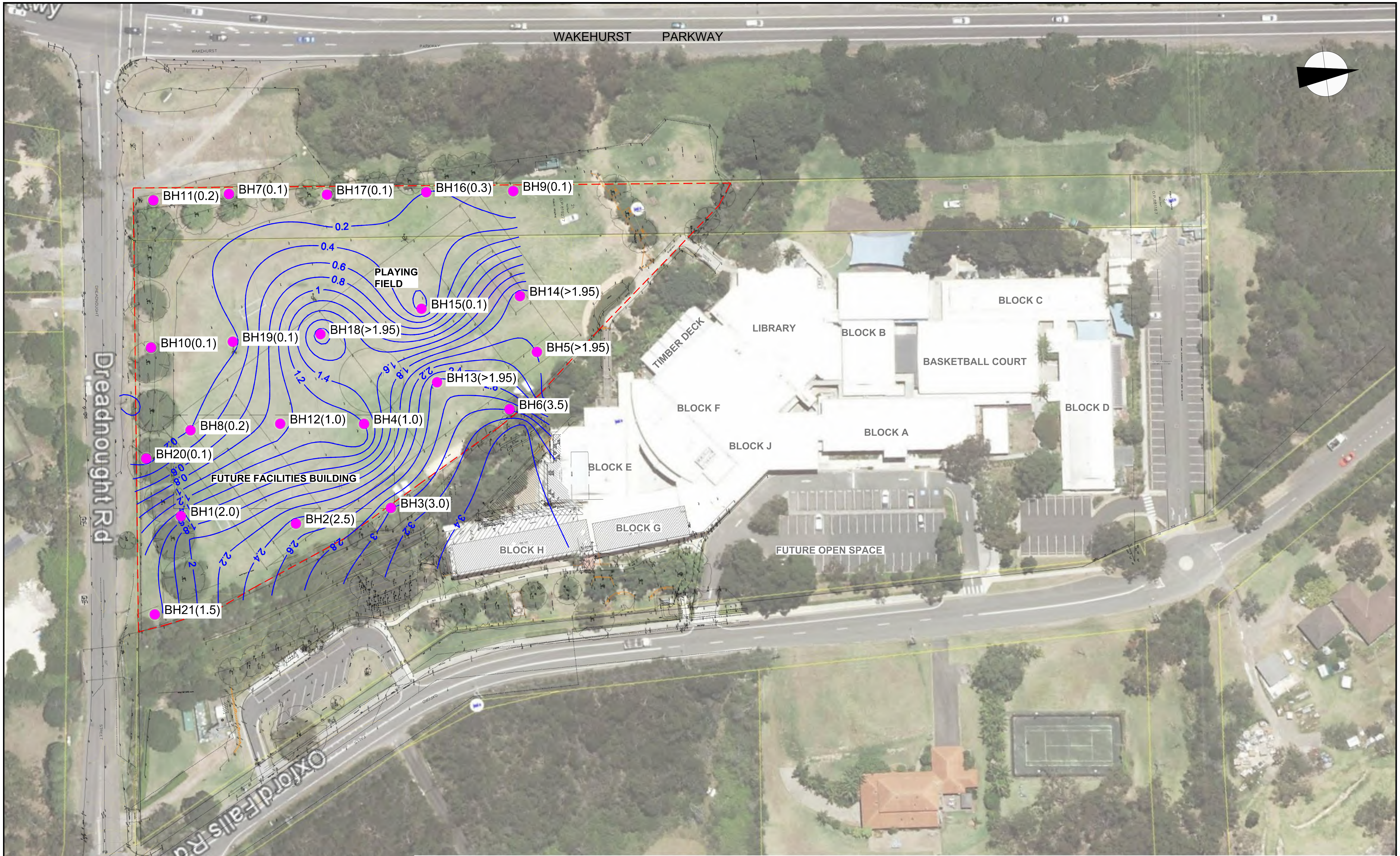
Appendix A: Report Figures

PLOT DATE: 23/10/2017 9:47:43 AM DWG FILE: S:\5 EIS\5C EIS JOBS\30000'S\E30807KM OXFORD FALLS\CAD\E30807KM.DWG

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.5.1557
AERIAL IMAGE ©: 2015 GOOGLE INC.

This plan should be read in conjunction with the EIS report.

Title:	SITE LOCATION PLAN
Location:	OXFORD FALLS GRAMMAR SCHOOL 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW
Report No: E30807KM	Figure No: 1
	ENVIRONMENTAL INVESTIGATION SERVICES



LEGEND

- APPROXIMATE SITE BOUNDARY
- BH (Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
- 2.0 — DEPTH OF FILL CONTOUR (metres) (CONTOURS ARE APPROXIMATE ONLY)

0 10 20 30 40 50
SCALE 1:1000 @A3 METRES

This plan should be read in conjunction with the EIS report.

Title: **SAMPLE LOCATION PLAN**

Location: OXFORD FALLS GRAMMAR SCHOOL
1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Report No: E30807KM

Figure No: 2

ENVIRONMENTAL INVESTIGATION SERVICES

EIS

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Appendix B: Laboratory Summary Table

EIS

TABLE A
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total	TRH					BTEX COMPOUNDS				
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful [2]	Total Scheduled[3]	PCBs	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	ASBESTOS FIBRES
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.2	0.5	1	3	100
General Solid Waste CT1 [1]			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	<50	<50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1 [1]			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	<50	<50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2 [1]			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	<50	<50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2 [1]			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	<50	<50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH1	0.0-0.2	Fill: silty sand	6	LPQL	9	10	34	LPQL	3	79	0.3	0.06	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH1	2.0-2.5	Clayey sand	LPQL	LPQL	8	1	9	LPQL	2	13	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
BH2	0.0-0.2	Fill: silty sand	5	LPQL	7	18	23	LPQL	2	51	0.1	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH2	0.5-0.95	Fill: sand	5	LPQL	16	15	73	LPQL	2	63	1.4	0.1	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
BH3	0.0-0.2	Fill: silty sand	LPQL	LPQL	7	6	12	LPQL	2	31	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH6	0.0-0.2	Fill: silty sand	LPQL	LPQL	13	5	13	LPQL	1	39	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH6	3.0-3.45	Fill: sand	LPQL	LPQL	7	13	21	LPQL	2	100	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
BH9	0.0-0.2	Fill: silty sand	8	LPQL	13	29	56	LPQL	4	200	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH11	0.0-0.2	Fill: silty sand	LPQL	LPQL	9	12	25	LPQL	7	45	0.4	0.06	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH12	0.0-0.2	Fill: silty sand	5	LPQL	7	10	15	LPQL	2	42	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH13	0.5-0.95	Fill: sand	LPQL	LPQL	16	2	9	LPQL	2	21	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH16	0.0-0.2	Fill: silty sand	6	LPQL	12	31	36	LPQL	4	160	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
BH18	0.0-0.2	Fill: silty sand	LPQL	LPQL	6	13	13	LPQL	3	48	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
BH18	1.5-1.95	Fill: clayey sand	LPQL	LPQL	19	3	8	LPQL	2	220	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
BH19	0.0-0.2	Fill: silty sand	LPQL	LPQL	7	10	18	LPQL	3	49	LPQL	LPQL	NA	NA	NA	NA	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not detected
Total Number of samples			15	15	15	15	15	15	15	15	15	15	5	5	5	5	5	15	15	15	15	15	15	15	15	15	10
Maximum Value			8	LPQL	19	31	73	LPQL	7	220	1.4	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NC
Statistical Analysis on Fill Samples																											
Number of Fill Samples [4]			14	14	14	14	14	14	14	14	14	14	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Mean Value [4]			4.8	NC	10.6	12.6	25.4	NC	2.8	82	0.2	0.06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Standard Deviation [4]			1.1	NC	4.2	8.6	18.9	NC	1.5	64.5	0.4	0.01	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
% UCL [4]			95%	NC	95%	NC	95%	NC	95%	95%	95%	95%	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UCL Value [4]			5.3	NC	12.6	NC	34.4	NC	3.5	129.7	0.4	0.06	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Explanation:

[1] - NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014)

[2] - Assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion

[3] - Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde

[4] - Statistical calculation undertaken using ProUCL version 5.0 (USEPA). Statistical calculation has only been undertaken on fill samples

Concentration above the CT1	VALUE
Concentration above SCC1	VALUE
Concentration above the SCC2	VALUE

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons	UCL: Upper Level Confidence Limit on Mean Value	CT: Contaminant Threshold
B(a)P: Benzo(a)pyrene	NA: Not Analysed	SCC: Specific Contaminant Concentration
PQL: Practical Quantitation Limit	NC: Not Calculated	HILs: Health Investigation Levels
LPQL: Less than PQL	NSL: No Set Limit	NEPM: National Environmental Protection Measure
PID: Photoionisation Detector	SAC: Site Assessment Criteria	BTEX: Monocyclic Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls	TRH: Total Recoverable Hydrocarbons	

Appendix C: Borehole Logs

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
1
1/1
E 337534
N 6265349

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Date: 25-9-17
Method: SPIRAL AUGER JK350
Logged/Checked by: T.C./W.T.
R.L. Surface: 74.2m
Datum: AHD

Depth (m)	Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
0		N > 10 2,10/50mm REFUSAL		FILL: Silty sand, fine to medium grained, brown, with nedium to coarse grained sandstone gravel and cobbles, trace of roots, bricks, metal and plastic fragments.	M			GRASS COVER MODERATE TO HIGH 'TC' BIT RESISTANCE
1.2				FILL: Sand, fine to medium grained, orange brown and dark grey, with fine to coarse grained sandstone gravel.				SOIL RESISTANCE APPEARS MODERATELY COMPACTED
1.7			SC	CLAYEY SAND: fine to medium grained, grey and orange brown.	M	(L)		ALLUVIAL
2.8		N = 9 3,5,4		CLAYEY SAND: fine to coarse grained, grey and dark grey.		L		
4.5	AFTER 1 HR	N > 30 9,20, 10/50mm REFUSAL						
4.8			-	SANDSTONE: fine to coarse grained, grey.	XW	EL		LOW RESISTANCE
5.0					DW	M		MODERATE TO HIGH RESISTANCE
6.0				END OF BOREHOLE AT 6.0m				

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
2
1/1

E 337534
N 6265380

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 74.2m

Date: 25-9-17
Datum: AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		FILL: Silty sand, fine to medium grained, dark brown.	M			GRASS COVER
	N = 25 8,10,15			FILL: Sand, fine to coarse grained, dark brown, grey and orange brown, with clay and fine to medium grained sandstone gravel.				APPEARS WELL COMPACTED
	N = 5 3,2,3	1–2						APPEARS POORLY COMPACTED
AFTER 1 HR			CL	SANDY CLAY: medium plasticity, brown.	MC≈PL	(F)		ALLUVIAL
	N = 14 5,7,7	3–4	SP	SAND: fine to coarse grained, grey and orange brown, with clay.	M	MD		
	N > 25 8,15, 10/50mm REFUSAL		-	SANDSTONE: fine to coarse grained, grey and dark grey.	XW	EL		
		5			DW	M		MODERATE TO HIGH 'TC' BIT RESISTANCE
				SANDSTONE: fine to medium grained, grey.				HIGH RESISTANCE
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples columns: ES, U50, DB, DS. Graphic Log column.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 3
1/1

