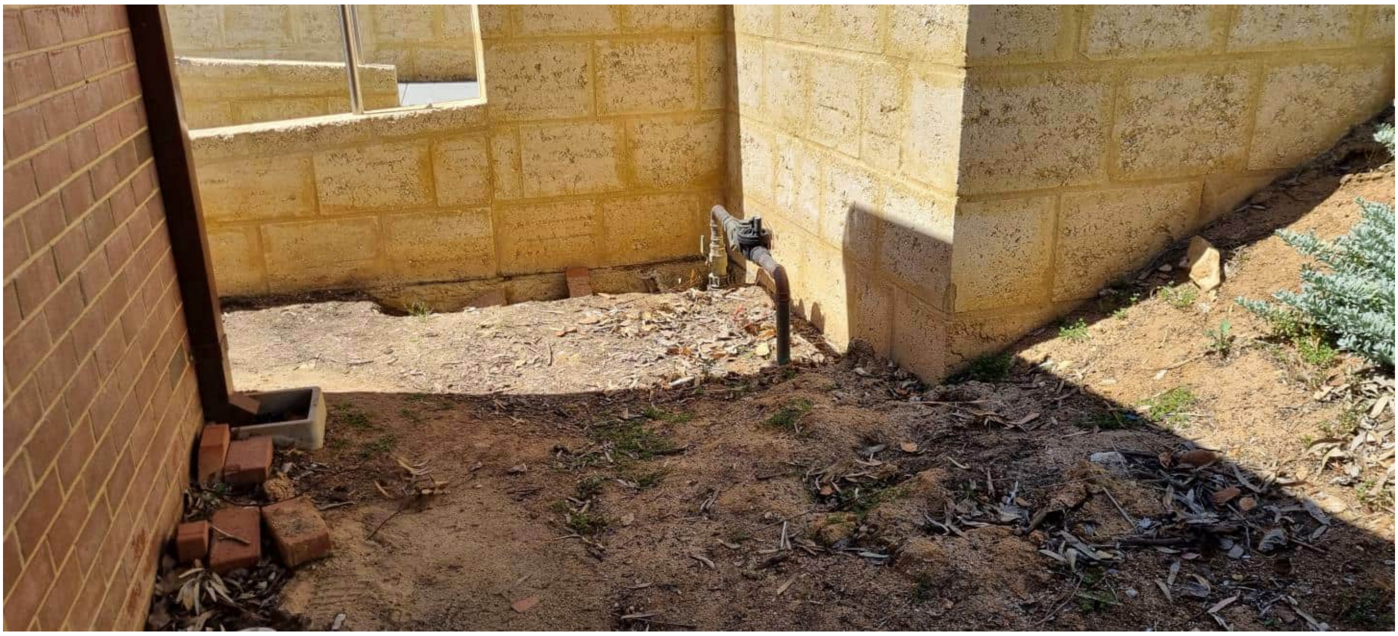
Photograph 7: Facing north-west from near borehole HA02; note half concrete pipe to left from adjacent church site.

Photograph 8: View of low point of area subject to inundation at south-east corner of building



Photograph 9: Downpipes discharging into concrete drain boxes: note leaves clogging drains

Appendix C: Borehole Reports

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS

Galt GEOTECHNICS

METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HE	Hand Excavation	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

SUPPORT

T	Timbering

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

WATER

►	Water Inflow	▼	Water Level
◄	Water Loss (complete)		
◁	Water Loss (partial)		

SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%) $= \frac{CRL}{TCL} \times 100$

RQD = Rock Quality Designation (%) $= \frac{ALC>100}{TCL} \times 100$

TCL	Length of Core Run
CRL	Length of Core Recovered
ALC>100	Total Length of Axial Lengths of Core Greater than 100 mm Long

METHOD OF SOIL DESCRIPTION
BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG & SOIL CLASSIFICATION SYMBOLS

Graphic	USCS	Soil Name	Graphic	USCS	Soil Name
▨		FILL (various types)	▨	SM	Silty SAND
▨		COBBLES / BOULDERS	▨	ML	SILT (low liquid limit)
▨	GP	GRAVEL (poorly graded)	▨	MH	SILT (high liquid limit)
▨	GW	GRAVEL (well graded)	▨	CL	CLAY (low plasticity)
▨	GC	Clayey GRAVEL	▨	CI	CLAY (medium plasticity)
▨	GM	Silty GRAVEL	▨	CH	CLAY (high plasticity)
▨	SP	SAND (poorly graded)	▨	OL	Organic SILT (low liquid limit)
▨	SW	SAND (well graded)	▨	OH	Organic SILT (high liquid limit)
▨	SC	Clayey SAND	▨	Pt	PEAT

NOTE: Dual classification given for soils with a fines content between 5% and 12%.

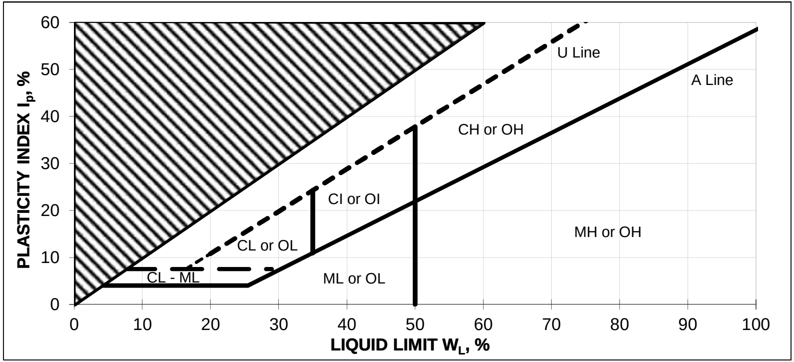
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-2017. Material properties are assessed in the field by visual/tactile methods in combination with field and laboratory testing techniques (where used).

NOTE: AS 1726-2017 defines a fine grained soil where the total dry mass of fine fractions (<0.075 mm particle size) exceeds 35%.

PARTICLE SIZE		
Soil Name		**Particle Size (mm)**
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	19 to 63
	Medium	6.7 to 19
	Fine	2.3 to 6.7
SAND	Coarse	0.6 to 2.36
	Medium	0.21 to 0.6
	Fine	0.075 to 0.21
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY - MODIFIED CASAGRANDE CHART - AS1726-2017



RESISTANCE TO EXCAVATION		
Symbol	**Term**	**Description**
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION	
Symbol	**Term**
D	Dry
M	Moist
W	Wet

CEMENTATION	
Cementation	**Description**
Weakly cemented	Soil may be easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate the soil by hand in air or water

CONSISTENCY		
Symbol	**Term**	**Undrained Shear Strength (kPa)**
VS	Very Soft	0 to 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very Stiff	100 to 200
H	Hard	>200

ORGANIC SOILS	
Material	**Organic Content % of dry mass**
Inorganic soil	<2%
Organic soil	2% to 25%
Peat	>25%

DENSITY		
Symbol	**Term**	**Density Index (%)**
VL	Very Loose	<15
L	Loose	15 to 35
MD	Medium Dense	35 to 65
D	Dense	65 to 85
VD	Very Dense	>85

BOREHOLE: BH01

Sheet 1 OF 1

Job Number:	WAG240472-01	**Contractor:**	GBI	**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Drill Rig:**	Melvelle	**Logged:**	MDS
Project:	Proposed Additions	**Inclination:**	-90°	**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V			0.0					SP-SC	FILL: SAND with fines, fine to coarse grained, sub-angular to sub-rounded, brown, trace to with low to medium plasticity fines		D	Paved Area
					B(BH01-1)			CL-CI	Sandy CLAY: low to medium plasticity, pale brown to brown		VSt H	
			0.5									
			1.0		B(BH01-2)			SC	Clayey SAND: fine to coarse grained, red/brown, 25-30% medium plasticity fines, 25% gravel			
			1.5									
			2.0					CI	Gravelly Sandy CLAY: medium plasticity, brown becoming reddish brown, with sand, with lateritic gravel			
			2.5									
		▼										
			3.0						Hole terminated at 2.80 m Target depth Groundwater encountered at 2.7 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH02

Sheet 1 OF 1

Job Number:	WAG240472-01	**Contractor:**	GBI	**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Drill Rig:**	Melvelle	**Logged:**	MDS
Project:	Proposed Additions	**Inclination:**	-90°	**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V			0.0					SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, yellow, trace fines		MD	Paved Area
								CH	Sandy GRAVEL: high plasticity, brown, 26% fine to coarse grained sand, 24% fine grained gravel		F	
			0.5								H	
			1.0		B(BH02-2)			CI-CH	Gravelly CLAY: medium to high plasticity, with lateritic gravel, trace sand			
			1.5									
			2.0						Hole terminated at 2.00 m Refusal on hard ground Groundwater not encountered			
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH03

Sheet 1 OF 1

Job Number:	WAG240472-01	**Contractor:**	GBI	**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Drill Rig:**	Melvelle	**Logged:**	MDS
Project:	Proposed Additions	**Inclination:**	-90°	**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V			0.0				▩	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown, trace fines, trace organics	D	VD	Grassed area
			0.5				▤	CI-CH	Sandy Gravelly CLAY: medium to high plasticity, brown becoming reddish brown, with lateritic gravel, with sand	M		
			1.0									
			1.5						Hole terminated at 1.50 m Refusal on hard ground Groundwater not encountered			
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH04

Sheet 1 OF 1

Job Number:	WAG240472-01	**Contractor:**	GBI	**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Drill Rig:**	Melvelle	**Logged:**	MDS
Project:	Proposed Additions	**Inclination:**	-90°	**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0				▩	SC	FILL: Clayey SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown, with medium plasticity fines, trace gravel, trace organics	D	D - VD	Grassed area
							▩	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, brown, trace fines, trace organics			
			0.5		B(BH04-1)			CI	Sandy CLAY: medium plasticity, red/brown, 45% fine to coarse grained sand, 11% gine grained gravel		F - St St - VSt	
	F		1.0					CI-CH	Gravelly CLAY: medium to high plasticity, reddish brown, with lateritic gravel, trace sand	M	H	
			1.5									
	H											
			2.0						Hole terminated at 2.00 m Refusal on hard ground Groundwater not encountered			
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

HAND AUGER BOREHOLE: HA01

Sheet 1 OF 1

Job Number:	WAG240472-01	**Operator:**		**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Inclination:**	-90°	**Logged:**	MDS
Project:	Proposed Additions			**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA			0.0 0.5				▩	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown becoming pale grey, becoming brown		MD D	
			1.0 1.5						Hole terminated at 0.90 m Refusal Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

HAND AUGER BOREHOLE: HA02

Sheet 1 OF 1

Job Number:	WAG240472-01	**Operator:**		**Date:**	25/10/2025
Client:	Santelli Chong Architects	**Inclination:**	-90°	**Logged:**	MDS
Project:	Proposed Additions			**Checked Date:**	13/11/2024
Location:	St Josephs School, 77 Wellington Street Northam			**Checked By:**	FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA			0.0				▩	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown becoming yellow, trace fines		MD	
			0.5				▩				D	
							▩				VD	
			1.0						Hole terminated at 0.90 m Refusal Groundwater not encountered			
			1.5									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

HAND AUGER BOREHOLE: HA03

Sheet 1 OF 1

Job Number: WAG240472-01
Client: Santelli Chong Architects
Project: Proposed Additions
Location: St Josephs School, 77 Wellington Street Northam

Operator:
Inclination: -90°

Date: 25/10/2025
Logged: MDS
Checked Date: 13/11/2024
Checked By: FAD

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA			0.0				▨	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown becoming brown	M	MD	
			0.5				▨	CI-CH	FILL: Sandy CLAY, medium to high plasticity, with sand, trace gravel		F	
							▨	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, brown, trace fines, trace gravel		L - MD	
			1.0								D	
							┅	CI-CH	Sandy CLAY: medium to high plasticity, reddish brown, with sand, trace gravel		VSt	
			1.5						Hole terminated at 1.40 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

GALT LIB 1.01.GLB Log GG_EXCAVATION WAG240472-01.GPJ <<DrawingFile>> 14/11/2024 10:03 10.02.00.04 Datgel DGD, CPT, Photo, Monitoring Tools | Lib: GALT 1.01 2013-02-21 Prj: GALT 1.01 2013-02-21

Appendix D: Laboratory Test Results

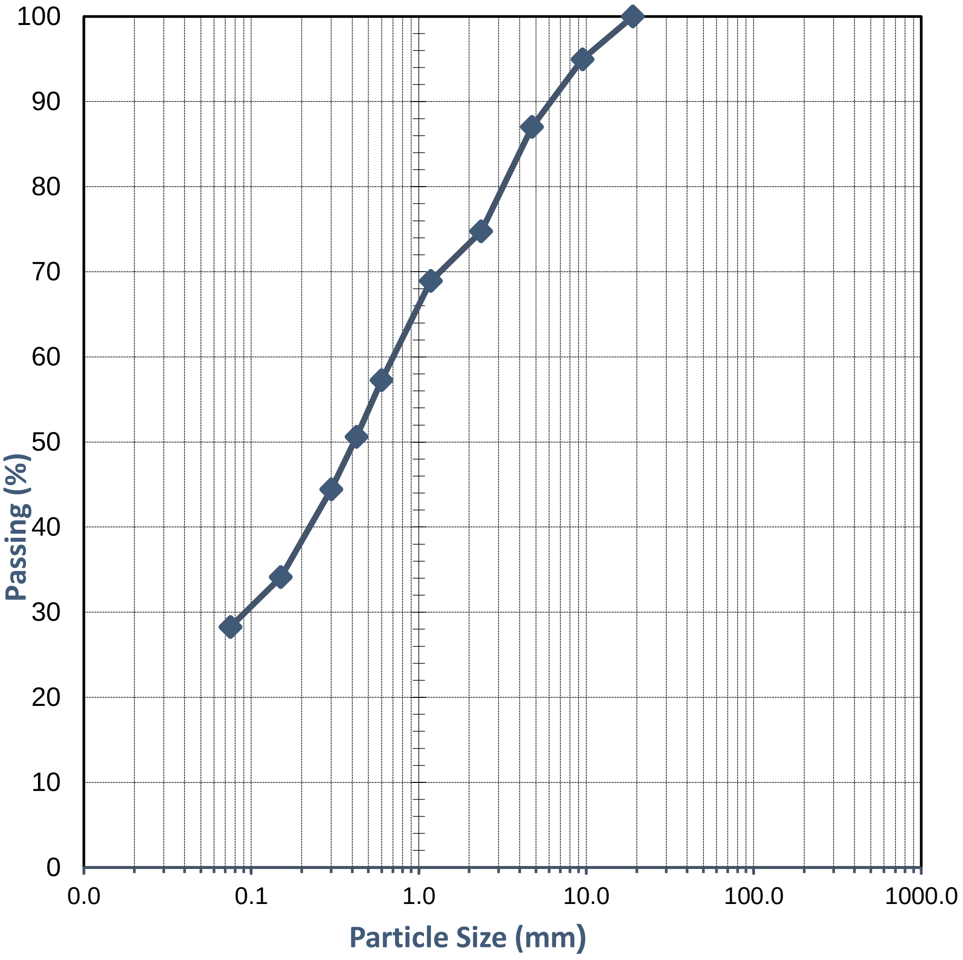
TEST REPORT - AS 1289.3.6.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17269_1_PSD
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17269
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH01 (1.1-1.8m)	*Date Tested:*	07/11 - 08/11/2024

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	95
4.75	87
2.36	75
1.18	69
0.600	57
0.425	51
0.300	44
0.150	34
0.075	28



Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 08/November/2024

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WESTERN GEOTECHNICAL
& Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17269_1_PI
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17269
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH01 (1.1-1.8m)	*Date Tested:*	8/11/2024

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50^{o}C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**43**
AS 1289.3.2.1	**Plastic Limit (%)**	**19**
AS 1289.3.3.1	**Plasticity Index (%)**	**24**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**9.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Curled**

Comments:

Approved Signatory:

Name: Linda Chiu

Date: 11/November/2024

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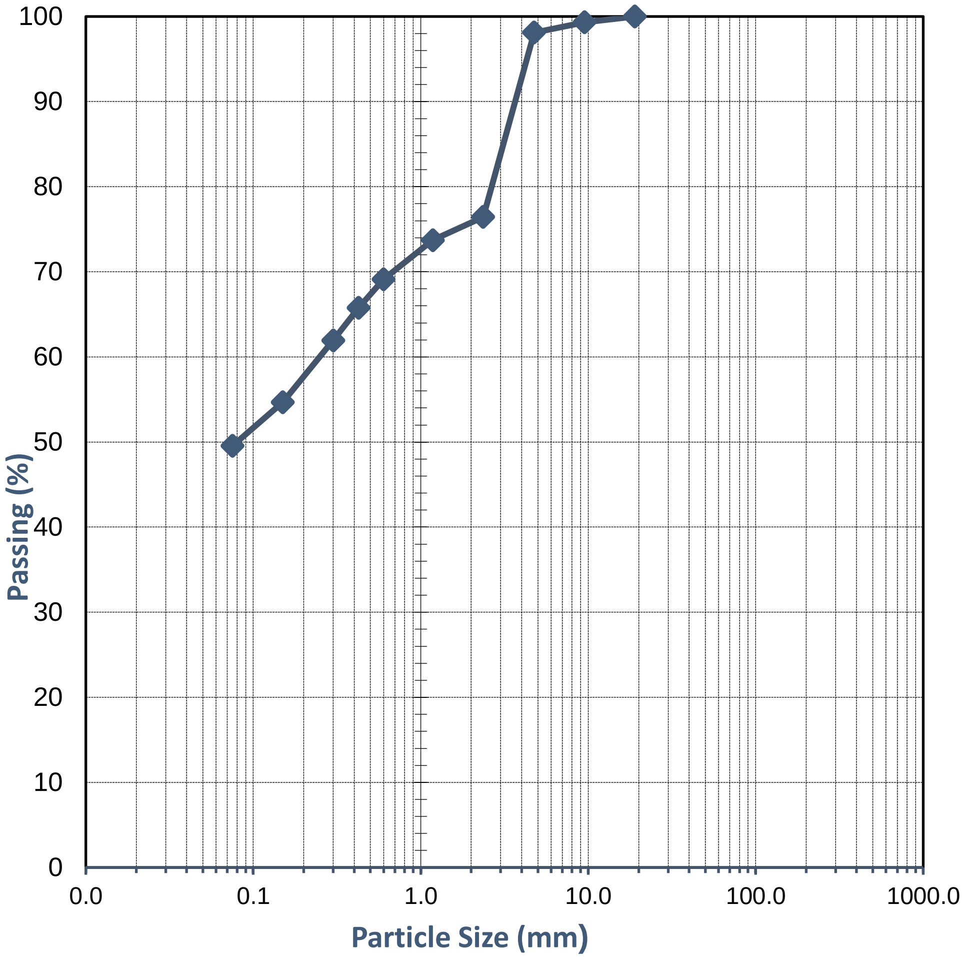
TEST REPORT - AS 1289.3.6.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17270_1_PSD
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17270
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH02 (0.2-0.9m)	*Date Tested:*	07/11 - 08/11/2024

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	99
4.75	98
2.36	76
1.18	74
0.600	69
0.425	66
0.300	62
0.150	55
0.075	50



Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 08/November/2024

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17270_1_PI
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17270
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH02 (0.2-0.9m)	*Date Tested:*	8/11/2024

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50ºC**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**60**
AS 1289.3.2.1	**Plastic Limit (%)**	**18**
AS 1289.3.3.1	**Plasticity Index (%)**	**42**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**10.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Curled**

Comments:

Approved Signatory:

Name: Linda Chiu

Date: 11/November/2024

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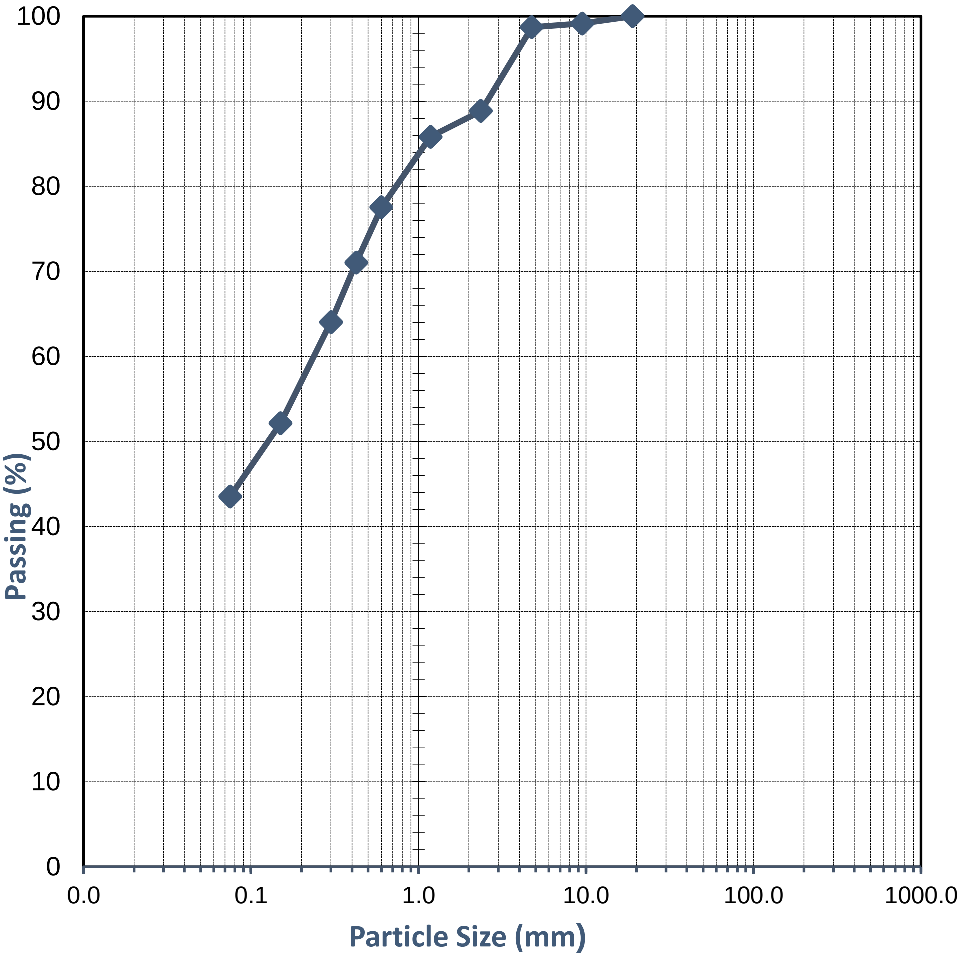
TEST REPORT - AS 1289.3.6.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17271_1_PSD
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17271
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH04 (0.5-1.0m)	*Date Tested:*	07/11 - 08/11/2024

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	99
4.75	99
2.36	89
1.18	86
0.600	78
0.425	71
0.300	64
0.150	52
0.075	44



Comments:

Approved Signatory:

Name: Natasha Bielawski
Date: 08/November/2024

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Santilli Chung Architects	*Ticket No.*	S15024
Client Address:	-	*Report No.*	WG24.17271_1_PI
Project:	Proposed Additions - St Josephs Secondary School	*Sample No.*	WG24.17271
Location:	77 Wellington Street, Northam	*Date Sampled:*	Not Specified
Sample Identification:	BH04 (0.5-1.0m)	*Date Tested:*	8/11/2024

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50^{o}C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**37**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**23**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**7.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Curled**

Comments:

Approved Signatory:

Name: Linda Chiu
Date: 11/November/2024

NATA
WORLD RECOGNISED ACCREDITATION

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Appendix E: CSIRO Pamphlet

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

PUBLISHING

BTF 18-2011
replaces
Information
Sheet 10/91

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

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

Soil Types

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

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

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

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

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

Erosion

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

Saturation

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

Seasonal swelling and shrinkage of soil

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

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

Shear failure

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

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth

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

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

Unevenness of Movement

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

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

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

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

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

Effects of Uneven Soil Movement on Structures

Erosion and saturation

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

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

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

Seasonal swelling/shrinkage in clay

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

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

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

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

Trees can cause shrinkage and damage

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

Movement caused by tree roots

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

Complications caused by the structure itself

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

Effects on full masonry structures

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

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

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

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

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

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

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

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

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

Water Service and Drainage

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

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

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

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

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

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

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

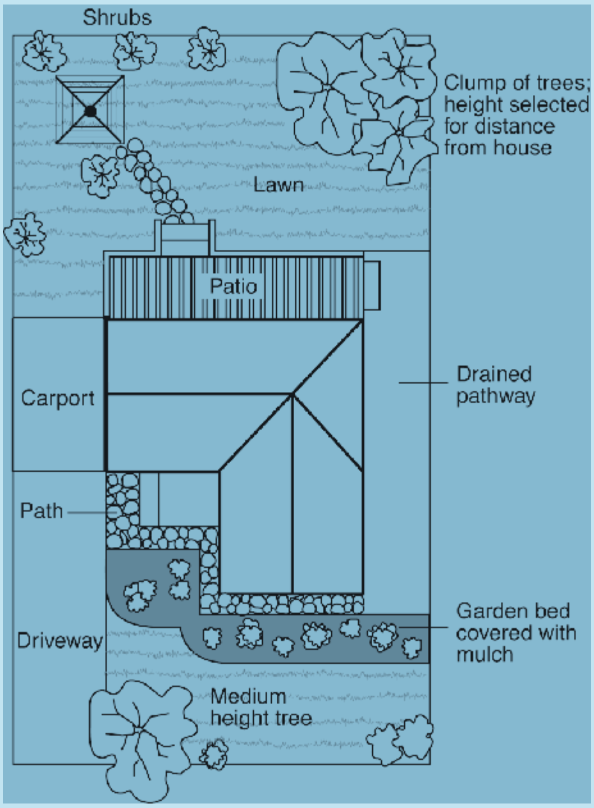
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