E 33753
N 6265408

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 73.7m
Date: 25-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						FILL: Silty sand, fine to coarse grained, brown, with root fibres.	M			GRASS COVER
		N = 4 2,2,2				FILL: Sandy clay, medium plasticity, red brown, fine to medium grained sand, trace of fine to coarse grained sandstone gravel, cobbles and boulders.	MC≈PL			APPEARS POORLY COMPACTED
		N = 23 3,8,15				FILL: Silty sand, fine to medium grained, orange brown, grey and brown, with fine to coarse grained sandstone gravel, cobbles and boulders, trace of brick.	M			APPEARS WELL COMPACTED
AFTER 1 HR		N > 16 1,5,11/ 20mm REFUSAL			SC	CLAYEY SAND: fine to coarse grained, grey.	M	MD		ALLUVIAL ORGANIC ODOUR
					-	SANDSTONE: fine to medium grained, orange brown and grey.	DW	VL-L		LOW 'TC' BIT RESISTANCE
						SANDSTONE: fine to coarse grained, grey.		L-M		MODERATE RESISTANCE
								M		MODERATE TO HIGH RESISTANCE
						END OF BOREHOLE AT 6.0m				

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BOREHOLE LOG

Borehole No. 4

1/1

E 337513
N 6265402

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 74.0m

Date: 25-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		FILL: Silty sand, fine to medium grained, brown and orange brown, trace of medium to coarse grained sandstone gravel, cobbles and boulders.	M			GRASS COVER
	N = 10 6,6,4			FILL: Sandy clay, medium plasticity, light brown mottled red and yellow brown, with medium to coarse grained sandstone gravel.				APPEARS WELL COMPACTED
		1	SC	CLAYEY SAND: fine to medium grained, grey mottled dark grey and orange brown.	M	L		ALLUVIAL
	N = 8 3,4,4	2						
	N = 14 3,5,9	3				MD		
AFTER 1 HR		4	SP	SAND: fine to coarse grained, orange brown, with medium grained, sub rounded to sub angular quartz gravel.	W			
	N > 17 6,7,10/ 20mm REFUSAL	5						
			-	SANDSTONE: fine to coarse grained, grey and orange brown.	DW	L-M		LOW TO MODERATE 'TC' BIT RESISTANCE
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples: ES, U50, DB, DS

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BOREHOLE LOG

Borehole No. **5**
1/1
E 337510
N 6265456

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 73.6m
Date: 25-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to medium grained, brown, with root fibres, trace of medium to coarse grained sandstone gravel.	D			GRASS COVER
	ES, DS	N > 10 10/20mm REFUSAL				FILL: Silty sand, fine to medium grained, orange brown, with fine to coarse grained sandstone gravel, cobbles and boulders.	M			APPEARS POORLY TO MODERATELY COMPACTED
			1							
	DS	N = 6 2,3,3								
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No.
6
1/1

E 337518
N 6265448

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 73.6m

Date: 25-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Silty sand, fine to coarse grained, brown, trace of fine to medium grained sandstone gravel.	M			GRASS COVER
						FILL: Sandstone boulder	-			HIGH 'TC' BIT RESISTANCE
			1			FILL: Silty sand, fine to coarse grained, brown, orange brown and grey, with fine to medium grained sandstone gravel, trace of timber and plastic fragments.	M			SOIL RESISTANCE APPEARS MODERATELY COMPACTED
		N = 15 4,11,4	2							
						FILL: Sand, fine to coarse grained, dark grey and orange brown, with string fibrefragments.				
ON COMPLETION		N = 6 3,3,3	3							APPEARS POORLY COMPACTED
					SC	CLAYEY SAND: fine to coarse grained, grey.	M-W	(MD)		ALLUVIAL
			4							
		N = SPT 20/70mm REFUSAL			-	SANDSTONE: fine to coarse grained, grey.	DW	VL-L		LOW 'TC' BIT RESISTANCE
			5					M-H		HIGH RESISTANCE
						END OF BOREHOLE AT 5.6m				'TC' BIT REFUSAL
			6							
			7							

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BOREHOLE LOG

Borehole No. 7

1/1

E 337443
N 6265377

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 76.1m

Date: 25-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Silty sand, fine to medium grained, brown, with root fibres.	M			GRASS COVER
								SP	SAND: fine to coarse grained, orange brown, with clay.	M	MD		ALLUVIAL
					N = 12 4,6,6	1							
					N = 14 3,6,8	2							
								SC	CLAYEY SAND: fine to coarse grained, grey, orange brown and red brown.				
					N = 17 7,7,10	3							
						4							
					N = 23 10,10,15			-	SANDSTONE: fine to coarse grained, grey, orange brown and red brown.	XW	EL		
						5			END OF BOREHOLE AT 4.95m				
						6							
						7							

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BOREHOLE LOG

Borehole No. **8**
1/1
E 337503
N 6265355

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 74.3m
Date: 26-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Silty sand, fine to medium grained, brown, yellow brown mottled red and light brown, with medium to coarse grained sandstone gravel and cobbles.	M			GRASS COVER
	ES, DS	N = 14 5,7,7			SC	CLAYEY SAND: fine to coarse grained, grey.	M	MD		ALLUVIAL
	ES, DS	N = 14 5,6,8	1–2							
AFTER 1 HR	DS	N = 21 10,11,10	3		SC	CLAYEY SAND: fine to coarse grained, grey and orange brown.				
			4		-	SANDSTONE: fine to coarse grained, grey.	DW	L-M		LOW 'TC' BIT RESISTANCE
	DS		5					M		MODERATE TO HIGH RESISTANCE
			6			END OF BOREHOLE AT 6.0m				
			7							

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BOREHOLE LOG

Borehole No. **9**

1/1

E 337457
N 6265456

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 73.6m

Date: 26-9-17
Datum: AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Silty sand, fine to medium grained, brown, with fine to coarse grained sandstone gravel.	M			GRASS COVER
					N = 7 4,4,3			SC	CLAYEY SAND: fine to medium grained, orange brown.	M	L		ALLUVIAL
						1			CLAYEY SAND: fine to coarse grained, grey and orange brown, trace of ironstone gravel.				
					N = 7 3,4,3								
						2			END OF BOREHOLE AT 1.95m				
						3							
						4							
						5							
						6							
						7							

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BOREHOLE LOG

Borehole No.
10
1/1
E 337478
N 6265347

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Date: 26-9-17
Method: SPIRAL AUGER JK350
R.L. Surface: 75.8m
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to coarse grained, brown, with roots.	D			GRASS COVER
					SP	SAND: fine to coarse grained, orange brown, with clay.	M	L		ALLUVIAL
	ES, DS	N = 9 3,4,5								
			1		SC	CLAYEY SAND: fine to coarse grained, orange brown and grey.		MD		
	DS	N = 10 3,4,6	2							
					SP	SAND: fine to coarse grained, grey, orange brown and red brown.				
	DS	N = 17 7,8,9	3							
			4		-	SANDSTONE: fine to coarse grained, orange brown.	XW-DW	EL-VL		VERY LOW TO LOW 'TC' BIT RESISTANCE
						END OF BOREHOLE AT 4.5m				
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No.
11
1/1
E 337442
N 6265352

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Date: 26-9-17
Method: SPIRAL AUGER JK350
R.L. Surface: 77.0m
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES/U50/DB/DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Silty sand, fine to medium grained, brown, with roots.	D			GRASS COVER
	ES, DS	N = 10 4,4,6			SC	CLAYEY SAND: fine to coarse grained, orange brown.	M	MD		ALLUVIAL
	DS	N = 14 5,6,8	1			CLAYEY SAND: fine to coarse grained, orange brown and red brown.				
▶ AFTER 1 HR ▼	ES, DS	N = 20 5,6,14	2–3		SP	SAND: fine to coarse grained, red brown and grey.				
	DS		4			SAND: fine to coarse grained, red brown, with clay.	W	(MD)		
					-	SANDSTONE: fine to coarse grained, orange brown, grey and red brown.	XW	EL		VERY LOW TO LOW 'TC' BIT RESISTANCE
			5				DW	L		LOW RESISTANCE
						END OF BOREHOLE AT 5.5m				
			6							
			7							

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BOREHOLE LOG

Borehole No. **12**

1/1

E 337510
N 6265378

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY | **Method:** SPIRAL AUGER JK350 | **R.L. Surface:** 74.3m

Date: 26-9-17 | **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Silty sand, fine to medium grained, brown, with roots.	M			GRASS COVER
	ES, DS	N = 30 6,20,10				FILL: Sand, fine to coarse grained, orange brown and grey, with clay, trace of fine grained sandstone gravel.				APPEARS WELL COMPACTED
	DS	N = 9 3,4,5	1		SP	SAND: fine to coarse grained, grey and dark grey, trace of clay.	M	L		ALLUVIAL
AFTER 1 HR	DS	N = 7 2,3,4	2.5		CL	SANDY CLAY: medium plasticity, grey, fine to coarse grained sand.	MC≈PL	VSt	300 350	
	DS	N = 25 6,7,18	4		-	SANDSTONE: fine to coarse grained, orange brown and grey.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
			6			END OF BOREHOLE AT 6.0m				

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BOREHOLE LOG

Borehole No. 13

1/1

E 337501
N 6265426

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY

Date: 26-9-17

Method: SPIRAL AUGER JK350

R.L. Surface: 74.0m

Datum: AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to coarse grained, brown, with roots.	M			GRASS COVER
	ES	N > 13 8,13/10mm REFUSAL				FILL: Sand, fine to coarse grained, orange brown and dark grey, with clay.				APPEARS MODERATELY COMPACTED
			1							
	DS	N = 13 7,6,7				FILL: Sand, fine to coarse grained, red brown and dark grey, with medium grained sandstone gravel.				
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No.
14
1/1

E 337480
N 6265454

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 73.8m
Date: 26-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Silty sand, fine to coarse grained, brown, with root fibres.	D			GRASS COVER
									FILL: Sand, fine to coarse grained, grey and brown, with medium to coarse grained sandstone gravel.	M			APPEARS MODERATELY COMPACTED
	■			■	N = 10 2,2,8								
						1			as above, but with polystyrene fragments.				
				■	N = 14 6,7,7								
						2			END OF BOREHOLE AT 1.95m				
						3							
						4							
						5							
						6							
						7							

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BOREHOLE LOG

Borehole No. **15**

1/1

E 337451
N 6265425

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 74.0m

Date: 26-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES U50 DB DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to coarse grained, brown, with roots.	M			GRASS COVER
					SP	SAND: fine to coarse grained, orange brown, trace of clay.	M	L		ALLUVIAL
	DS	N = 8 3,4,4								
			1		SC	CLAYEY SAND: fine to coarse grained, orange brown and grey.				
	DS	N = 10 3,4,6						MD		
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. **16**
1/1
E 337451
N 6265433