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

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

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

Gardens for a reactive site



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

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

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

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

Condensation

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

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

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

The garden

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

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

Existing trees

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

Information on trees, plants and shrubs

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

Excavation

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

Remediation

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

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

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

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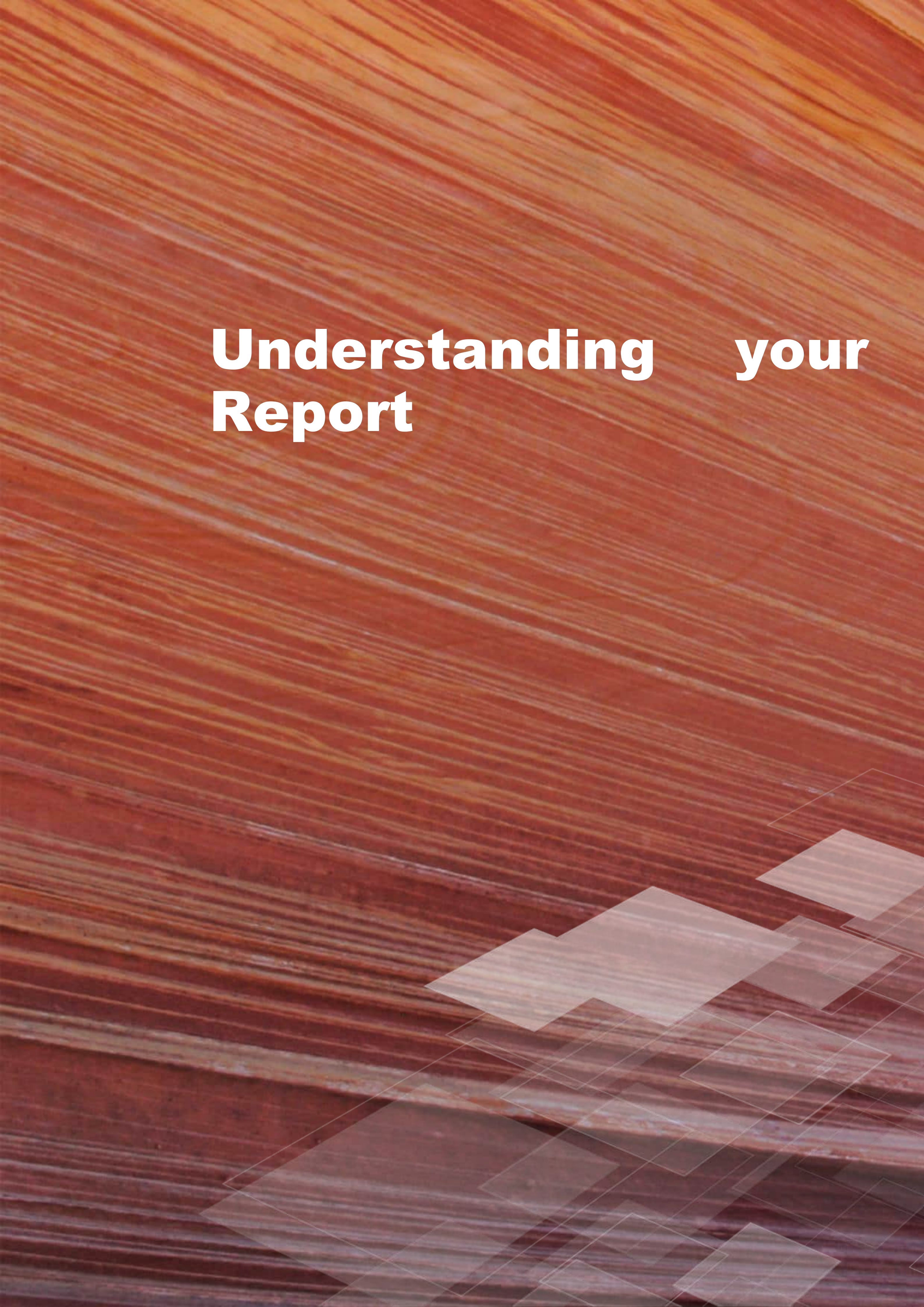


Understanding your Report

1. EXPECTATIONS OF THE REPORT

The following sections have been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. DATA PROVIDED BY THIRD PARTIES

Where data is provided by third parties, it will be identified as such in our reports. We necessarily rely on the completeness and accuracy of data provided by third parties in order to draw conclusions presented in our reports. We are not responsible for omissions, incomplete or inaccurate data associated with third party data, including where we have been requested to provide advice in relation to field investigation data provided by third parties.

4. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques prepared by Galt. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

5. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

6. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

7. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

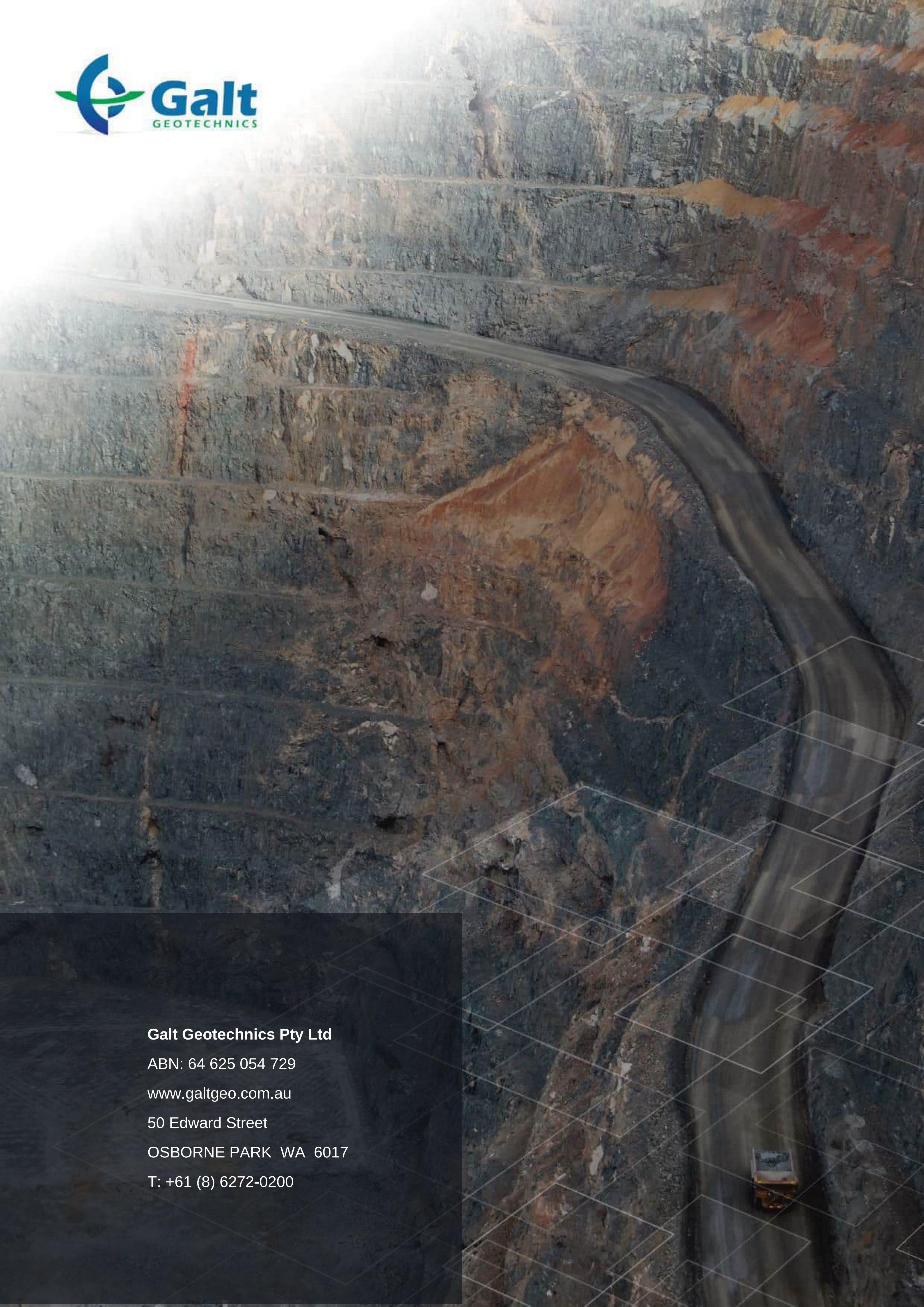
The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

8. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.



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St Joseph's School Northam

Appendix D

Traffic Impact Assessment

PJA Transport

transport ● engineering ● placemaking

Catholic Education Western Australia Limited

St Joseph's School, Northam

Transport Impact Statement

January 2025

Project Code: 08492

Version Control and Approval

Version	Date	Main Contributor	Issued by	Approved by
A – Draft	26 November 2024	Cameron Steel	Tanya Moran	Tanya Moran
B - Final	08 January 2025	Cameron Steel	Tanya Moran	Tanya Moran

Prepared for

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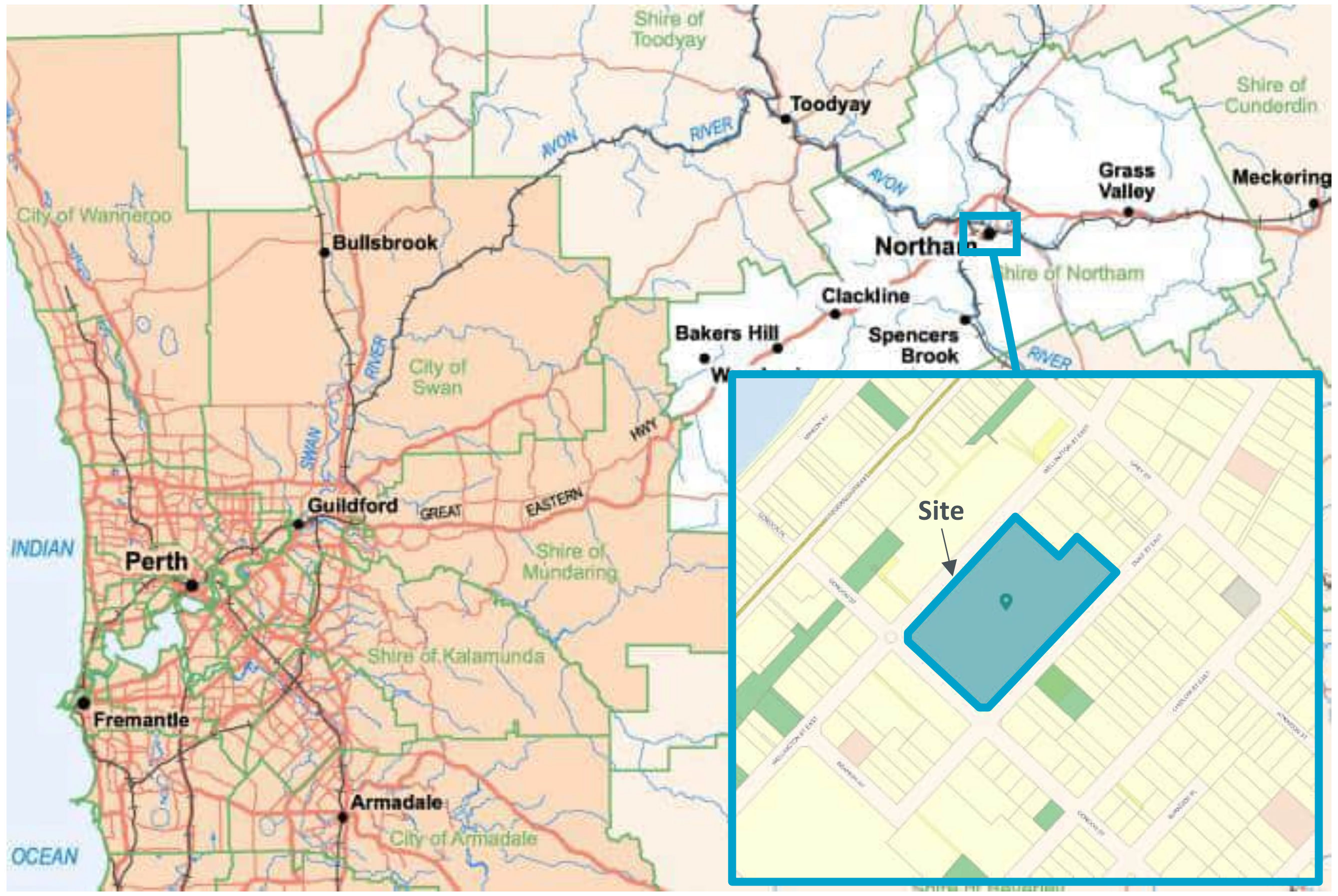
Appendices

1 Introduction

1.1 Project Background

PJA has been engaged by *Catholic Education Western Australia Limited* ("the Applicant") to undertake a transport assessment in relation to a development application (DA) for a proposed expansion of education streams at St Joseph's School ("the School"), located at 77 Wellington Street East, Northam, WA 6401 ("the Site"). The Site is located within the Northam townsite in the Wheatbelt Region, falling under the jurisdiction of the *Shire of Northam* Local Government Area (LGA), just under 100km east of the Perth CBD by road. The context of the Site location is shown in **Figure 1-1**.

Figure 1-1: Site Location



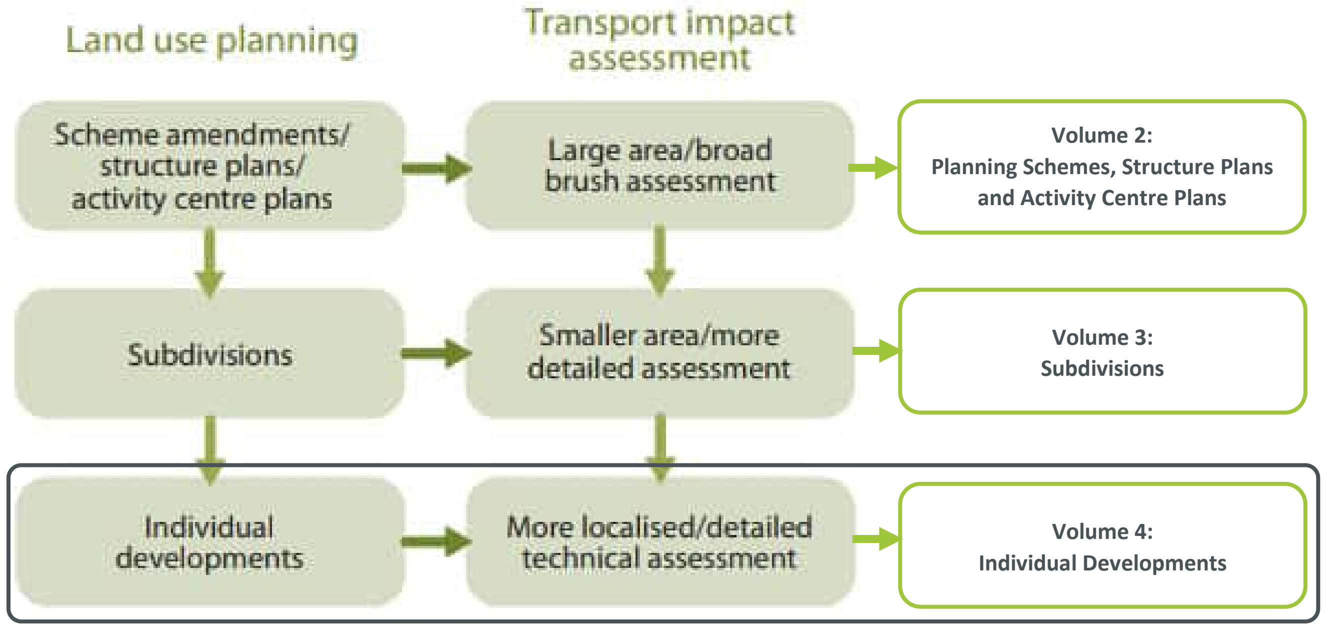
Base Image Sources: Shire of Northam

The Site is around 2.36ha and is bound by Wellington Street East on the northwest, developed lots on the northeast, Duke Street on the southeast and Gordon Street on the southwest.

1.2 Purpose of a Transport Impact Assessment

The planning system in Western Australia stipulates that all developments go through a process of stages to ensure that the statutory planning is consistent with the strategic planning. A more detailed assessment of the transport networks for developments is required within the land use planning stages. The *Western Australian Planning Commission* (WAPC) *Transport Impact Assessment Guidelines* indicate the level of detail required at each stage as shown in **Figure 1-2**.

Figure 1-2: WAPC Land Use / Transport Planning Process



Source: Western Australian Planning Commission (WAPC)

The proposed St Joseph's School expansion forms part of a Development Application (DA) and would fall under *Volume 4* of the WAPC Guidelines. This means that the level of detail required at this stage allows for a *more localised/detailed technical* assessment of the existing and proposed transport networks to be undertaken. The intent of this TIS is to "*demonstrate that the proposed development is consistent with the transportation aspects of the structure and subdivision planning for the area*" and in a more detailed level, demonstrate that the proposed development would satisfy the following:

- *Provide safe and efficient access for all modes.*
- *Be well integrated with the surrounding land uses.*
- *Not adversely impact on the surrounding land uses.*
- *Not adversely impact on the surrounding transport networks and the users of those networks.*

1.3 Extent of Assessment Required

The level of assessment required is dependent upon the number of vehicular trips the proposed development is considered to generate within the peak hour of the development. As detailed further in **Section 6**, the proposed development, or school expansion, is considered to generate less than 100 vehicle trips within the peak hour. Hence, the development requires a level of assessment associated with a Transport Impact Statement (TIS). However, as this application is for a Joint Development Assessment Panel (JDAP), PJA has prepared a hybrid of a Transport Impact Statement (moderate impact) and a Transport Impact Assessment (high impact) aligned similarly to *Volume 4 Part B and Part C* of the WAPC TIA Guidelines. The area to be covered by this TIS is to include, as a minimum:

- *The proposed development site.*
- *All roads fronting the site, for the extent of the site frontage plus 100 metres beyond the site.*
- *Pedestrian routes to the nearest bus stops (for all bus routes passing within 400 metres of the site).*
- *Pedestrian routes to nearest train station(s) (if within 800 metres).*
- *Pedestrian/cycle routes to any major attractors within 400 metres, (five-minutes walk) of the site, for example, for a small residential development attractors could be a corner shop, the primary school and the nearby park.*
- *The area(s) likely to be affected by the site specific issue(s).*

The extent of the transport network analysis based on a 5-minute cycle is shown in **Figure 1-3**.

Figure 1-3: Extent of the 5-minute Cycle Catchment from the Site

Base Image Source: Targomo

This TIS has followed the format of the WAPC TIS checklist provided in **Appendix A** and outlines the following Sections:

- **Section 2**: Existing Situation
- **Section 3**: Development Application Proposal
- **Section 4**: Changes to External Transport Network
- **Section 5**: Integration with Surrounding Area
- **Section 6**: Analysis of Transport Network
- **Section 7**: Safe Routes to School
- **Section 8**: Management Plans
- **Section 9**: Conclusions and Recommendations.

1.4 Planning Context

The Site is zoned for “Public Purposes” and “Mixed-Use” under the *Shire of Northam Local Planning Scheme No. 6* (LPS6).

The *St Joseph’s Catholic Church, Hall & Presbytery (Convent and School)* portions of the Site is a *Heritage Listed Place No. 01897*.

There is no structure planning for the Site and there have not been any prior transport assessments.

The *Shire of Northam* have indicated that the TIS should specifically address the following matters (adapted):

- *Indicate how the parking would be managed in the event there should be a function held in the church, such as funeral.*
- *Identify if there are any adverse impacts of on-street parking on the surrounding streets, particularly Duke Street, and if so, a potential solution forward*.

2 Existing Situation

2.1 Land Uses

The existing land uses on the Site include St Joseph's Church (Catholic Parish), P.B Kirby Parish Centre, a caretaker's residence and St Joseph's School (Secondary Campus). Surrounding the Site, there is a range of commercial, mixed-use and residential land uses as shown in **Figure 2-1**.

Figure 2-1: Existing Land Uses within and surrounding the Site

Base Image Source: Nearmap (September 2024)

The mixed-use lots adjacent to the northeast boundary of the Site include the offices of *Wheatbelt Aboriginal Health Service, Juniper Community Home Care, Moorditj Koort Aboriginal Corportation, Essential Personnel Lifestyle Services, Grey Street Surgery, Acumentis, ConsultAg, Mortlock Ryan & Co Barristers and Solicitors, Amity and Wheatbelt Medical Specialists*.

St Joseph's Church holds a morning mass each morning at 8am, in which around 5-8 people attend[1]. Additionally, the venue also holds weddings and funerals on occasions, sporadically throughout the year.

St Joseph's School provides private Catholic education for students from Year 7 to Year 12 (Y7-12). It is currently a two-stream school offering pathways in ATAR, General and vocational education and training (VET). Students in Year 11-12 are permitted to drive to/from school with relevant permission granted by the school. The layout of the Secondary Campus is shown in **Figure 2-2**, with the Administration building fronting Duke Street.

Figure 2-2: Existing St Joseph's School (Secondary Campus) Site Layout Plan

Source: Santelli Chong Architects (Revision A – 22 October 2024)

The 2024 student intake includes 318 students and 37 full-time equivalent (FTE) staff.

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[1] Advised by the School to Santelli Chong Architects, email dated 18 September 2024.

The School operates Monday to Friday from 8.45am to 3.10pm with an early finish on Thursday at 2.30pm (consistent with all other schools in Northam).

The key existing trip attracting land uses surrounding the broader Site are shown in **Figure 2-3**.

Figure 2-3: Key Land Uses Surrounding the Site

Base Image Source: Nearmap

The St Joseph's School (Primary Campus) for students from Pre-Kindergarten to Year 6 (PK-Y6) is located at 1 Lance Street, around 1km southeast of the Site.

There are two major shopping centres nearby with *Northam Boulevard Shopping Centre* opposite the Site on Wellington Street East and *Northam Village Square Shopping Centre* around 300m southwest of the Site on Duke Street or 500m via Wellington Street.

The *Northam Library* on Fitzgerald Street is around 450m northwest of the Site via Gordon Street.

There are food and beverage (F&B) options available on Fitzgerald Street and Peel Terrace which are around 500m to 1km north of the Site.

The *Northam Recreation Centre* is around 1-1.5km northeast of the Site

The School noted that four (4) students currently board at the *Northam Residential College*, around 1.5-2km northwest of the Site, and all travel to school in a single vehicle.

2.2 Parking Provision and Demand

The *Northam LPS6* does not specify a parking rate for an educational facility. Additionally, Department of Education and Department of Finance does not assess school parking requirements for private secondary schools in the same way as public secondary schools. As such, to establish a base case, reference is made to the recently published *WA Planning Manual Non-Residential Car Parking Rates in Perth and Peel, November 2024*.

Appendix A of this WAPC document provides guidance to minimum and maximum parking rates for 'Educational Establishment' in Local and Neighbourhood Centres, Urban Corridors and Mixed Use Precincts. The guide recommends parking rates of:

- 10 spaces per 100 students (minimum).
- 25 spaces per 100 students (maximum).

These rates result in the following minimum and maximum parking requirements, as a base case.

Table 2-1: St Joseph's School (Secondary Campus) population and parking

Year	Projected Total Student Number	Projected Total Staff Number (Full time equivalent)	Minimum Parking	Maximum Parking
2019	282	24	28	71
2025	330	34	33	83
2026	375	36	38	94
2027	408	37	41	102
2028	438	38	44	110
2029	468	39	47	117
2030	515	39	52	129

Based on this guide, at the St Joseph's School expected maximum student and staff intake in 2030, a minimum of 52 and a maximum of 129 car parking bays are recommended.

To determine compliance, a summary of the existing carparking bay provisions on the Site and on the frontage roads are assessed, shown in **Figure 2-4** and provided in **Table 2-2**.

Figure 2-4: Existing Carparking Supply Locality Plan

Table 2-2: Existing Carparking Supply

Location	Form	Total Supply	Accessible ACROD Bays
Site Carpark	Off-street 90-degree angled bays	93	3
Wellington Street East	On-street parallel bays	43	0
Gordon Street	On-street parallel bays	30	0
Surrounding Carparks	Off-street 90-degree angled bays	~ 368	1
	Total	**~ 534**	**4**

As assessed, the Site Carpark of 93 spaces alone falls within the 52 to 129 parking bays recommended by WAPC for education establishments, demonstrating compliance.