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 73.7m
Date: 26-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to coarse grained, brown, with roots.	M			GRASS COVER
					SC	CLAYEY SAND: fine to coarse grained, orange brown.	M	L		ALLUVIAL
	DS	N = 8 3,4,4								
			1							
						CLAYEY SAND: fine to coarse grained, orange brown and grey.				
	DS	N = 14 5,6,8						MD		
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. 17
1/1

E 337449
N 6265404

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 74.4m

Date: 26-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Silty sand, fine to coarse grained, brown, with root fibres.	M			GRASS COVER
								SP	SAND: fine to coarse grained, dark brown, with clay.	M	L		ALLUVIAL
				■	N = 7 3,3,4	1							
				■	N = 20 4,10,10			SC	CLAYEY SAND: fine to coarse grained, red brown and grey.		MD		
						2			END OF BOREHOLE AT 1.95m				
						3							
						4							
						5							
						6							
						7							

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BOREHOLE LOG

Borehole No.
18
1/1

E 337482
N 6265396

Client: OXFORD FALLS GRAMMAR SCHOOL
Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS
Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY
Method: SPIRAL AUGER JK350
R.L. Surface: 74.1m
Date: 26-9-17
Datum: AHD
Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	ES		0			FILL: Silty sand, fine to coarse grained, brown, with root fibres.	M			GRASS COVER
						FILL: Clayey sand, fine to coarse grained, orange brown.				APPEARS WELL COMPACTED
	DS	N = 17 20,11,6	1							
						FILL: Clayey sand, fine to coarse grained, grey and brown, timber and plastic fragments.	W			
	ES, DS	N = 1 0,0,1								APPEARS POORLY COMPACTED
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. 19

1/1

E 337480
N 6265371

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY

Date: 26-9-17

Method: SPIRAL AUGER JK350

R.L. Surface: 74.2m

Datum: AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■					0			FILL: Silty sand, fine to coarse grained, brown, with root fibres.	M			GRASS COVER
								SC	CLAYEY SAND: fine to coarse grained, orange brown and grey.	M	MD		ALLUVIAL
	■			■	N = 10 8,6,4								
						1							
									CLAYEY SAND: fine to coarse grained, orange brown and grey.				
				■	N = 10 5,4,6								
						2			END OF BOREHOLE AT 1.95m				
						3							
						4							
						5							
						6							
						7							

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BOREHOLE LOG

Borehole No. **20**
1/1

E 337509
N 6565341

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 74.6m

Date: 26-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION			0			FILL: Silty sand, fine to coarse grained, brown, with roots.	M			GRASS COVER
					SM	SILTY SAND: fine to coarse grained, brown and orange brown, with clay.	M	L		ALLUVIAL
	DB	N = 13 6,8,5	1							
			2			END OF BOREHOLE AT 1.95m				
			3							
			4							
			5							
			6							
			7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
21
1/1
E 337554
N 6265336

Client: OXFORD FALLS GRAMMAR SCHOOL

Project: PROPOSED SPORTING FACILITY, CARPARK AND PLAYING FIELDS

Location: 1078 OXFORD FALLS ROAD, OXFORD FALLS, NSW

Job No. 30807SY **Method:** SPIRAL AUGER JK350 **R.L. Surface:** 73.5m

Date: 26-9-17 **Datum:** AHD

Logged/Checked by: T.C./W.T.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION			■			0			FILL: Silty sand, fine to coarse grained, brown and orange brown, with fine to medium grained sandstone gravel, trace of clay.	M			GRASS COVER
				■	N = 6 4,4,2			SC	CLAYEY SAND: fine to coarse grained, orange brown and grey.	M	L		ALLUVIAL
						2			END OF BOREHOLE AT 1.95m				

EXPLANATORY NOTES – ENVIRONMENTAL LOGS

INTRODUCTION

These notes have been provided to supplement the environmental report with regards to drilling and field logging. Not all notes are necessarily relevant to all reports. Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and manmade processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies involve gathering and assimilating limited facts about these characteristics and properties in order to understand the ground on a particular site under certain conditions. These conditions are directly relevant only to the ground at the place where, and time when, the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below (note that unless stated in the report, the soil classification is based on a qualitative field assessment, not laboratory testing):

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as shown in the following table:

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

DRILLING OR EXCAVATION METHODS

The following is a brief summary of drilling and excavation methods currently adopted by the Company, and some comments on their use and application. All except test pits and hand auger drilling require the use of a mechanical drilling rig.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descend into the pit. The depth of penetration is limited to approximately 3m for a backhoe and up to 6m for an excavator. Limitations of test pits include problems associated with disturbance and difficulty of reinstatement; and the consequent effects on nearby structures. Care must be taken if construction is to be carried out near test pit locations to either properly re-compact the backfill during construction, or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as fill, hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (e.g. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The locations of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as: N = 13 (4, 6, 7)
- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as: N>30 (15, 30/40mm)

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60 tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "Nc" on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open;
- A localised perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (e.g. bricks, concrete, plastic, slag/ash, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes

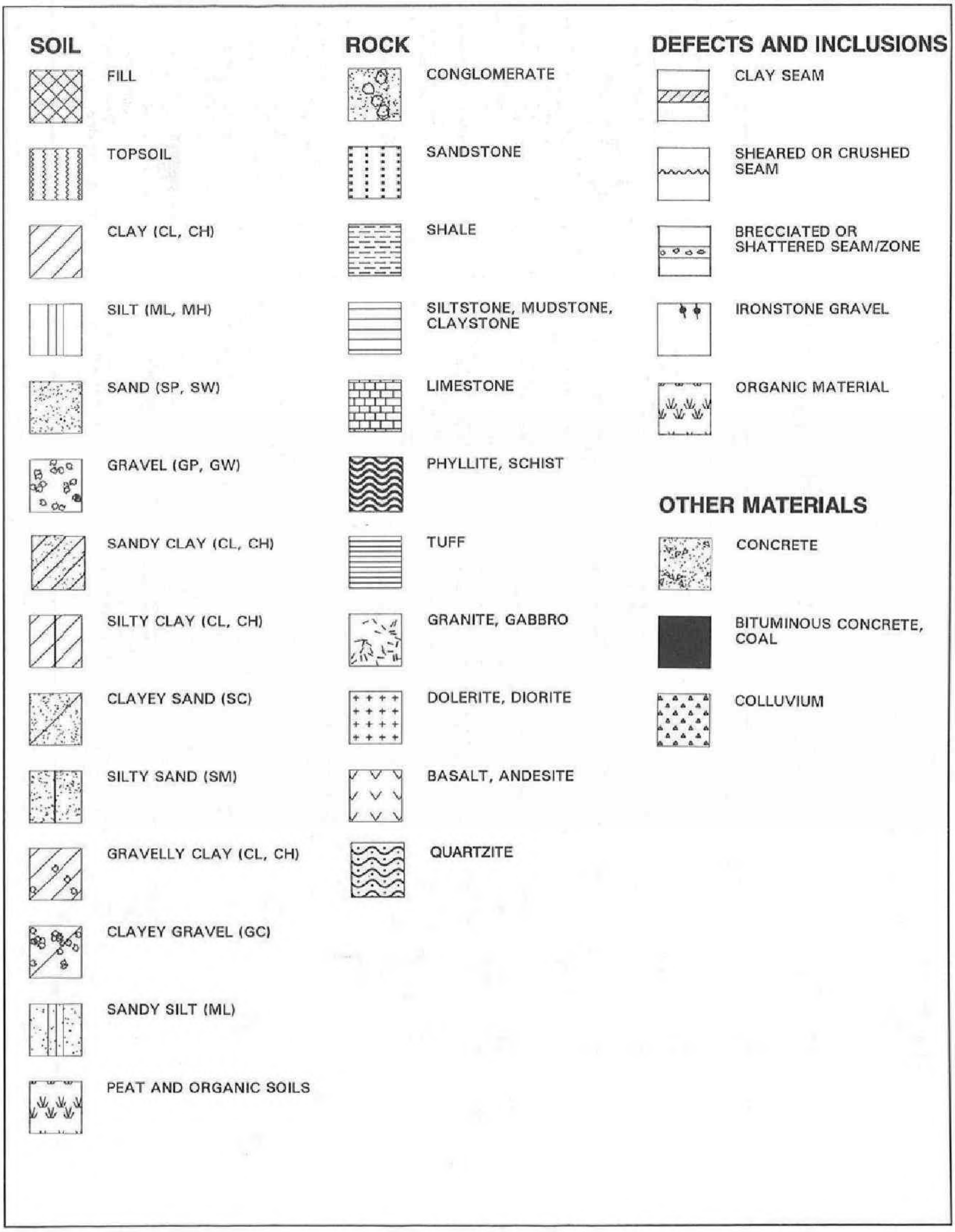
LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classifications and rocks strengths indicated on the environmental logs unless noted in the report.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, EIS should be notified immediately.

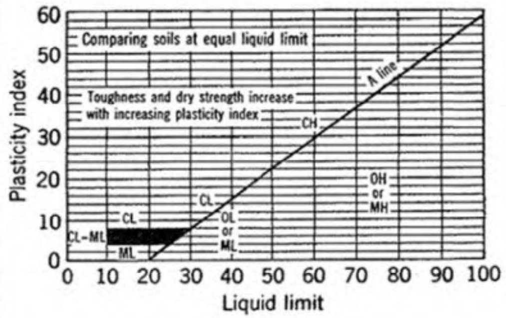
GRAPHIC LOG SYMBOLS FOR SOIL AND ROCKS



Major division	Subdivision		Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)	Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than 75 µm sieve size[b] (The 75 µm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols. $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Identification Procedures on Fraction Smaller than 380 µm Sieve Size

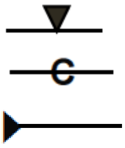
Major division	Subdivision	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils More than half of material is *smaller* than 75 µm sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions. Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. GW-GC, well graded gravel-sand mixture with clay fines).
2 Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown. Extent of borehole collapse shortly after drilling. Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 / 7 / 3 R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample heads pace test).
Moisture (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless)	D	DRY – Runs freely through fingers.
	M	MOIST – Does not run freely but no free water visible on soil surface.
	W	WET – Free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – Unconfined compressive strength less than 25kPa
	S	SOFT – Unconfined compressive strength 25-5 0kPa
	F	FIRM – Unconfined compressive strength 50-1 00kPa
	St	STIFF – Unconfined compressive strength 100- 200kPa
	VSt	VERY STIFF – Unconfined compressive strength 200- 400kPa
	H	HARD – Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based o n tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (ID) Range (%)** / **SPT ' N' Value Range (Blows/300mm)**
	VL	Very Loose <15 / 0-4
	L	Loose 15-35 / 4-10
	MD	Medium Dense 35-65 / 10-30
	D	Dense 65-85 / 30-50
	VD	Very Dense >85 / >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS CONTINUED

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining and Geomechanics Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL	0.03	Easily remoulded by hand to a material with soil properties.
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low:	L	0.3	A piece of core 150 mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium Strength:	M	1	A piece of core 150 mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
High:	H	3	A piece of core 150 mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
Very High:	VH	10	A piece of core 150 mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
Extremely High:	EH		A piece of core 150 mm long x 50mm dia. is very difficult to break with h and-held hammer . Rings when struck with a hammer.

ROCK STRENGTH

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to (i.e. relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Iron stained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

Appendix D: Laboratory Report & COC Documents

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	EIS Job Number: E30807KM Date Results Required: STANDARD Page: 1 of 1	EIS ENVIRONMENTAL INVESTIGATION SERVICES REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Rob Muller

Location: Oxford Falls

Sampler: Tom Clent

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	PID	Sample Description	Combo 3	Combo 3a	Combo 6	Combo 6a	8 Metals	PAHs	TRH/BTEX	BTEX	Asbestos
25/09/2017	1	BH1	0.0-0.2	G, A	0	Fill: silty sand				X					
25/09/2017	2	BH1	2.0-2.5	G, A	0	Clayey sand	X								
25/09/2017	3	BH2	0.0-0.2	G, A	0	Fill: silty sand		X							
25/09/2017	4	BH2	0.5-0.95	G, A	0	Fill: sand	X								
25/09/2017	5	BH3	0.0-0.2	G, A	0	Fill: silty sand		X							
25/09/2017	6	BH6	0.0-0.2	G, A	0	Fill: silty sand				X					
25/09/2017	7	BH6	3.0-3.45	G, A	0	Fill: sand	X								
26/09/2017	8	BH9	0.0-0.2	G, A	0	Fill: silty sand				X					
26/09/2017	9	BH11	0.0-0.2	G, A	0	Fill: silty sand				X					
26/09/2017	10	BH12	0.0-0.2	G, A	0	Fill: silty sand		X							
26/09/2017	11	BH13	0.5-0.95	G, A	0	Fill: sand		X							
26/09/2017	12	BH16	0.0-0.2	G, A	0	Fill: silty sand	X								
26/09/2017	13	BH18	0.0-0.2	G, A	0	Fill: silty sand				X					
26/09/2017	14	BH18	1.5-1.95	G, A	0	Fill: clayey sand	X								
26/09/2017	15	BH19	0.0-0.2	G, A	0	Fill: silty sand		X							

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 176661
Date Received: 28/9/17
Time Received: 14:20
Received by: MT
Temp: Cool/Ambient 14.7
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

Sample Containers:
G - 250mg Glass Jar
A - Ziplock Asbestos Bag
P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
Rob Muller	28/9/17	12:15pm	MT ELS	28/9/17 14:20

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Environmental Investigation Services
Attention	Rob Muller

Sample Login Details	
Your reference	E30807KM, Oxford Falls
Envirolab Reference	176661
Date Sample Received	28/09/2017
Date Instructions Received	28/09/2017
Date Results Expected to be Reported	06/10/2017

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	15 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	14.7
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	Organophosphorus Pesticides	PCBsin Soil	Acid Extractable metalsin soil	Asbestos ID - soils
BH1-0.0-0.2	✓	✓	✓	✓	✓	✓	✓	✓
BH1-2.0-5.0	✓	✓	✓				✓	
BH2-0.0-0.2	✓	✓	✓				✓	✓
BH2-0.5-0.95	✓	✓	✓				✓	
BH3-0.0-0.2	✓	✓	✓				✓	✓
BH6-0.0-0.2	✓	✓	✓	✓	✓	✓	✓	✓
BH6-3.0-3.45	✓	✓	✓				✓	
BH9-0.0-0.2	✓	✓	✓	✓	✓	✓	✓	✓
BH11-0.0-0.2	✓	✓	✓	✓	✓	✓	✓	✓
BH12-0.0-0.2	✓	✓	✓				✓	✓
BH13-0.5-0.95	✓	✓	✓				✓	✓
BH16-0.0-0.2	✓	✓	✓				✓	
BH18-0.0-0.2	✓	✓	✓	✓	✓	✓	✓	✓
BH18-1.5-1.95	✓	✓	✓				✓	
BH19-0.0-0.2	✓	✓	✓				✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.

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CERTIFICATE OF ANALYSIS 176661

Client Details

Client	Environmental Investigation Services
Attention	Rob Muller
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E30807KM, Oxford Falls**
Number of Samples	15 Soil
Date samples received	28/09/2017
Date completed instructions received	28/09/2017

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	06/10/2017
Date of Issue	06/10/2017

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Paul Ching
Authorised by Asbestos Approved Signatory: Paul Ching

Results Approved By
Dragana Tomas, Senior Chemist
Long Pham, Team Leader, Metals
Paul Ching, Senior Analyst
Steven Luong, Chemist

Authorised By

David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		176661-1	176661-2	176661-3	176661-4	176661-5
Your Reference	UNITS	BH1	BH1	BH2	BH2	BH3
Depth		0.0-0.2	2.0-5.0	0.0-0.2	0.5-0.95	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	25/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	129	127	127	116	130

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		176661-6	176661-7	176661-8	176661-9	176661-10
Your Reference	UNITS	BH6	BH6	BH9	BH11	BH12
Depth		0.0-0.2	3.0-3.45	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	128	96	112	88	127

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		176661-11	176661-12	176661-13	176661-14	176661-15
Your Reference	UNITS	BH13	BH16	BH18	BH18	BH19
Depth		0.5-0.95	0.0-0.2	0.0-0.2	1.5-1.95	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	123	130	105	117	102

svTRH (C10-C40) in Soil						
Our Reference		176661-1	176661-2	176661-3	176661-4	176661-5
Your Reference	UNITS	BH1	BH1	BH2	BH2	BH3
Depth		0.0-0.2	2.0-5.0	0.0-0.2	0.5-0.95	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	25/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	29/09/2017	29/09/2017	30/09/2017	30/09/2017	30/09/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	82	80	82	79	81

svTRH (C10-C40) in Soil						
Our Reference		176661-6	176661-7	176661-8	176661-9	176661-10
Your Reference	UNITS	BH6	BH6	BH9	BH11	BH12
Depth		0.0-0.2	3.0-3.45	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	30/09/2017	30/09/2017	30/09/2017	30/09/2017	30/09/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	82	76	80	84	83

svTRH (C10-C40) in Soil						
Our Reference		176661-11	176661-12	176661-13	176661-14	176661-15
Your Reference	UNITS	BH13	BH16	BH18	BH18	BH19
Depth		0.5-0.95	0.0-0.2	0.0-0.2	1.5-1.95	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	30/09/2017	30/09/2017	30/09/2017	30/09/2017	30/09/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	79	85	85	79	85

PAHs in Soil						
Our Reference		176661-1	176661-2	176661-3	176661-4	176661-5
Your Reference	UNITS	BH1	BH1	BH2	BH2	BH3
Depth		0.0-0.2	2.0-5.0	0.0-0.2	0.5-0.95	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	25/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/09/2017	27/09/2017	27/09/2017	27/09/2017	27/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	0.3	<0.1
Pyrene	mg/kg	0.1	<0.1	0.1	0.3	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	0.3	<0.2
Benzo(a)pyrene	mg/kg	0.06	<0.05	<0.05	0.1	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	mg/kg	0.3	<0.05	0.1	1.4	<0.05
Surrogate p-Terphenyl-d14	%	106	99	98	102	98

PAHs in Soil						
Our Reference		176661-6	176661-7	176661-8	176661-9	176661-10
Your Reference	UNITS	BH6	BH6	BH9	BH11	BH12
Depth		0.0-0.2	3.0-3.45	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/09/2017	27/09/2017	27/09/2017	27/09/2017	27/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.1	0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	0.06	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	mg/kg	<0.05	<0.05	0.1	0.4	<0.05
Surrogate p-Terphenyl-d14	%	101	105	101	103	101

PAHs in Soil						
Our Reference		176661-11	176661-12	176661-13	176661-14	176661-15
Your Reference	UNITS	BH13	BH16	BH18	BH18	BH19
Depth		0.5-0.95	0.0-0.2	0.0-0.2	1.5-1.95	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/09/2017	27/09/2017	27/09/2017	27/09/2017	27/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate p-Terphenyl-d14	%	97	107	103	105	105

Organochlorine Pesticides in soil						
Our Reference		176661-1	176661-6	176661-8	176661-9	176661-13
Your Reference	UNITS	BH1	BH6	BH9	BH11	BH18
Depth		0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	80	78	86	80	90

Organophosphorus Pesticides						
Our Reference		176661-1	176661-6	176661-8	176661-9	176661-13
Your Reference	UNITS	BH1	BH6	BH9	BH11	BH18
Depth		0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	80	78	86	80	90

PCBs in Soil						
Our Reference		176661-1	176661-6	176661-8	176661-9	176661-13
Your Reference	UNITS	BH1	BH6	BH9	BH11	BH18
Depth		0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	80	78	86	80	90

Acid Extractable metals in soil						
Our Reference		176661-1	176661-2	176661-3	176661-4	176661-5
Your Reference	UNITS	BH1	BH1	BH2	BH2	BH3
Depth		0.0-0.2	2.0-5.0	0.0-0.2	0.5-0.95	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	25/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Arsenic	mg/kg	6	<4	5	5	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	9	8	7	16	7
Copper	mg/kg	10	1	18	15	6
Lead	mg/kg	34	9	23	73	12
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	2	2	2	2
Zinc	mg/kg	79	13	51	63	31

Acid Extractable metals in soil						
Our Reference		176661-6	176661-7	176661-8	176661-9	176661-10
Your Reference	UNITS	BH6	BH6	BH9	BH11	BH12
Depth		0.0-0.2	3.0-3.45	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Arsenic	mg/kg	<4	<4	8	<4	5
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	13	7	13	9	7
Copper	mg/kg	5	13	29	12	10
Lead	mg/kg	13	21	56	25	15
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	1	2	4	7	2
Zinc	mg/kg	39	100	200	45	42

Acid Extractable metals in soil						
Our Reference		176661-11	176661-12	176661-13	176661-14	176661-15
Your Reference	UNITS	BH13	BH16	BH18	BH18	BH19
Depth		0.5-0.95	0.0-0.2	0.0-0.2	1.5-1.95	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Arsenic	mg/kg	<4	6	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	16	12	6	19	7
Copper	mg/kg	2	31	13	3	10
Lead	mg/kg	9	36	13	8	18
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	4	3	2	3
Zinc	mg/kg	21	160	48	220	49

Moisture						
Our Reference		176661-1	176661-2	176661-3	176661-4	176661-5
Your Reference	UNITS	BH1	BH1	BH2	BH2	BH3
Depth		0.0-0.2	2.0-5.0	0.0-0.2	0.5-0.95	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	25/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Moisture	%	6.9	13	6.4	9.5	7.9

Moisture						
Our Reference		176661-6	176661-7	176661-8	176661-9	176661-10
Your Reference	UNITS	BH6	BH6	BH9	BH11	BH12
Depth		0.0-0.2	3.0-3.45	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Moisture	%	6.1	15	9.6	4.1	6.7

Moisture						
Our Reference		176661-11	176661-12	176661-13	176661-14	176661-15
Your Reference	UNITS	BH13	BH16	BH18	BH18	BH19
Depth		0.5-0.95	0.0-0.2	0.0-0.2	1.5-1.95	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/09/2017	29/09/2017	29/09/2017	29/09/2017	29/09/2017
Date analysed	-	03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Moisture	%	11	2.2	0.8	20	1.2

Asbestos ID - soils						
Our Reference		176661-1	176661-3	176661-5	176661-6	176661-8
Your Reference	UNITS	BH1	BH2	BH3	BH6	BH9
Depth		0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled		25/09/2017	25/09/2017	25/09/2017	25/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	6/10/2017	6/10/2017	6/10/2017	6/10/2017	6/10/2017
Sample mass tested	g	Approx. 15g	Approx. 15g	Approx. 25g	Approx. 25g	Approx. 50g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		176661-9	176661-10	176661-11	176661-13	176661-15
Your Reference	UNITS	BH11	BH12	BH13	BH18	BH19
Depth		0.0-0.2	0.0-0.2	0.5-0.95	0.0-0.2	0.0-0.2
Date Sampled		26/09/2017	26/09/2017	26/09/2017	26/09/2017	26/09/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	6/10/2017	6/10/2017	6/10/2017	6/10/2017	6/10/2017
Sample mass tested	g	Approx. 25g	Approx. 15g	Approx. 15g	Approx. 40g	Approx. 25g
Sample Description	-	Brown sandy soil	Brown sandy soil	Brown coarse-grained soil & rocks	Brown sandy soil	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibre detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.