It is also noted that there is a 12.5m long bus zone (around 1 bus) on Gordon Street (west of Wellington Street), a 50m long bus zone (around 4-5 buses) on Wellington Street East for bus parking and a 60m long flush pavement pullover area on Duke Street East which is currently used for the regional town *PTA School Bus Services*, discussed further in **Section 2.9**. Therefore, there is potential for additional local school bus service(s) to utilise the bus zone parking on Wellington Street East and Gordon Street to accommodate a minimum of 5 coach-size PTA school buses (50 seats per bus) or 8 small PTA school buses (15-25 seats per bus). This equates to a maximum of 250 students in total, based on the minimum number of buses accommodated without parking turnover at 100% seating capacity (as per *PTA School Bus Services* Specifications) and 100% of St Joseph's School students onboard.

Carparking restrictions are noted at the following locations only:

- 1P (Monday-Friday: 7am-5.30pm and Saturday: 7am-1pm)
  - Gordon Street (northwest of Wellington Street).

PJA engaged *Matrix Traffic and Transport Data* to collate traffic data and provide video footage (with permission from the school) of the roads fronting the school from 7.30am to 9.30am and 2.30pm to 4.30pm on Tuesday 29 October 2024. The location of the cameras and viewpoints are provided in **Appendix C**. **Table 2-3** and **Table 2-4** summarise the observations in relation to on-street parking and pick-up/drop-offs around the Site.

Table 2-3: AM school drop-off period

Location	Cars Arrivals	Cars Arrival Times	School Bus Arrivals	School Bus Arrival Times	Other parking activity observed
Duke Street	8	8.17am and 8.52am	17	8.17am and 8.39am	Car arrivals had very low dwell time. A further two (2) passenger cars temporarily (up to 7-minutes) stopped on-street at a residential property with one dropping off a younger child.
Gordon Street	0	-	0	-	Zero vehicles parked throughout the whole peak hour period between Wellington Street and Chidlow Street. Within the 100m section from the Site boundary, the maximum occupancy at any given time was observed to be 6 cars parked with the highest turnover for any 5-minute period being 4 cars.
Wellington Street East	0	-	0	-	Primarily vehicles parked for access to the shopping centre. Three (3) vehicles dropped a student off on the school side and one (1) dropped off a student on the shopping centre side

Table 2-4: PM school pick-up period

Location	Cars Arrivals	Cars Arrival / Departure Times	School Bus Arrivals	School Bus Arrival/ Departure Times	Other parking activity observed
Duke Street	3	2.53pm and 3.12pm ** departing 3.09pm to 3.14pm	17	3.12pm ** departing 3.15pm to 3.22pm	-
Gordon Street	0	-	0	-	Zero vehicles parked throughout the whole peak hour period between Wellington Street and Chidlow Street. Within the 100m section from the Site boundary, the maximum occupancy at any given time was observed to be 8 cars parked with the highest turnover for any 5-minute period being 4 cars.
Wellington Street East	0	-	0	-	Primarily vehicles parked for access to the shopping centre. A proportion of students also cross Wellington Street East and access the shopping centre. Three (3) vehicles picked up students from the shopping centre side and two (2) vehicles picked up students from the school side.

It is also noted that the informal carpark across Wellington Street and Gordon Street intersection (diagonally across from the school) was **underutilised**, with the maximum occupancy at any given time during the peak periods showing only 6 cars parked. Additionally, the rear carpark of the Northam Town Hall opposite Gordon Street was **also underutilised**, with the maximum occupancy at any given time during the peak periods showing 1 car parked.

A parking demand survey of the Site carpark was also estimated based upon a review of *Nearmap* aerial imagery and showed the following occupancy rates at the available dates.

- Monday 16 September 2024: 54 cars parked.
- Friday 1 December 2023: 23 cars parked.
- Monday 12 December 2022: 2 cars parked.

Noting that the *Nearmap* imagery time of day is unknown, the aerial is from school days and appears during day times where parking occupancy is around 58% of the total supply. At this time there is one (1) vehicle parked on Duke Street East, 18 cars parked on Wellington Street East and four (4) vehicles parked on Gordon Street. Nine (9) cars are parked in the informal carpark on the corner of Gordon Street and Wellington Street, 90 cars are parked at the shopping centre carpark and two (2) cars are parked at the Town Hall carpark. Therefore, of the approximate total supply, the peak parking occupancy is observed to be around 33%.

In summary, these are very low private car trips when compared to most private schools in Western Australia.

The parking demand survey indicates that the Site carpark would generally operate at around 58% of the supply during the day. Accordingly, even if assuming the school carpark was fully occupied by school staff and church attendees, the assessment herein for the ultimate development shows there is sufficient supply on surrounding streets and carparks to accommodate any shortfall. The Northam Town Hall rear carpark appears to be primarily empty from the survey, in addition to the on-street parking being underutilised, which would facilitate additional long-term parking, or as a short-term pick-up and drop-off area.

2.3 Access Arrangements

The existing access arrangements at the Site are shown in **Figure 2-5** at the following locations.

- Wellington Street East
  - Carpark entry only from both directions.
  - Carpark exit only marked as a left-turn only.
  - Two pedestrian access gates.
- Duke Street East
  - Carpark combined entry and exit.
  - Two pedestrian accesses via Administration building.
  - Service access to sheds.

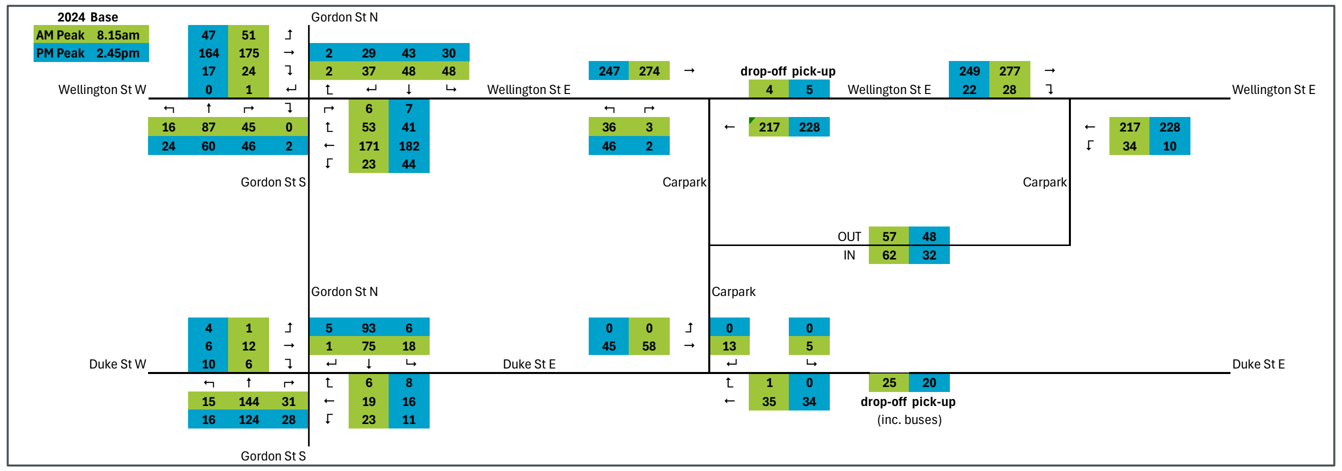
Figure 2-5: Existing Site Access Arrangements

Base Image Source: Nearmap (September 2024)

2.4 Traffic Generation

A review of the video survey footage indicated that in the AM and PM peak, the Site generates 178vph (92vph in and 86vph out) and 130vph (57vph in and 73vph out), respectively. This is inclusive of passenger cars entering and exiting the carpark and passenger cars/school bus services dropping off or picking up students (counted as 2vph i.e. 1vph in and 1vph out). A summary of the traffic volumes recorded on the road network during the peak hour survey periods are shown in **Figure 2-6**.

Figure 2-6: Link Volume Plot Diagram of Peak Hour Traffic Volumes on Surrounding Road Network



Information was provided by the School that all staff travel to school by car (as the driver) with the exception of five (5) teachers that car-share in one vehicle. However, it is noted that not all staff trips would have been captured within the peak hour time periods due to their potential earlier or later start/finish. Therefore, the traffic generation rates based upon the current student enrolment (318 students) are provided in **Table 2-5**.

Table 2-5: Existing Traffic Generation Rates per Student Enrolled

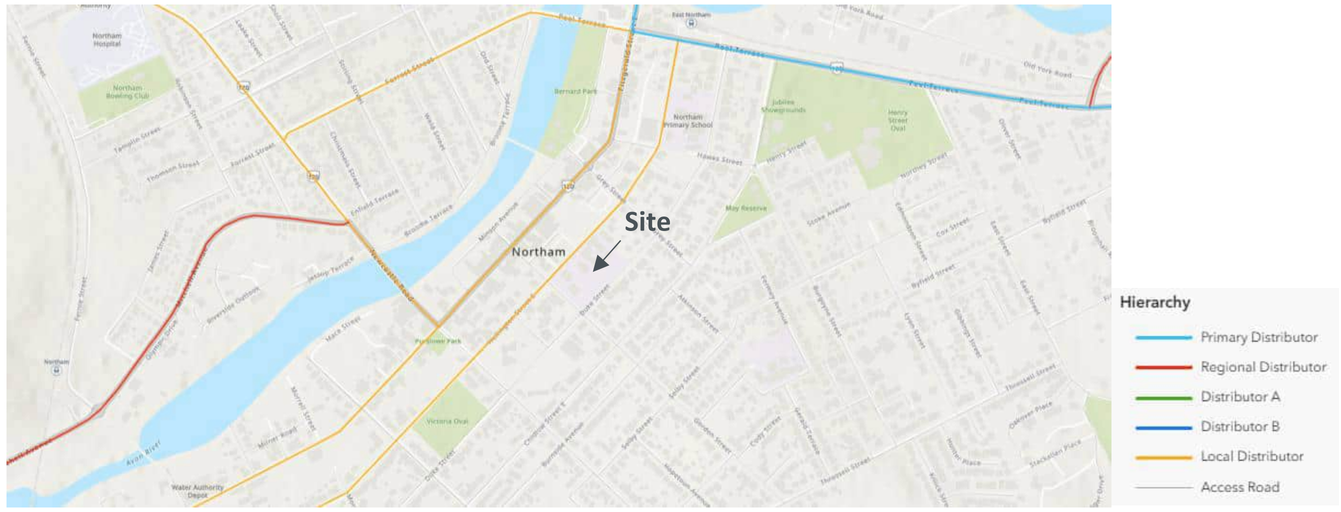
Peak	Inbound (% Split)	Outbound (% Split)	Total
AM (8.15am – 9.15am)	0.29 (52%)	0.27 (48%)	0.56
PM (2.45pm – 3.45pm)	0.18 (44%)	0.23 (56%)	0.41

These rates are considered to represent the typical traffic volume generation of the School on a regular school day. It is noted that these rates are lower (about half) than the trip rates for a school provided in the WAPC TIA Guidelines (1.0vph/student at 50% in, 50% out) which are based on the 4-year (2002-2006) *Perth and Regions Travel Survey* (PARTS) of 10,947 households in the wider Perth Metropolitan region. However, as Northam is not within the Perth Metropolitan area or within the *WA Public Transport Area*, the School is eligible for transport assistance through the *PTA School Bus Services* in which students living greater than a 4.5km route from their school are eligible. Based on the School's advice (noting over a third of existing students) and as observed via the traffic/carpark surveys, the bus take-up is healthy. Therefore, a single bus service replaces multiple separate private car trips, as indicated by the school's actual calculated traffic generation rates.

2.5 Surrounding Road Network

The road network surrounding the Site in alignment with the *Main Roads WA* (MRWA) *Functional Road Hierarchy* is shown in **Figure 2-7,** with the *Primary Distributor* road sections under the jurisdiction of MRWA (state road) and all other roads sections under the jurisdiction of the *Shire of Northam* (local road). The speed zoning on the roads surrounding the Site are shown in **Figure 2-8**. The majority of roads do not have a posted speed limit and adopt the default 50km/h speed limit in built up areas.

Figure 2-7: Functional Road Hierarchy of the Road Network Surrounding the Site



Source: Main Roads WA

Figure 2-8: Speed Zoning on the Road Network Surrounding the Site

Source: Main Roads WA

It is noted that both Wellington Street East and Duke Street East have 40km/h School Zone Speed Limit signage for school days from 7.30am-9am and 2.30pm-4pm but is not shown by MRWA.

The Restricted Access Vehicle (RAV) Permits on the road network surrounding the Site are shown in **Figure 2-9** for the tandem drive (a prime mover with two rear axle groups) access network and **Figure 2-10** for the tri drive (a prime mover with three rear axle groups) access network.