Method ID	Methodology Summary
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			03/10/2017	1	03/10/2017	03/10/2017		03/10/2017	03/10/2017
TRH C_6 - C_9	mg/kg	25	Org-016	<25	1	<25	<25	0	115	90
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	1	<25	<25	0	115	90
Benzene	mg/kg	0.2	Org-016	<0.2	1	<0.2	<0.2	0	97	84
Toluene	mg/kg	0.5	Org-016	<0.5	1	<0.5	<0.5	0	107	90
Ethylbenzene	mg/kg	1	Org-016	<1	1	<1	<1	0	123	93
m+p-xylene	mg/kg	2	Org-016	<2	1	<2	<2	0	123	92
o-Xylene	mg/kg	1	Org-016	<1	1	<1	<1	0	121	94
naphthalene	mg/kg	1	Org-014	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	124	1	129	125	3	129	99

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	13	29/09/2017	29/09/2017		[NT]	[NT]
Date analysed	-			[NT]	13	03/10/2017	03/10/2017		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	13	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	13	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	13	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	13	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	13	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	13	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	13	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	13	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	13	105	128	20	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	30/09/2017
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	1	<50	<50	0	111	112
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	1	<100	<100	0	109	112
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	1	<100	<100	0	106	82
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	1	<50	<50	0	111	112
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	1	<100	<100	0	109	112
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	1	<100	<100	0	106	82
Surrogate o-Terphenyl	%		Org-003	83	1	82	83	1	95	82

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	13	29/09/2017	29/09/2017		[NT]	[NT]
Date analysed	-			[NT]	13	30/09/2017	30/09/2017		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	13	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	13	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	13	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	13	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	13	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	13	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	13	85	83	2	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			27/09/2017	1	27/09/2017	27/09/2017		27/09/2017	27/09/2017
Date analysed	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Naphthalene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	89	92
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	97	96
Phenanthrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	101	101
Anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	1	0.1	<0.1	0	96	97
Pyrene	mg/kg	0.1	Org-012	<0.1	1	0.1	<0.1	0	93	93
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	93	91
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	1	0.06	<0.05	18	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	108	1	106	103	3	112	111

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	13	27/09/2017	27/09/2017		[NT]	[NT]
Date analysed	-			[NT]	13	29/09/2017	29/09/2017		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	13	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	13	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	13	103	102	1	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
HCB	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	89	95
gamma-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	89	94
Heptachlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	87	91
delta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	83	87
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	84	88
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	89	93
Dieldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	96	101
Endrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	81	85
pp-DDD	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	86	90
Endosulfan II	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	89	92
Methoxychlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	78	1	80	78	3	73	78

QUALITY CONTROL: Organophosphorus Pesticides					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	83	88
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	84	89
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	82	88
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	95	93
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	105	99
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	94	96
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	93	99
Surrogate TCMX	%		Org-008	78	1	80	78	3	82	86

QUALITY CONTROL: PCBs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date extracted	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	100	104
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	78	1	80	78	3	82	86

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	176661-6
Date prepared	-			29/09/2017	1	29/09/2017	29/09/2017		29/09/2017	29/09/2017
Date analysed	-			03/10/2017	1	03/10/2017	03/10/2017		03/10/2017	03/10/2017
Arsenic	mg/kg	4	Metals-020	<4	1	6	6	0	114	100
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	104	100
Chromium	mg/kg	1	Metals-020	<1	1	9	8	12	111	98
Copper	mg/kg	1	Metals-020	<1	1	10	9	11	104	98
Lead	mg/kg	1	Metals-020	<1	1	34	31	9	105	96
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	95	98
Nickel	mg/kg	1	Metals-020	<1	1	3	3	0	107	100
Zinc	mg/kg	1	Metals-020	<1	1	79	66	18	124	87

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	13	29/09/2017	29/09/2017		[NT]	[NT]
Date analysed	-			[NT]	13	03/10/2017	03/10/2017		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	13	<4	<4	0	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	13	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	13	6	9	40	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	13	13	12	8	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	13	13	13	0	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	13	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	13	3	3	0	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	13	48	47	2	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Appendix E: Soil Suitability Analysis Report and Recommendations

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 45188 **Sample N°: 1** **Date Received: 3/10/17** **Report Status:** ○ Draft ◉ Final

Client Name:	**Environmental Investigation Services**	Project Name:	**Soil assessment for School Oval**
Client Contact:	**Rob Muller**		
Client Job N°:		SESL Quote N°:	**Q7388**
Client Order N°:		Sample Name:	**BH1 0.0-0.2**
Address:	**PO Box 976 NORTH RYDE BC NSW 1670**	Description:	**Soil**
		Test Type:	**FSC, OM_WB, BSP**

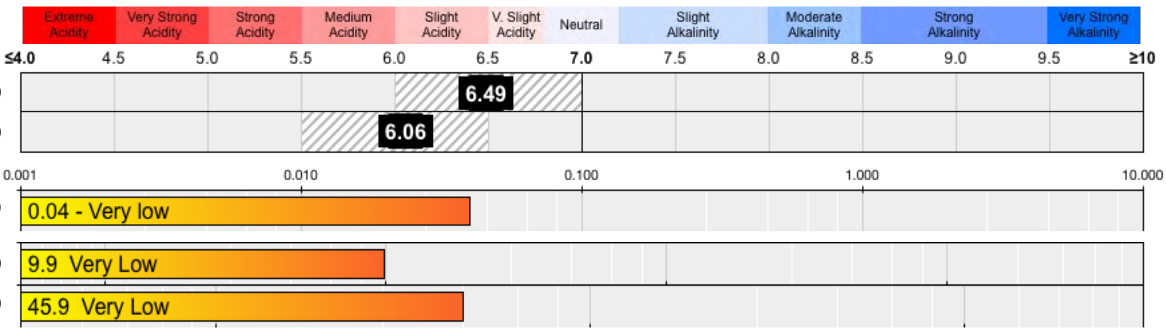
RECOMMENDATIONS

Sample 'BH1 0.0-0.2' was tested to determine its use in a school oval. The soil is slightly acidic in CaCl2 with desirably low salinity, sodium and chloride levels. The cation exchange is close to being balanced. The eCEC is low indicating poor nutrient retention. Nitrate, potassium and sulphate need boosting. Organic matter = 6.2% (very high).
The soil is a light sandy clay loam with a weak crumb structure and rapid permeability. The soil once compacted through pedestrian traffic especially during wet periods will start to waterlog and turf growth will fail. We suggest capping the soil with an imported media is used as passive amenity turf. However if this soil is to be used as a sportsfield further management is required.

Amendment Strategy
We recommend adding 30g/m2 of urea to boost nitrogen.
Add sulphate of potash at 40g/m2.
To help withstand compaction for passive amenity turf cap existing ameliorated soil with 100mm of an imported 80/20 media.
Alternatively use the soil from Sample 3 to cap this soil.

SOIL SAMPLE DEPTH (mm): ◉ 100 ○ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

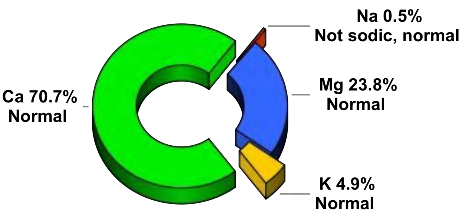
pH and ELECTRICAL CONDUCTIVITY

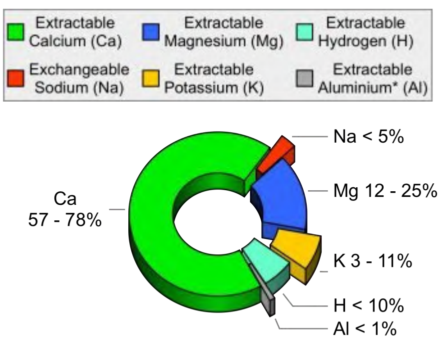


CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2 \leq 5.5$
Al only determined if pH in $CaCl_2$ is ≤ 5.2





CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	3	4.1 – 6.0
Comment: Calcium low		
Mg:K	4.9	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	0.05	< 0.07
Comment: Acceptable		
K:Na	10.5	N/A

Sodium Absorption Ratio: D.N.T.

EXCHANGEABLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:	H:	Al:
0.04	0.42	6.08	2.05		

SOLUBLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
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Batch N°: 45188 **Sample N°: 1** **Date Received: 3/10/17** **Report Status:** ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Legend: Very Low | Low | Marginal | Adequate | High

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	7	0.9	4	3.1
Phosphate-P (PO_4)	101	13.4	8.4	Drawdown
Potassium (K) †	165	21.9	29.3	7.4
Sulphate-S (SO_4)	3.5	0.5	9	8.5
Calcium (Ca) †	1220	162.3	208.3	46
Magnesium (Mg) †	249	33.1	21.7	Drawdown
Iron (Fe)	475	63.2	73.4	10.2
Manganese (Mn) †	11	1.5	5.9	4.4
Zinc (Zn) †	29	3.9	0.7	Drawdown
Copper (Cu)	3.5	0.5	0.8	0.3
Boron (B) †	<0.1	0	0.4	0.4

Explanation of graph ranges:

Very Low Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

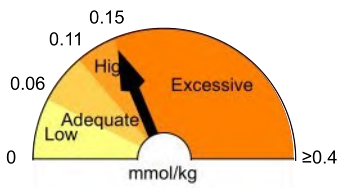
Marginal Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



0.15

Excessive. Exceeds environmental threshold. Implement improved P management to reduce potential for nonpoint P pollution.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (meq/100g^{-1}):	**8.6**
Eff. Cation Exch. Capacity (eCEC):	**8.6**
Base Saturation (%):	**100**
Exchangeable Acidity (meq/100g^{-1}):	-
Exchangeable Acidity (%):	-

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 100mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	**Light Sandy Clay Loam**
Colour:	-
Estimated clay content:	**25%**
Size:	**Fine (1 - 10mm)**
Gravel content:	**Gravelly**
Aggregate strength:	**Pedal - Weak**
Structural unit:	**Crumb**
Potential infiltration rate:	**Rapid**
Permeability (mm/hr):	**>120**
Calculated EC_{SE} (dS/m):	**0.4**

– Non-saline. Salinity effects on plants are mostly negligible.

Organic Carbon (OC%)†: **2.8 – Very high**
Organic Matter (OM%): **6.2**
Additional comments:

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

Date Report Generated 16/10/2017

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

SESL AUSTRALIA Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 45188 **Sample N°: 2** **Date Received: 3/10/17** **Report Status:** ○ Draft ⦿ Final

Client Name:	**Environmental Investigation Services**	Project Name:	**Soil assessment for School Oval**
Client Contact:	**Rob Muller**		
Client Job N°:		SESL Quote N°:	**Q7388**
Client Order N°:		Sample Name:	**BH4 0.5-0.95**
Address:	**PO Box 976 NORTH RYDE BC NSW 1670**	Description:	**Soil**
		Test Type:	**FSC, OM_WB, BSP**

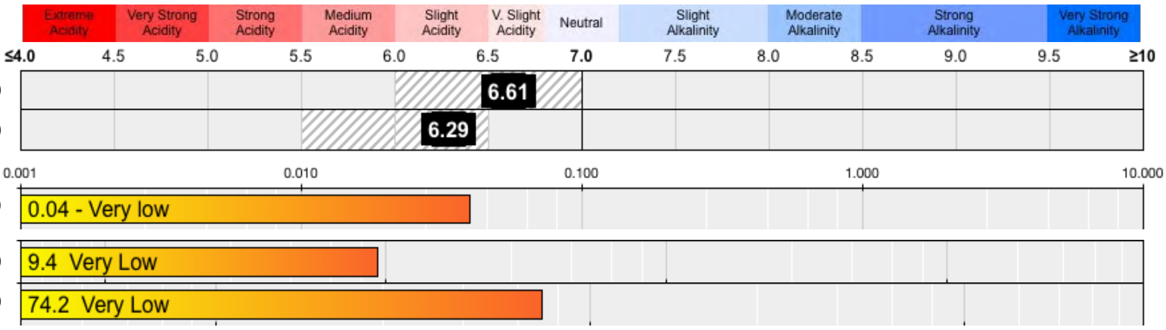
RECOMMENDATIONS

Sample 'BH4 0.5-0.95' was tested to determine its use in a school oval. The soil is slightly acidic in CaCl2 with desirably low salinity, sodium and chloride levels. The cation exchange is calcic. The eCEC is low indicating poor nutrient retention. All nutrients need boosting aside from phosphorus. Organic matter = 1.1% (very low).
The soil is a sandy clay loam with a moderate crumb structure and moderate permeability. The soil once compacted through pedestrian traffic especially during wet periods will start to waterlog and turf growth will fail. We suggest capping the soil with an imported media is used as passive amenity turf. However if this soil is to be used as a sportsfield further management is required.

Amendment Strategy
We recommend adding a multipurpose NPK+TE fertliser that has low P.
To help withstand compaction for passive amenity turf cap existing ameliorated soil with 100mm of an imported 80/20 media.
Alternatively use the soil from Sample 3 to cap this soil.

SOIL SAMPLE DEPTH (mm): ⦿ 100 ○ 150 ○ 200 **FERTILITY RATING:** ○ Low ⦿ Moderate ○ High

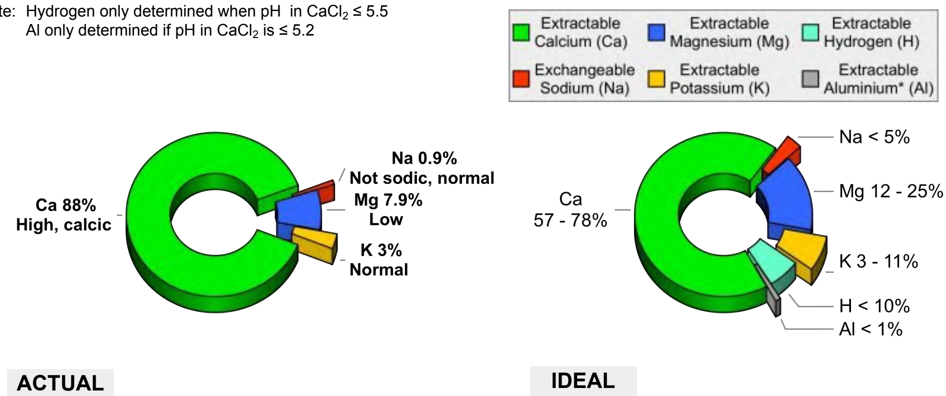
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	11.3	4.1 – 6.0
Comment: Potential magnesium deficiency		
Mg:K	2.6	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	0.03	< 0.07
Comment: Acceptable		
K:Na	3.5	N/A

Sodium Absorption Ratio: D.N.T.

EXCHANGEABLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:	H:	Al:
0.04	0.14	4.05	0.36		

SOLUBLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile
Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 45188 **Sample N°: 2** **Date Received: 3/10/17** **Report Status:** ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	1.7		0.2	4	3.8
Phosphate-P (PO_4)	109		14.5	8.4	Drawdown
Potassium (K) †	55		7.3	23.7	16.4
Sulphate-S (SO_4)	20		2.7	9	6.3
Calcium (Ca) †	811		107.9	168.5	60.6
Magnesium (Mg) †	44		5.9	17.8	11.9
Iron (Fe)	223		29.7	73.4	43.7
Manganese (Mn) †	3.1		0.4	5.9	5.5
Zinc (Zn) †	32		4.3	0.7	Drawdown
Copper (Cu)	1.6		0.2	0.8	0.6
Boron (B) †	<0.1		0	0.4	0.4

Explanation of graph ranges:

Very Low Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

Low Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

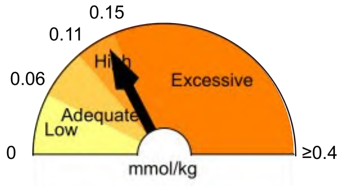
Marginal Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

Adequate Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

High The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and selected soil depth.

Phosphorus Saturation Index



0.14

High. Soil P will not limit plant growth. No P recommended this season.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): -
Sum of Base Cations (meq/100g^{-1}): **4.6**
Eff. Cation Exch. Capacity (eCEC): **4.6**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g^{-1}): -
Exchangeable Acidity (%): -

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**
– to neutralise Al (g/sqm): -

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **0**
The CGAR is corrected for a soil depth of 100mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Sandy Clay Loam**
Colour: -
Estimated clay content: **20 - 30%**
Size: **Fine (1 - 10mm)**
Gravel content: **Gravelly**
Aggregate strength: **Pedal - Moderate**
Structural unit: **Crumb**
Potential infiltration rate: **Moderate**
Permeability (mm/hr): **20 - 60**
Calculated EC_{SE} (dS/m): **0.4**
– Non-saline. Salinity effects on plants are mostly negligible.
Organic Carbon (OC%)†: **0.5 – Very low**
Organic Matter (OM%): **1.1**
Additional comments:

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

Date Report Generated 16/10/2017

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
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Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 45188 **Sample N°: 3** **Date Received: 3/10/17** **Report Status:** ○ Draft ◉ Final

Client Name:	**Environmental Investigation Services**	Project Name:	**Soil assessment for School Oval**
Client Contact:	**Rob Muller**		
Client Job N°:		SESL Quote N°:	**Q7388**
Client Order N°:		Sample Name:	**BH7 0.0-0.2**
Address:	**PO Box 976 NORTH RYDE BC NSW 1670**	Description:	**Soil**
		Test Type:	**FSC, OM_WB, BSP**

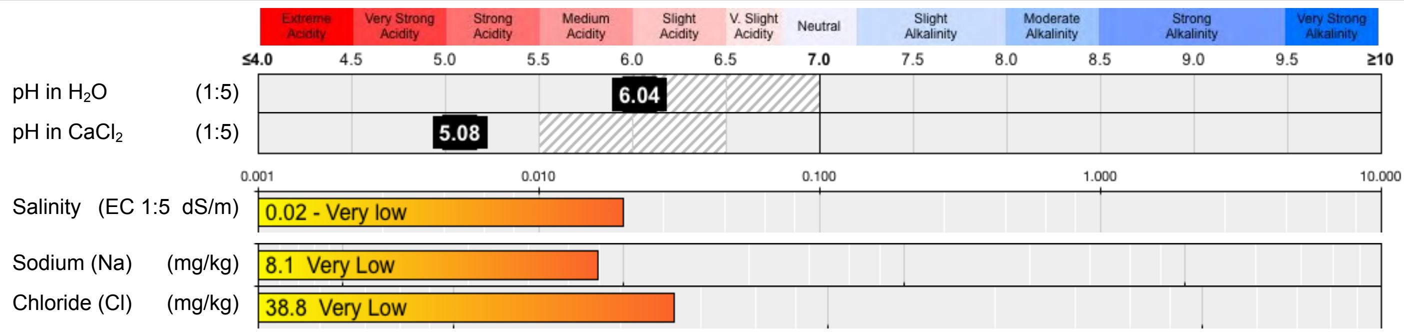
RECOMMENDATIONS

Sample 'BH7 0.0-0.2' was tested to determine its use in a school oval. The soil is strongly acidic in CaCl2 with desirably low salinity, sodium and chloride levels. The cation exchange is highly acidic. The eCEC is low indicating poor nutrient retention. All nutrients need boosting aside from phosphorus. Organic matter = 3.1% (moderate).
The soil is a sandy loam with a weak crumb structure and rapid permeability. This soil is the best choice out of the 3 samples for use in a school oval. This soil could be used as the capping layer for the other 2 soils.

Amendment Strategy
We recommend adding a multipurpose NPK+TE fertliser that has low P.
A small amount of lime at just 50g/m2 will reduce the exchangeable acidity.

SOIL SAMPLE DEPTH (mm): ◉ 100 ○ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

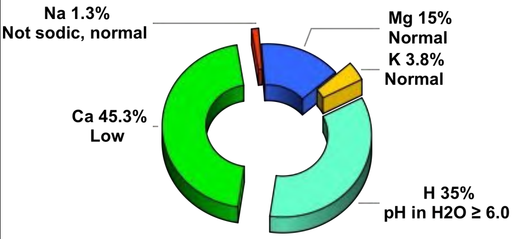
pH and ELECTRICAL CONDUCTIVITY



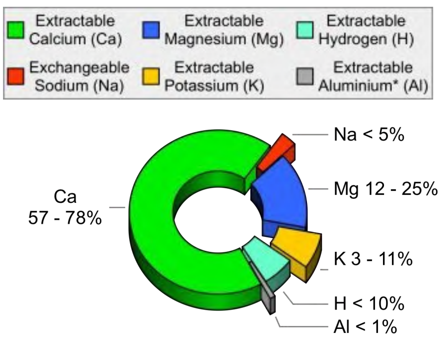
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL



IDEAL

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	3	4.1 – 6.0
Comment: Calcium low		
Mg:K	4	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	0.06	< 0.07
Comment: Acceptable		
K:Na	3	N/A

Sodium Absorption Ratio: D.N.T.