Figure 2-9: Tandem Drive Access Network on the Road Network Surrounding the Site

Source: Main Roads WA

Figure 2-10: Tri Drive Access Network on the Road Network Surrounding the Site

Source: Main Roads WA

None of the Site frontage roads are part of the permitted RAV network.

2.6 Traffic Management on Frontage Streets

For the extent of the streets fronting the Site and 100m either side, the road information is provided in **Table 2-6**.

Table 2-6: Traffic Management on Frontage Streets

	Wellington Street East	Gordon Street	Duke Street
Road Hierarchy	Local Distributor	Access Road	Access Road
Speed Limit	50km/h (default) and 40km/h School Zone	50km/h (default)	50km/h (default) and 40km/h School Zone
Road Reserve Width	20.0m	20.0m	20.0m
Pavement Width	12.0m (including on-street parking)	7.0m	10.0m
No. of Traffic Lanes	2	2	2
Path Provision	3.0m (western side) 4.0m (eastern side)	2.0m (both sides)	2.0m (both sides)
Parking Provision	On-street (both sides)	On-street (southern side east of Wellington Street and both sides west of Wellington Street)	On-street bus zone (western side)
Intersecting Roads	Gordon Street (Roundabout)	Duke Street (4-way Give-Way) Wellington Street (Roundabout) Elizabeth Place (Priority T-Intersection)	Gordon Street (4-way Give-Way) Grey Street (4-way Stop)
Crossovers	7x carpark crossovers	5x carpark crossovers 9x property driveways	5x carpark crossovers 18x property driveways
Indicative Daily Traffic Volume *	Up to 6,000vpd	Up to 3,000vpd	Up to 3,000vpd
Recorded/Estimated Weekday Traffic Volume	1,685vpd (11.1% trucks) **	1,210vpd ***	920vpd ***
Recorded 85th Percentile Vehicle Speed	51.1km/h **	Unknown	Unknown

**Based on Main Roads WA Road Hierarchy for Western Australia Road Types and Criteria*

***Main Roads WA Traffic Map Survey Site No. 17730 Monday to Friday 2022/23 Two-Way*

****Matrix Traffic and Transport Data Survey (29/10/2024) – assuming the peak hour traffic accounts for 20% of the daily traffic*

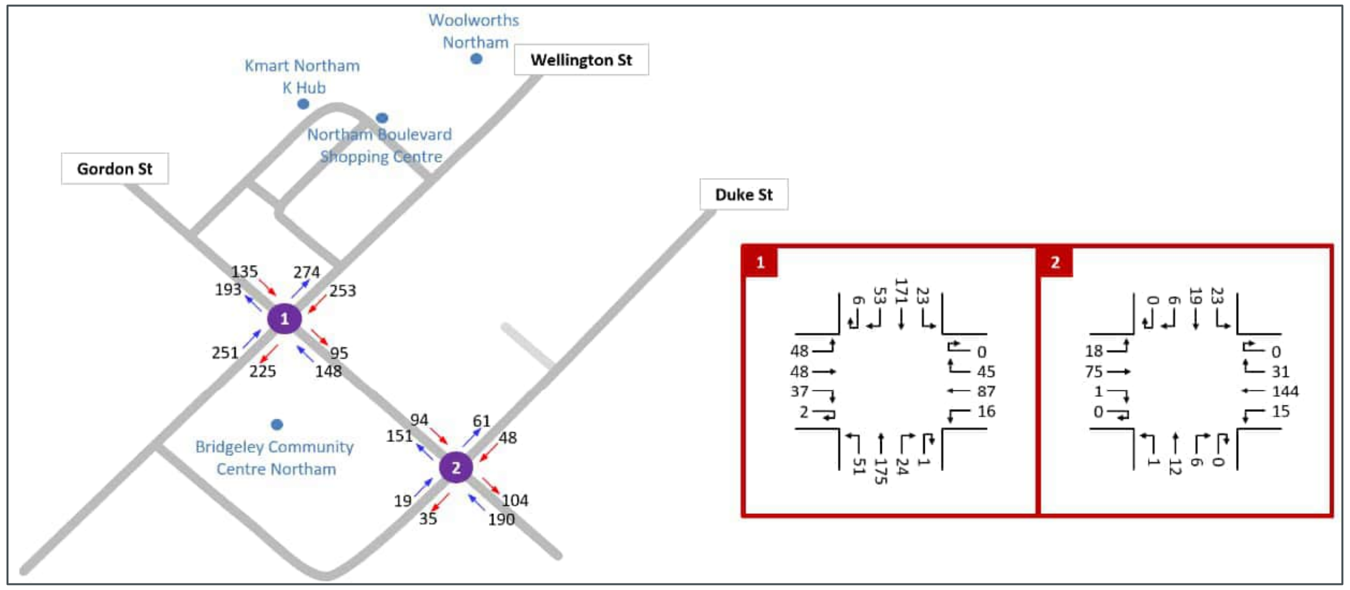
As indicated within *Liveable Neighbourhoods 2009*, a 7.4m wide pavement is suitable for one vehicle and one bus to pass each other while passing a parked car (on one side only) and a 9.7m wide pavement is suitable where parking demand is likely to be high and vehicle volumes are between 1,000-3,000 vehicles per day (vpd). Given Duke Street has a 10.0m wide pavement, it is considered to be appropriate for vehicles to park on both sides of the road and accommodate two-way traffic flow.

PJA engaged *Matrix Traffic and Transport Data* to undertake classified intersection turning counts from 7.30am to 9.30am and 2.30pm to 4.30pm on Tuesday 29 October 2024 at the following intersections:

- Wellington Street & Gordon Street
- Gordon Street & Duke Street

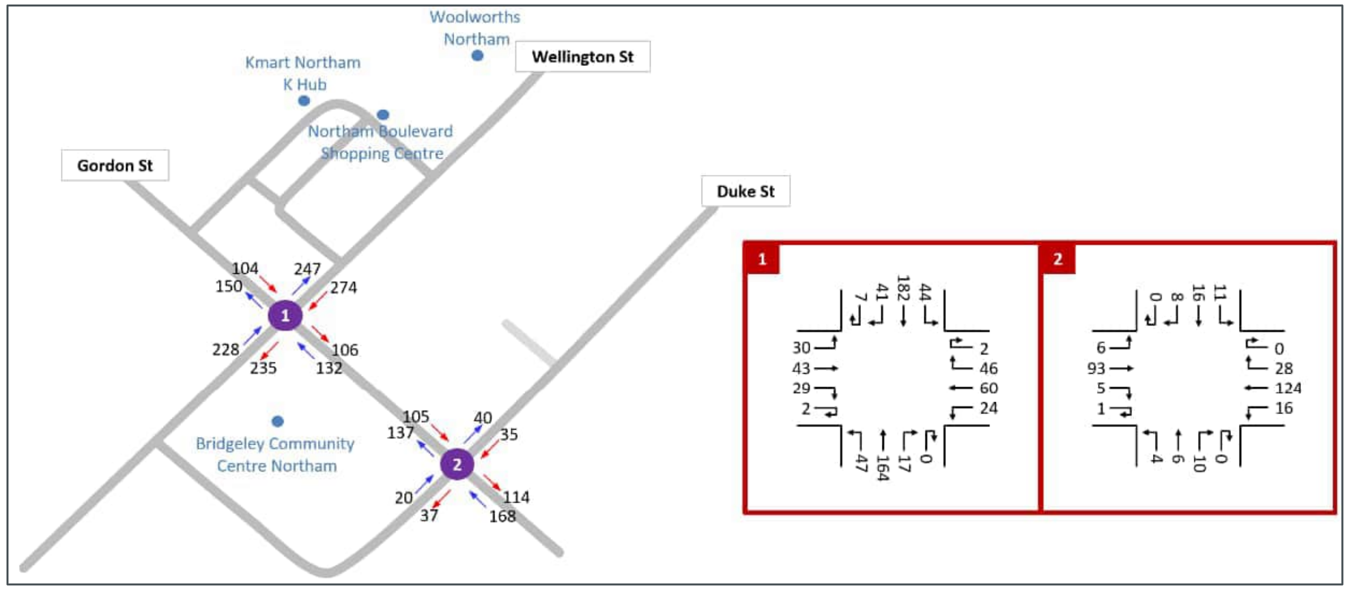
The peak hour periods for the network of intersections were indicated to occur at 8.15am and 2.45pm starts. The turning volume diagrams for each intersection at these time periods is shown in **Figure 2-11** for the AM peak and **Figure 2-12** for the PM peak.

Figure 2-11: AM Peak (8.15am – 9.15am) Intersection Turning Volumes in Vehicles per Hour



Source: Matrix Traffic and Transport Data

Figure 2-12: PM Peak (2.45pm – 3.45pm) Intersection Turning Volumes in Vehicles per Hour



Source: Matrix Traffic and Transport Data

2.7 Operation of Surrounding Intersections

The Wellington Street & Gordon Street intersection operates as a single lane full movement roundabout with a 4m painted central island radii.

The Gordon Street & Duke Street intersection operates as a 4-way priority controlled (give-way) full movement intersection with Gordon Street forming the major through road and Duke Street forming the minor leg approaches.

The video footage shows the intersections to operate adequately with no capacity, excessive delays or queues observed. The buses in and out of the pick-up/drop-off area flow well showing little to no impacts on the through and right-turn movements on Gordon Street being blocked.

2.8 Pedestrian and Cycle Networks

Each street connecting to the School generally has 2.0m wide paths on both sides of the street.

The School provides bicycle/scooter parking on-site.

2.9 Public Transport Networks

The *Transwa Northam Railway Station* is around 800m north of the Site and operates both regional coach and train services, which consist of the GS2 and N3 coach lines and the *AvonLink*, *MerredinLink* and *Prospector* train lines. A summary of the services are provided in **Table 2-7**.

Table 2-7: Public Transport Network Surrounding the Site

Line	Route	Frequency
GS2 Coach	East Perth to Albany / Gnowangerup / Katanning via Northam and Narrogin	One (1) service departing East Perth: everyday excluding Thursday and Saturday. One (1) service departing Albany: everyday excluding Tuesday, Wednesday and Saturday.
N3 Coach	East Perth to Geraldton via Northam and Mullewa	One (1) service departing East Perth: Monday and Thursday at 7.15am One (1) service departing Geraldton: Tuesday and Friday at 11.30am
AvonLink	Midland to Northam	One (1) service departing Midland: Monday to Friday at 5.50pm One (1) service departing Northam: Monday to Friday at 6.30am
MerredinLink	East Perth to Merredin	One (1) service departing East Perth: Monday, Wednesday and Friday at 8.45am One (1) service departing Merredin: Monday, Wednesday and Friday at 1.05-1.10pm
Prospector	East Perth to Kalgoorlie	One (1) service departing East Perth: everyday (two (2) services on Monday and Friday) One (1) service departing Kalgoorlie: everyday (two (2) services on Monday and Friday)

There are no local bus or train routes operating within Northam. However, the School is serviced by the PTA School Bus Service, operating from all neighbouring towns and rural communities. Registration for the School Bus Service can be made by parents directly on the School Bus Services website. Each bus accommodates around 50 students[2]. The current school buses service Wundowie, Inkpen, Mokine, Jiladine, Meckering (includes Cunderdin Shuttle), York, Goomalling, Southern Brook, Grass Valley, Toodyay, Toodyay Road, Irishtown/Bolgart, Beverley and Jennapullin. The School has indicated that **around 120-130 students currently travel by the PTA School Bus Services**.

2.10 Historic Recorded Crash Statistics

A crash extract for the extent of the Site frontage streets, for the last five years of available reported crashes, is shown in **Figure 2-13**.

Figure 2-13: Site Frontage Streets Historic Recorded Crash Statistics (1 January 2019 – 31 December 2023)

Source: Main Roads WA Crash Map

A total of 13 crashes have been reported in the five years, with 4 crashes at the Wellington Street East and Gordon Street intersection, 3 crashes at the Duke Street and Grey Street intersection, 2 at the shopping centre crossover and single site crashes at all other locations. One medical severity crash was recorded at the Wellington Street East and Gordon Street intersection and all other crashes were property damage only (PDO). There is an observed pattern of right-angle crash types on the road network. However, as the midblock crashes on Wellington Street East show 85th percentile vehicle speeds of 51.1km/h which is approximately in alignment with the *Safe Speeds Safe System* threshold for side impact crash types of 50km/h where the survivability of a crash is 90%. The remaining crashes occur at intersections where the impact speeds are considered to be lower. Therefore, the overall crash risk is considered to be low.

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[2] PTA School Bus Services Large Coach Size Bus Fleet.

3 Development Application Proposal

3.1 Layout

The proposed DA consists of renovating and expanding the School buildings to accommodate an additional stream of students with the campus. It is proposed that a first-floor extension be constructed onto the existing Science & Library building, the covered area be demolished and replaced with an elevated first-floor building, as well as two (2) transportable classrooms being installed on the grass area adjacent to Duke Street. A covered walkway is also proposed to connect the 1st floors of each building. The DA architectural plans are provided in **Appendix B**, with the expansion extent shown in **Figure 3-1**.

3.2 Land Uses

The expansion is proposed to be undertaken in stages between 2025 and 2030 with an average increase of around 28 students each year, with an ultimate yield of 485 students by 2030. A breakdown of the proposed student and staff yields per year is provided in **Table 3-1**.

Table 3-1: Proposed Development Yields

Year	Students	Staff (FTE)
2025	335	37
2026	380	39
2027	408	40
2028	436	41
2029	460	42
2030	485	43
Difference (2024 to 2030)	**+167**	**+6**

3.3 Hours of Operation

There are no proposals to modify the School operating times.

3.4 Access Arrangements

There are no proposals to modify or provide additional accesses to the Site.

3.5 Parking Provision

There are no proposals to provide additional car parking or bicycle parking.

Figure 3-1: Proposed Expansion Locality Plan on Existing Layout

Source: Santelli Chong Architects (Revision B – 10 December 2024)

4 Changes to External Transport Network

4.1 Pedestrian Network

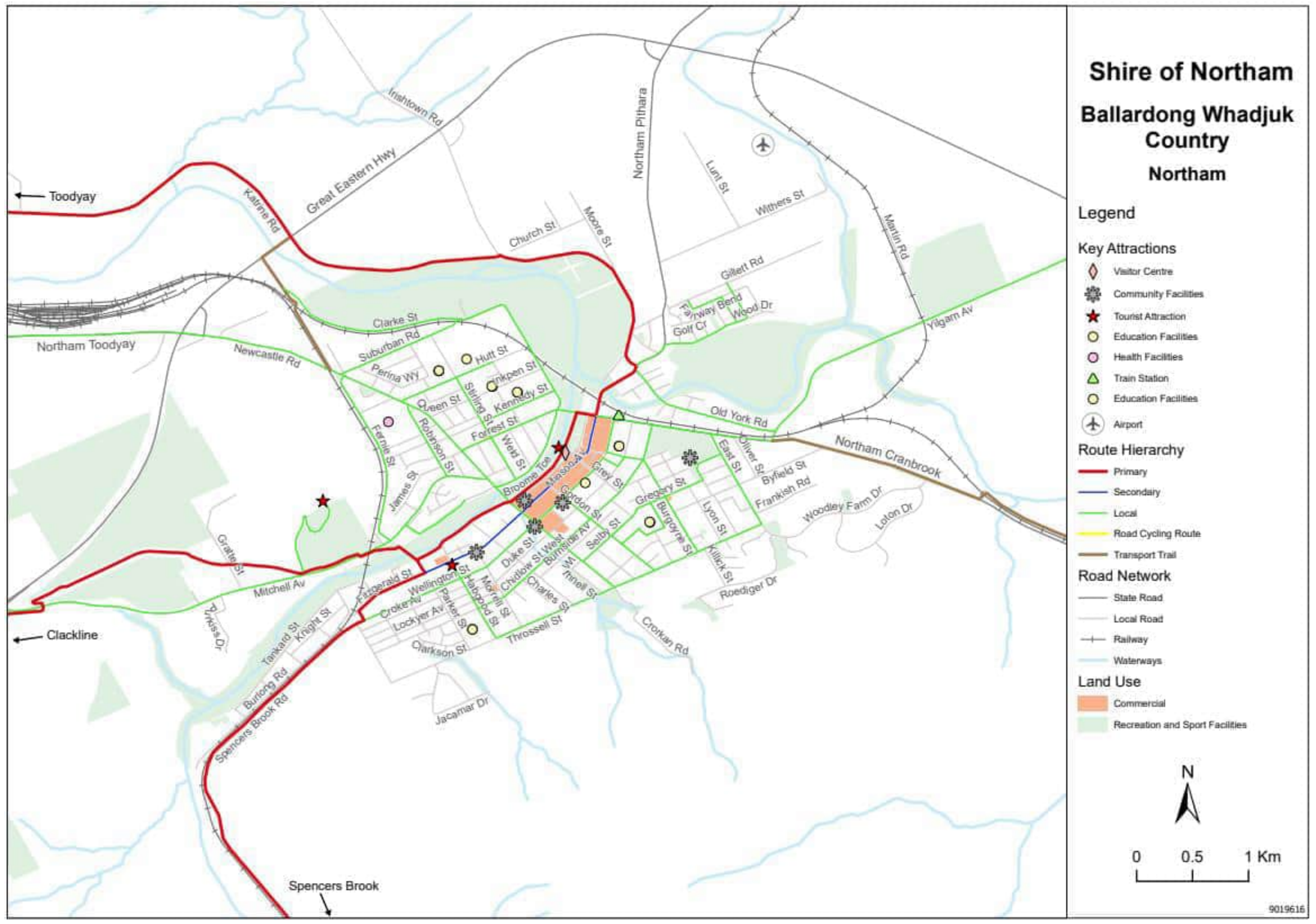
The *Northam Town Centre Development and Connectivity Strategy – January 2018 (Version 8)* highlights Wellington Street East for *Priority 2 Upgrades* comprising of upgrading footpaths to ensure consistent paving treatment and materials; introducing public art / activation on blank facades; increasing tree canopy and landscaping; and improving street lighting (including feature lighting).

There are no proposals within the DA to upgrade the path network or pedestrian crossing facilities.

4.2 Cycling Network

The *Department of Transport WA* (DoT) *Avon Central Coast 2050 Cycling Strategy* outlines the long-term cycle network aspirations for the *Shire of Northam* townsite as shown in **Figure 4-1**.

Figure 4-1: DoT Avon Central Coast 2050 Cycling Strategy Northam Townsite Cycle Network Map



Source: Department of Transport WA (August 2023)

Wellington Street and Gordon Street are both identified as *Local Routes* under the *Western Australia Cycling Network Hierarchy*, designating routes by their function, rather than built form. However, it is recommended within the DoT *Planning and Designing for Bike Riding in Western Australia – Shared and Separated Paths Guideline* that Local Routes comprise of shared paths with a desirable width of 3.0m (2.5m minimum). It is noted that the path fronting the School is around 4.0m wide on Wellington Street East and 2.0m wide on Gordon Street.

There are no proposals within the DA to upgrade the cycle network or pedestrian crossing facilities.

4.3 Bus and Train Network

PJA has been advised that there are no proposals to modify the PTA School Bus Services or any public transport services.

4.4 Road Network

The *Shire of Northam Local Planning Strategy* (August 2024) does not indicate any plans to upgrade the road network surrounding the Site. However, the strategy does note there is opportunity for the Shire to improve/enhance the pedestrian connections between Wellington Street East and the *Avon River Foreshore*, which may in turn improve pedestrian connectivity for students travelling via the northwest.

5 Integration with Surrounding Area

5.1 Desire Lines to External Land Uses

The key external land uses constituting cross trips between sites may include the *Northam Boulevard Shopping Centre, Northam Library, Northam Recreation Centre* and the Fitzgerald Street food and beverage strip, shown previously in **Figure 2-3**.

The travel desire lines to the *Northam Boulevard Shopping Centre* are considered to consist of the connection between the school pedestrian access gates on Wellington Street East and the stairs almost directly opposite the access gates, which involves the crossing of Wellington Street East.

The travel desire lines to the *Northam Library* are considered to consist of the connections between Wellington Street East and Fitzgerald Street which may be via Gordon Street (crossing at the Wellington Street East intersection) or via the Northam Boulevard Shopping Centre. There are a series of raised plateaus on Fitzgerald Street with priority given to traffic, where the pedestrian crossing distance is shorter and provides a connection between each side of the street and ultimately to the Northam Library.

The travel desire lines to the *Northam Recreation Centre* are considered to consist of the connections between Duke Street and Henry Street. There is a 2.0 wide path on the southern side of Henry Street which connects to the 2.0m wide path on the northern side of Hawes Street via two crossings at the 5-leg roundabout with Chidlow Street West and Burgoyne Street. Hawes Street than connects to Duke Street with dropped kerb ramps at the T-intersection adjacent to Northam Primary School. On the eastern side of Duke Street East there is a 2.0m wide path which connects to the school via a dropped kerb ramp refuge crossing at Grey Street and crossing Duke Street East at a midblock location (unprotected) to the pedestrian accesses at the Administration building.

The travel desire lines to the Fitzgerald Street food and beverage strip are similar to the Northam Library desire lines but to the north via Grey Street.

6 Analysis of Transport Network

6.1 Trip Generation Impacts

The frontage roads indicate two-way traffic volumes of 514vph (PM peak) to 521vph (AM peak) on Wellington Street East, 236vph (PM peak) to 242vph (AM peak) on Gordon Street and 75vph (PM peak) to 109vph (AM peak) on Duke Street East.

Adopting the trip generation rates calculated previously in **Table 2-5** and applying these to the forecast student yields for 2030 (485 students), the likely additional trips generated by the School are provided in **Table 6-1**.

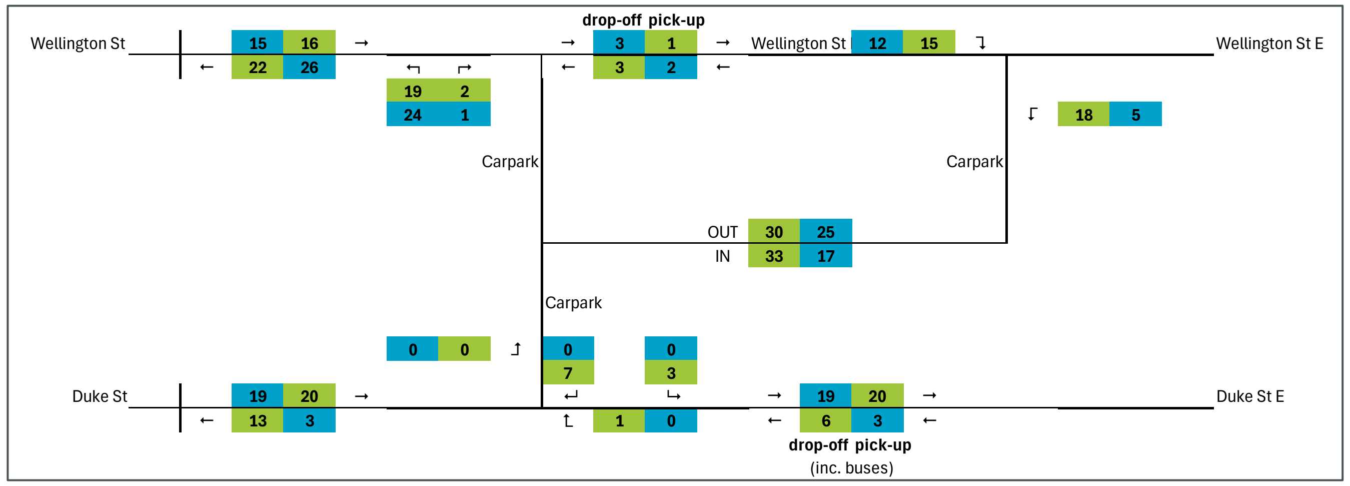
Table 6-1: Trip Generation of Additional Students

Peak	Inbound (vph)	Outbound (vph)	Total (vph)
AM (8.15am – 9.15am)	48	45	93
PM (2.45pm – 3.45pm)	30	38	68

The traffic impacts resulting from additional students at the Site are less than 100vph in a given peak period. In accordance with the *WAPC TIA Guidelines* this indicates the development would have a "moderate impact" (i.e. 10 -100 vehicle trips in the peak hour). Given the additional traffic is under the capacity threshold of 100vph and the surrounding road network is considered to be abundantly under capacity (noting the existing low rate of trips), it is considered that further capacity-based analysis is not required.

Adopting the same distribution of vehicle trips as noted with the existing travel patterns observed in the traffic survey, the additional trips are distributed accordingly among the movements shown in **Figure 6-1**.

Figure 6-1: Distributed Additional Development Traffic



The increase of two-way traffic on the road sections between the Site accesses and the Gordon Street intersections equate to a total of 559vph (AM peak) and 555vph (PM peak) on Wellington Street East and a total of 108vph (AM peak) and 131vph (PM peak) on Duke Street East.

6.2 Pedestrian and Cycle Access/Amenity

The traffic volume affecting the ability of a pedestrian to cross a 2-lane undivided road is considered to be 1,100vpd as per the *WAPC TIA Guidelines*, in which the peak hour traffic volumes on the Site frontage roads are much lower than.