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)

EXCHANGEABLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:	H:	Al:
0.04	0.12	1.45	0.48	1.12	0.00

SOLUBLE CATIONS cmol(+)/kg

Na:	K:	Ca:	Mg:

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
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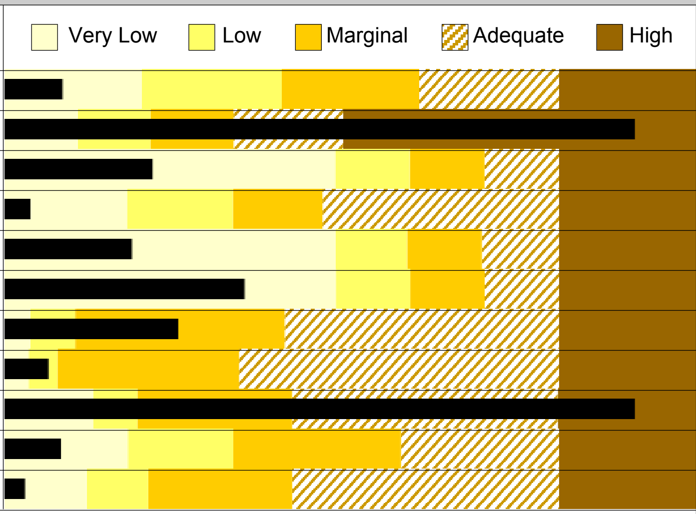
Web: www.sesl.com.au

Batch N°: 45188 | **Sample N°: 3** | **Date Received: 3/10/17** | **Report Status:** ○ Draft ⦿ Final

PLANT AVAILABLE NUTRIENTS

Major Nutrients	Result (mg/kg)	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	2.2	0.3	4	3.7
Phosphate-P (PO_4)	121	16.1	8.4	Drawdown
Potassium (K) †	47.5	6.3	23.7	17.4
Sulphate-S (SO_4)	<3.20	0.4	9	8.6
Calcium (Ca) †	291	38.7	168.5	129.8
Magnesium (Mg) †	58	7.7	17.8	10.1
Iron (Fe)	173	23	73.4	50.4
Manganese (Mn) †	3.5	0.5	5.9	5.4
Zinc (Zn) †	5.7	0.8	0.7	Drawdown
Copper (Cu)	<0.64	0.1	0.8	0.7
Boron (B) †	<0.1	0	0.4	0.4



Explanation of graph ranges:

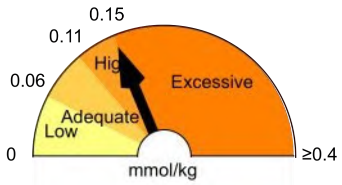
- **Very Low** – Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.
- **Low** – Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.
- **Marginal** – Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.
- **Adequate** – Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.
- **High** – The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and selected soil depth.

Phosphorus Saturation Index



0.15

Excessive. Exceeds environmental threshold. Implement improved P management to reduce potential for nonpoint P pollution.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.8**
Sum of Base Cations (meq/100g^{-1}):	**2.1**
Eff. Cation Exch. Capacity (eCEC):	**3.2**
Base Saturation (%):	**65.63**
Exchangeable Acidity (meq/100g^{-1}):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate

– to achieve pH 6.0 (g/sqm): **0**

– to neutralise Al (g/sqm): **0**

Gypsum Application Rate

– to achieve 67.5% exch. Ca (g/sqm): **81**

The CGAR is corrected for a soil depth of 100mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture:	**Sandy Loam**
Colour:	**-**
Estimated clay content:	**10 - 20%**
Size:	**Fine (1 - 10mm)**
Gravel content:	**Not gravelly**
Aggregate strength:	**Pedal - Weak**
Structural unit:	**Crumb**
Potential infiltration rate:	**Rapid**
Permeability (mm/hr):	**>120**
Calculated EC_{SE} (dS/m):	**0.3**

– Non-saline. Salinity effects on plants are mostly negligible.

Organic Carbon (OC%)†: **1.4 – Moderate**

Organic Matter (OM%): **3.1**

Additional comments:

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

Date Report Generated 16/10/2017

METHOD REFERENCES:
pH (1:5 H_2O) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO_4, K, SO_4, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Appendix F: UCL Calculations

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	23/10/2017 8:02:50 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4	Mean	4.786
Maximum	8	Median	4
SD	1.188	Std. Error of Mean	0.318
Coefficient of Variation	0.248	Skewness	1.762
Normal GOF Test			
Shapiro Wilk Test Statistic	0.719	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5.348	95% Adjusted-CLT UCL (Chen-1995)	5.468
		95% Modified-t UCL (Johnson-1978)	5.373
Gamma GOF Test			
A-D Test Statistic	1.559	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.734	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.336	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.228	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	20.92	k star (bias corrected MLE)	16.49
Theta hat (MLE)	0.229	Theta star (bias corrected MLE)	0.29
nu hat (MLE)	585.8	nu star (bias corrected)	461.6
MLE Mean (bias corrected)	4.786	MLE Sd (bias corrected)	1.179
		Approximate Chi Square Value (0.05)	412.8
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	406.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.352	95% Adjusted Gamma UCL (use when n<50)	5.432
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.333	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics				
Minimum of Logged Data	1.386		Mean of logged Data	1.542
Maximum of Logged Data	2.079		SD of logged Data	0.219
Assuming Lognormal Distribution				
95% H-UCL	5.347		90% Chebyshev (MVUE) UCL	5.618
95% Chebyshev (MVUE) UCL	6		97.5% Chebyshev (MVUE) UCL	6.529
99% Chebyshev (MVUE) UCL	7.569			
Nonparametric Distribution Free UCL Statistics				
Data do not follow a Discernible Distribution (0.05)				
Nonparametric Distribution Free UCLs				
95% CLT UCL	5.308		95% Jackknife UCL	5.348
95% Standard Bootstrap UCL	N/A		95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A		95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A			
90% Chebyshev(Mean, Sd) UCL	5.738		95% Chebyshev(Mean, Sd) UCL	6.17
97.5% Chebyshev(Mean, Sd) UCL	6.769		99% Chebyshev(Mean, Sd) UCL	7.946
Suggested UCL to Use				
95% Student's-t UCL	5.348		or 95% Modified-t UCL	5.373

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	23/10/2017 8:04:19 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	6	Mean	10.57
Maximum	19	Median	9
SD	4.237	Std. Error of Mean	1.133
Coefficient of Variation	0.401	Skewness	0.73

Normal GOF Test

Shapiro Wilk Test Statistic	0.866	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.58	95% Adjusted-CLT UCL (Chen-1995)	12.67
		95% Modified-t UCL (Johnson-1978)	12.61

Gamma GOF Test

A-D Test Statistic	0.796	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.736	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.205	k star (bias corrected MLE)	5.709
Theta hat (MLE)	1.467	Theta star (bias corrected MLE)	1.852
nu hat (MLE)	201.7	nu star (bias corrected)	159.8
MLE Mean (bias corrected)	10.57	MLE Sd (bias corrected)	4.425
		Approximate Chi Square Value (0.05)	131.6
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	128.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.84	95% Adjusted Gamma UCL (use when n<50)	13.18

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.24	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Row	Label	Value	Label	Value
58	**Lognormal Statistics**			
59	Minimum of Logged Data	1.792	Mean of logged Data	2.287
60	Maximum of Logged Data	2.944	SD of logged Data	0.386
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	13.1	90% Chebyshev (MVUE) UCL	13.88
64	95% Chebyshev (MVUE) UCL	15.38	97.5% Chebyshev (MVUE) UCL	17.47
65	99% Chebyshev (MVUE) UCL	21.58		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	Data appear to follow a Discernible Distribution at 5% Significance Level			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	12.43	95% Jackknife UCL	12.58
72	95% Standard Bootstrap UCL	12.36	95% Bootstrap-t UCL	12.88
73	95% Hall's Bootstrap UCL	12.47	95% Percentile Bootstrap UCL	12.29
74	95% BCA Bootstrap UCL	12.71		
75	90% Chebyshev(Mean, Sd) UCL	13.97	95% Chebyshev(Mean, Sd) UCL	15.51
76	97.5% Chebyshev(Mean, Sd) UCL	17.64	99% Chebyshev(Mean, Sd) UCL	21.84
77				
78	**Suggested UCL to Use**			
79	95% Student's-t UCL	12.58		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.			
84	For additional insight the user may want to consult a statistician.			
85				

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	23/10/2017 8:05:36 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	8	Mean	25.43
Maximum	73	Median	19.5
SD	18.88	Std. Error of Mean	5.047
Coefficient of Variation	0.743	Skewness	1.605

Normal GOF Test

Shapiro Wilk Test Statistic	0.817	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.223	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	34.37	95% Adjusted-CLT UCL (Chen-1995)	36.04
		95% Modified-t UCL (Johnson-1978)	34.73

Gamma GOF Test

A-D Test Statistic	0.41	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.14	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.231	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.497	k star (bias corrected MLE)	2.01
Theta hat (MLE)	10.18	Theta star (bias corrected MLE)	12.65
nu hat (MLE)	69.91	nu star (bias corrected)	56.27
MLE Mean (bias corrected)	25.43	MLE Sd (bias corrected)	17.94
		Approximate Chi Square Value (0.05)	40.03
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	38.21

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	35.75	95% Adjusted Gamma UCL (use when n<50)	37.44

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
58	Lognormal Statistics											
59					Minimum of Logged Data	2.079					Mean of logged Data	3.022
60					Maximum of Logged Data	4.29					SD of logged Data	0.658
61												
62	Assuming Lognormal Distribution											
63					95% H-UCL	38.74					90% Chebyshev (MVUE) UCL	38.87
64					95% Chebyshev (MVUE) UCL	45.12					97.5% Chebyshev (MVUE) UCL	53.81
65					99% Chebyshev (MVUE) UCL	70.87						
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data appear to follow a Discernible Distribution at 5% Significance Level											
69												
70	Nonparametric Distribution Free UCLs											
71					95% CLT UCL	33.73					95% Jackknife UCL	34.37
72					95% Standard Bootstrap UCL	33.5					95% Bootstrap-t UCL	40.16
73					95% Hall's Bootstrap UCL	66.06					95% Percentile Bootstrap UCL	34
74					95% BCA Bootstrap UCL	36.14						
75					90% Chebyshev(Mean, Sd) UCL	40.57					95% Chebyshev(Mean, Sd) UCL	47.43
76					97.5% Chebyshev(Mean, Sd) UCL	56.95					99% Chebyshev(Mean, Sd) UCL	75.64
77												
78	Suggested UCL to Use											
79					95% Student's-t UCL	34.37						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
84	For additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	23/10/2017 8:06:53 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nickel

General Statistics

Total Number of Observations	14	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1	Mean	2.786
Maximum	7	Median	2
SD	1.477	Std. Error of Mean	0.395
Coefficient of Variation	0.53	Skewness	1.932

Normal GOF Test

Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.485	95% Adjusted-CLT UCL (Chen-1995)	3.653
		95% Modified-t UCL (Johnson-1978)	3.519

Gamma GOF Test

A-D Test Statistic	0.957	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.277	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.901	k star (bias corrected MLE)	3.898
Theta hat (MLE)	0.568	Theta star (bias corrected MLE)	0.715
nu hat (MLE)	137.2	nu star (bias corrected)	109.2
MLE Mean (bias corrected)	2.786	MLE Sd (bias corrected)	1.411
		Approximate Chi Square Value (0.05)	86.04
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	83.32

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.534	95% Adjusted Gamma UCL (use when n<50)	3.649

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.259	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0	Mean of logged Data	0.919
Maximum of Logged Data	1.946	SD of logged Data	0.463

Assuming Lognormal Distribution

95% H-UCL	3.612	90% Chebyshev (MVUE) UCL	3.821
95% Chebyshev (MVUE) UCL	4.298	97.5% Chebyshev (MVUE) UCL	4.96
99% Chebyshev (MVUE) UCL	6.26		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.435	95% Jackknife UCL	3.485
95% Standard Bootstrap UCL	3.42	95% Bootstrap-t UCL	3.993
95% Hall's Bootstrap UCL	6.427	95% Percentile Bootstrap UCL	3.429
95% BCA Bootstrap UCL	3.571		
90% Chebyshev(Mean, Sd) UCL	3.97	95% Chebyshev(Mean, Sd) UCL	4.506
97.5% Chebyshev(Mean, Sd) UCL	5.251	99% Chebyshev(Mean, Sd) UCL	6.713

Suggested UCL to Use

95% Student's-t UCL	3.485	or 95% Modified-t UCL	3.519

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	23/10/2017 8:00:26 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Zinc

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	21	Mean	82
Maximum	220	Median	50
SD	64.51	Std. Error of Mean	17.24
Coefficient of Variation	0.787	Skewness	1.366

Normal GOF Test

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	112.5	95% Adjusted-CLT UCL (Chen-1995)	117.1
		95% Modified-t UCL (Johnson-1978)	113.6

Gamma GOF Test

A-D Test Statistic	0.751	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.233	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.231	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.194	k star (bias corrected MLE)	1.772
Theta hat (MLE)	37.37	Theta star (bias corrected MLE)	46.29
nu hat (MLE)	61.44	nu star (bias corrected)	49.61
MLE Mean (bias corrected)	82	MLE Sd (bias corrected)	61.61
		Approximate Chi Square Value (0.05)	34.44
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	32.76

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	118.1	95% Adjusted Gamma UCL (use when n<50)	124.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.931	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
58	Lognormal Statistics											
59					Minimum of Logged Data	3.045					Mean of logged Data	4.162
60					Maximum of Logged Data	5.394					SD of logged Data	0.703
61												
62	Assuming Lognormal Distribution											
63					95% H-UCL	129.7					90% Chebyshev (MVUE) UCL	128.1
64					95% Chebyshev (MVUE) UCL	149.7					97.5% Chebyshev (MVUE) UCL	179.7
65					99% Chebyshev (MVUE) UCL	238.6						
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data appear to follow a Discernible Distribution at 5% Significance Level											
69												
70	Nonparametric Distribution Free UCLs											
71					95% CLT UCL	110.4					95% Jackknife UCL	112.5
72					95% Standard Bootstrap UCL	109.1					95% Bootstrap-t UCL	131.8
73					95% Hall's Bootstrap UCL	113.5					95% Percentile Bootstrap UCL	110.2
74					95% BCA Bootstrap UCL	115.8						
75					90% Chebyshev(Mean, Sd) UCL	133.7					95% Chebyshev(Mean, Sd) UCL	157.1
76					97.5% Chebyshev(Mean, Sd) UCL	189.7					99% Chebyshev(Mean, Sd) UCL	253.5
77												
78	Suggested UCL to Use											
79					95% H-UCL	129.7						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
83	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
84	For additional insight the user may want to consult a statistician.											
85												
86	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.											
87	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.											
88	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.											
89	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.											
90												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	23/10/2017 8:09:03 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Total PAHs

General Statistics

Total Number of Observations	14	Number of Distinct Observations	5
Number of Detects	5	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.05
Maximum Detect	1.4	Maximum Non-Detect	0.05
Variance Detects	0.293	Percent Non-Detects	64.29%
Mean Detects	0.46	SD Detects	0.541
Median Detects	0.3	CV Detects	1.177
Skewness Detects	1.926	Kurtosis Detects	3.867
Mean of Logged Detects	-1.278	SD of Logged Detects	1.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.748	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.344	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.196	Standard Error of Mean	0.105
SD	0.35	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.381	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.368	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.51	95% KM Chebyshev UCL	0.652
97.5% KM Chebyshev UCL	0.849	99% KM Chebyshev UCL	1.236

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.416	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.69	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.364	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.135	k star (bias corrected MLE)	0.587
Theta hat (MLE)	0.405	Theta star (bias corrected MLE)	0.783
nu hat (MLE)	11.35	nu star (bias corrected)	5.874
MLE Mean (bias corrected)	0.46	MLE Sd (bias corrected)	0.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.315	nu hat (KM)	8.833
Approximate Chi Square Value (8.83, α)	3.226	Adjusted Chi Square Value (8.83, β)	2.793
95% Gamma Approximate KM-UCL (use when n>=50)	0.538	95% Gamma Adjusted KM-UCL (use when n<50)	0.621

Gamma ROS Statistics using Imputed Non-Detects

Row				
58	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
59	GROS may not be used when kstar of detected data is small such as < 0.1			
60	For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
61	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
62	Minimum	0.01	Mean	0.171
63	Maximum	1.4	Median	0.01
64	SD	0.374	CV	2.194
65	k hat (MLE)	0.399	k star (bias corrected MLE)	0.361
66	Theta hat (MLE)	0.428	Theta star (bias corrected MLE)	0.473
67	nu hat (MLE)	11.18	nu star (bias corrected)	10.12
68	MLE Mean (bias corrected)	0.171	MLE Sd (bias corrected)	0.284
69			Adjusted Level of Significance (β)	0.0312
70	Approximate Chi Square Value (10.12, α)	4.014	Adjusted Chi Square Value (10.12, β)	3.519
71	95% Gamma Approximate UCL (use when n>=50)	0.43	95% Gamma Adjusted UCL (use when n<50)	0.491
72				
73	**Lognormal GOF Test on Detected Observations Only**			
74	Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
75	5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
76	Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**	
77	5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level	
78	**Detected Data appear Lognormal at 5% Significance Level**			
79				
80	**Lognormal ROS Statistics Using Imputed Non-Detects**			
81	Mean in Original Scale	0.171	Mean in Log Scale	-3.876
82	SD in Original Scale	0.374	SD in Log Scale	2.409
83	95% t UCL (assumes normality of ROS data)	0.348	95% Percentile Bootstrap UCL	0.349
84	95% BCA Bootstrap UCL	0.426	95% Bootstrap t UCL	0.762
85	95% H-UCL (Log ROS)	14.97		
86				
87	**UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed**			
88	KM Mean (logged)	-2.382	95% H-UCL (KM -Log)	0.339
89	KM SD (logged)	1.012	95% Critical H Value (KM-Log)	2.811
90	KM Standard Error of Mean (logged)	0.302		
91				
92	**DL/2 Statistics**			
93	**DL/2 Normal**		**DL/2 Log-Transformed**	
94	Mean in Original Scale	0.18	Mean in Log Scale	-2.828
95	SD in Original Scale	0.37	SD in Log Scale	1.345
96	95% t UCL (Assumes normality)	0.356	95% H-Stat UCL	0.52
97	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
98				
99	**Nonparametric Distribution Free UCL Statistics**			
100	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**			
101				
102	**Suggested UCL to Use**			
103	95% KM (t) UCL	0.381	95% KM (Percentile Bootstrap) UCL	N/A
104	Warning: One or more Recommended UCL(s) not available!			
105				
106	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
107	Recommendations are based upon data size, data distribution, and skewness.			
108	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
109	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
110				

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	23/10/2017 8:11:06 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

BaP

General Statistics

Total Number of Observations	14	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	11
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.06	Minimum Non-Detect	0.05
Maximum Detect	0.1	Maximum Non-Detect	0.05
Variance Detects	5.3333E-4	Percent Non-Detects	78.57%
Mean Detects	0.0733	SD Detects	0.0231
Median Detects	0.06	CV Detects	0.315
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects	-2.643	SD of Logged Detects	0.295

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.055	Standard Error of Mean	0.00424
SD	0.013	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0625	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.062	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0677	95% KM Chebyshev UCL	0.0735
97.5% KM Chebyshev UCL	0.0815	99% KM Chebyshev UCL	0.0972

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	16.61	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00441	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	99.69	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	18.02	nu hat (KM)	504.6
		Adjusted Level of Significance (β)	0.0312
Approximate Chi Square Value (504.60, α)	453.5	Adjusted Chi Square Value (504.60, β)	447.1
95% Gamma Approximate KM-UCL (use when n>=50)	0.0612	95% Gamma Adjusted KM-UCL (use when n<50)	0.0621

	A	B	C	D	E	F	G	H	I	J	K	L
58	Lognormal GOF Test on Detected Observations Only											
59	Shapiro Wilk Test Statistic					0.75	Shapiro Wilk GOF Test					
60	5% Shapiro Wilk Critical Value					0.767	Detected Data Not Lognormal at 5% Significance Level					
61	Lilliefors Test Statistic					0.385	Lilliefors GOF Test					
62	5% Lilliefors Critical Value					0.512	Detected Data appear Lognormal at 5% Significance Level					
63	Detected Data appear Approximate Lognormal at 5% Significance Level											
64												
65	Lognormal ROS Statistics Using Imputed Non-Detects											
66	Mean in Original Scale					0.0315	Mean in Log Scale					-3.743
67	SD in Original Scale					0.0261	SD in Log Scale					0.785
68	95% t UCL (assumes normality of ROS data)					0.0438	95% Percentile Bootstrap UCL					0.0433
69	95% BCA Bootstrap UCL					0.0468	95% Bootstrap t UCL					0.0499
70	95% H-UCL (Log ROS)					0.055						
71												
72	UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed											
73	KM Mean (logged)					-2.92	95% H-UCL (KM -Log)					0.0601
74	KM SD (logged)					0.183	95% Critical H Value (KM-Log)					1.806
75	KM Standard Error of Mean (logged)					0.0598						
76												
77	DL/2 Statistics											
78	DL/2 Normal						DL/2 Log-Transformed					
79	Mean in Original Scale					0.0354	Mean in Log Scale					-3.465
80	SD in Original Scale					0.0225	SD in Log Scale					0.46
81	95% t UCL (Assumes normality)					0.046	95% H-Stat UCL					0.0449
82	DL/2 is not a recommended method, provided for comparisons and historical reasons											
83												
84	Nonparametric Distribution Free UCL Statistics											
85	Detected Data appear Approximate Normal Distributed at 5% Significance Level											
86												
87	Suggested UCL to Use											
88	95% KM (t) UCL					0.0625	95% KM (Percentile Bootstrap) UCL					N/A
89	Warning: One or more Recommended UCL(s) not available!											
90												
91	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
92	Recommendations are based upon data size, data distribution, and skewness.											
93	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
94	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
95												