The crossing distance on Wellington Street East for pedestrians crossing between both sides of the rows of on-street parking is around 12m from kerb to kerb. On Duke Street East, the crossing distance is around 10m from kerb to kerb.

The surrounding path network is considered to be sufficient with 2-3 students able to walk side by side or two students to pass in opposing directions on the generally 2m wide footpaths on the surrounding streets. Additionally, having paths on both sides of the street allows for improved feelings of safety and amenity.

There are dropped kerb ramps at intersections to facilitate suitable crossing locations along the desire lines. A 2.0m wide pedestrian refuge is provided on the Duke Street East crossing adjacent to Gordon Street and Grey Street which may also store a small or standard bicycle. There are currently no supervised school crossings. However, both Wellington Street East and Duke Street East are speed zoned for schools at 40km/h (during school start and finish times) which should reduce vehicle approach speeds and potential impact speeds, noting the *Safe System Principles* for hit-pedestrian crash types is 30km/h.

With an increase in student volumes proposed there is potential for higher volumes of pedestrians crossing Wellington Street East, in particular, as this was observed to be a key desire line within the video survey. Therefore, there is an opportunity for a school crossing (in some form) to be provided to facilitate students crossing along this desire line and improve the safety and amenity of the pedestrian crossing facilities. A potential location may be in alignment with the parking aisle build out adjacent to the shopping centre crossover.

Pedestrian access to the School is achievable via two points of the Administration building on Duke Street East and via two gates on Wellington Street East.

7 Safe Routes to School

Prioritising safe, direct, and convenient routes for walking and cycling in safe routes to school planning encourages active travel and addresses critical road safety concerns, which have benefits for both individual health and community wellbeing. Reducing traffic volumes and speeds around schools, along with implementing infrastructure such as raised pedestrian crossings and high-quality footpaths that separate children from motor vehicles, significantly lowers the risk of accidents. These measures make active travel a more viable and attractive option. Encouraging regular physical activity through active travel, such as walking or cycling, has significant benefits for children's physical and mental health. It lowers the risk of chronic diseases, boosts cognitive function, and fosters a sense of independence.

A safe walk/cycle to school assessment process ensures that students can travel safely while promoting healthier, more active lifestyles during childhood and beyond.

It is also noted that enhancements in technology such as eRideables expand active travel catchments. However, as the legal riding age for eRidebales is 16 years old, this reduces the potential for students to travel by eRideables to students generally in Year 10-12.

In order to determine appropriate active travel routes to school, a 400m, 800m and 1200m radius catchment zone has been considered which captures the areas shown in **Figure 7-1**.

Figure 7-1: School Active Travel Catchment Zones

Base Image Source: Nearmap (September 2024)

A 400m catchment radius represents a typical 5-minute walk with 800m representing a 10-minute walk and a 1,200m catchment radius representing a 15-minute walk. The 400m radius captures the area within the residential dwellings generally bound by the Avon River, Hawes Street, Selby Street and Gardiner Street.

The 800m radius extents out to Forrest Street, Peel Terrace, Throssell Street and Charles Street. Whereas the 1,200m radius captures up to Inkpen Street, Old York Road, Roediger Drive and Habgood Street, which appears to capture most residential dwellings within the Northam Townsite. The majority of residential streets within these areas appear to have a path on at least one side of the street with the grid-type street layout allowing for direct routes and reduced crossing points. The paths are either concrete or asphalt which generally provide a greater level of comfort to brick paving paths, when maintained in a good condition. The typical path width appears to be 2.0m which is more suitable for walking than it is riding. However, given the majority of dwellings would be within a 20-minute walk (as indicated by Google Maps pedestrian routes from the 1,200m radius boundaries), walking trips of this distance for secondary school students may generally be appropriate. Therefore, it is considered that the existing provision of active travel does facilitate the promotion of students to travel to school by active travel modes.

8 Management Plans

8.1 Parking

The *Shire of Northam* have requested that this TIS address the potential parking impacts:

- Indicate how in the occasional event where there should be a function held in the church, such as funeral, how the parking be managed.
- Indicate the impact of on-street parking on surrounding streets, Duke Street in particular, and a potential solution forward.

In response to the above, the parking demand survey provided in **Section 2.2** indicated that the Site carpark would generally operate at around 58% of the supply during the day. However, even if assuming the carpark was fully occupied by school staff and church attendees, the assessment herein shows there is sufficient supply on surrounding streets and carparks to accommodate any shortfall in these infrequent cases.

The Northam Town Hall rear carpark appears to be primarily empty from the survey, in addition to the on-street parking being underutilised, which would facilitate additional long-term parking, or as a short-term pick-up and drop-off area with students able to access the School by crossing Gordon Street at the intersections or at midblock locations. Gordon Street was observed to be carrying less than 250vph in both peak hours within the traffic survey and this low traffic volume is noted in the WAPC TIA Guidelines as being appropriate for pedestrians to cross between gaps in traffic.

As indicated in **Section 2.6**, the 10.0m wide road pavement on Duke Street East enables vehicles to park on both sides of the road, while facilitating passing movements between a car and a bus. However, due to the school bus embayment and other crossovers, parking may only be achievable over small portions of the street. Duke Street East is around 255m long between the solid dividing lines at each intersection approach. Therefore, assuming only 50% of the length of the southern side is outside of residential driveways and adding the around 60m of appropriate parking sections on the northern side, it is considered that Duke Street East could easily accommodate around 30 parked cars.

Notwithstanding the assessment findings that no parking action is needed, there are alternative strategies to further manage the parking at the schools discretion which could involve the church communicating when funerals or other events are being held on specific days and the school could promote a “walk/ride to school day” with the offering of incentives to participate. Hence, reducing the need for car parking or pick-up/drop-off. The School may enrol in the DoT *YourMove Program* or adopt similar initiative and activities to promote active travel to school, even just for the days where church parking is higher.

8.2 Traffic

The School could provide a traffic management plan within the parent handbook which outlines the following measures to be complied with.

- Drop-off & Pick-up
  - All cars are to follow the directional arrows marked on the Church car park.
  - When driving through to pick up or drop off students, please pull as far forward as possible to keep the traffic flowing on Wellington Street.
- Bus Students
  - Students should enter and exit the school grounds by way of the designated bus gates.
  - Students are not permitted to leave the school grounds once they arrive at school by bus.
- Confirmation of Road Rules (such as no standing across yellow lines, speed zones etc).

9 Conclusions & Recommendations

9.1 Conclusions

A summary of the content included within the preparation of this TIS are noted as follows.

- A development application (DA) is being sought for a proposed expansion of education streams at St Joseph's School, located at 77 Wellington Street East, Northam, WA 6401 ("the Site"). In which the *Shire of Northam* require a TIS to assist the DA assessment and specifically *indicate how in the event where there should be a function held in the church, such as funeral, the parking be managed* and to *indicate the impact of on-street parking on surrounding streets, Duke Street in particular, and a potential solution forward*.
- The Site is shared with St Joseph's Church in which an off-street carpark facilitates both land uses with a supply of 93 car parking bays (including one ACROD bay).
- St Joseph's School provides private Catholic education for students from Year 7 to Year 12 (Y7-12), with a 2024 yield of 318 students and 37 full-time equivalent (FTE) staff. It is currently a two-stream school offering pathways in ATAR, General and vocational education and training (VET) and operates Monday to Friday from 8.45am to 3.10pm with an early finish on Thursday at 2.30pm (consistent with all other schools in Northam).
- The Site frontage streets consist of Wellington Street East (providing access to the carpark via separated entry/exit crossovers and pedestrian access via two gates), Duke Street East (providing access to the carpark via a single combined full movement entry/exit crossover and pedestrian access at two locations via the Administration building) and Gordon Street.
  - Wellington Street East is a Local Distributor with a default 50km/h speed limit and a 40km/h school speed zone. The pavement width is 12.0m with on-street car parking available for 43 vehicles on both sides and a bus zone on the school side. There is a 3.0m wide path on the shopping centre side and a 4.0m wide path on the school side. The daily traffic volume (two-way) is around 1,700vpd.
  - Duke Street East is an Access Road with a default 50km/h speed limit and a 40km/h school speed zone. The pavement width is 10.0m with around a 60m long bus embayment fronting the School. There are 2.0m wide paths on both sides of the street. The pavement is wide enough to accommodate on-street car parking on both sides while allowing two-way traffic flow. Excluding the crossovers and bus embayment, around 30 cars can be accommodated with on-street parking. It is estimated that Duke Street East has a daily traffic volume (two-way) of around 900vpd.
  - Gordon Street is an Access Road with a default 50km/h speed limit. The pavement width is around 7.0m with embayed on-street car parking on one side for 4-16 vehicles on three sections. There are 2.0m wide paths on both sides of the street. It is estimated that the daily traffic volume (two-way) is around 1,200vpd.
- A video survey indicated that up to six (6) cars and seventeen (17) school buses complete pick-up/drop-off trips on the frontage streets. In addition, the vehicle movements of the carpark accesses indicate that the School currently generates 178vph in the AM peak and 130vph in the PM peak. This converts to a vehicle trip rate of 0.56 per student in the AM peak and 0.41 per student in the PM peak specific for the school.
- The proposed expansion consisting of a first-floor extension to the Science & Library building is considered to yield a total of 485 students (167 additional students from 2024 by 2030) with the additional vehicle trips representing 93vph in the AM peak and 68 in the PM peak. The increase of two-way traffic on the road sections between the Site accesses and the Gordon Street intersections equate to a total of 559vph (AM peak) and 555vph (PM peak) on Wellington Street East and a total of 108vph (AM peak) and 131vph (PM peak) on Duke Street East. These are considered to be small net increases with no adverse effect on the existing capacity of roads surrounding the School as confirmed via WAPC definition of a 'moderate' traffic impact.
- Based on the space available for bus parking and the underutilisation of that space, there is potential for additional local school bus service(s) to utilise the bus zone parking on Wellington Street East and Gordon Street to accommodate a minimum of 5 coach-size PTA school buses (50 seats per bus) or 8 small PTA school buses (15-25 seats per bus). This equates to a maximum of 250 students in total, based on the minimum number of buses accommodated without parking turnover at 100% seating capacity (as per *PTA School Bus Services* Specifications) and 100% of St Joseph's School students onboard.
- Surrounding the Site there are a number of carparks with a total supply of around 368 bays. Based on an aerial review of the area and the surveyed demand for the Site, the on-street carparking demand and carparks accessible from the frontage street, current demand is only around 33% of the total supply.
- The Northam Town Hall rear carpark appears to be primarily empty from the survey, in addition to the on-street parking being underutilised, which would facilitate additional long-term parking, or as a short-term pick-up and drop-off area with students able to access the School by crossing Gordon Street at the intersections or at midblock locations.
- The parking demand survey indicated that the Site carpark would generally operate at around 58% of the supply during the day. Accordingly, even if assuming the school carpark was fully occupied by school staff and church attendees, the assessment herein for the ultimate development shows there is sufficient supply on surrounding streets and carparks to accommodate any shortfall.
- Notwithstanding that no real parking management issues arise for action, alternative strategies to further manage carparking could be undertaken, if desired. Such strategies could involve the church communicating to the school when funerals or other events are being held on specific days, the school could promote a "walk/ride to school day" with the offering of incentives to participate and reducing the overall private vehicle car parking or pick-up/drop-off, and/or the School may enrol in

the DoT *YourMove Program* or adopt similar initiative and activities to promote active travel to school, even just for the days where church parking is higher.

- There was no evidence to suggest that an existing parking issue exists on Duke Street East and through education to parents/students of where to drop off/pick up, parking can be managed adequately.

9.2 Recommendations

- Investigation of a potential school crossing (in some form) on Wellington Street East between the pedestrian access gates at the School and the stairway at the *Northam Boulevard Shopping Centre*.

Appendix A

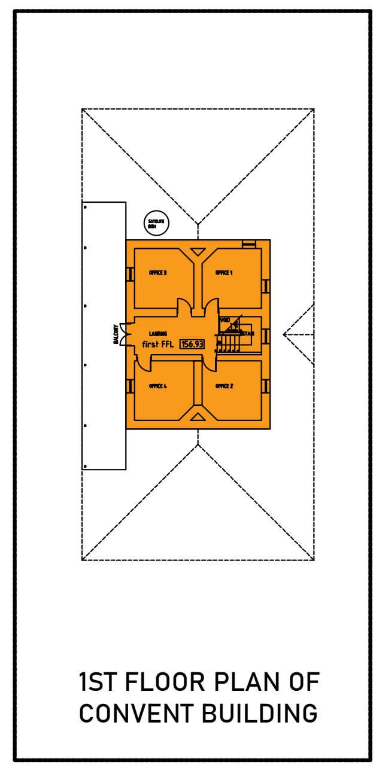
TIA Checklist

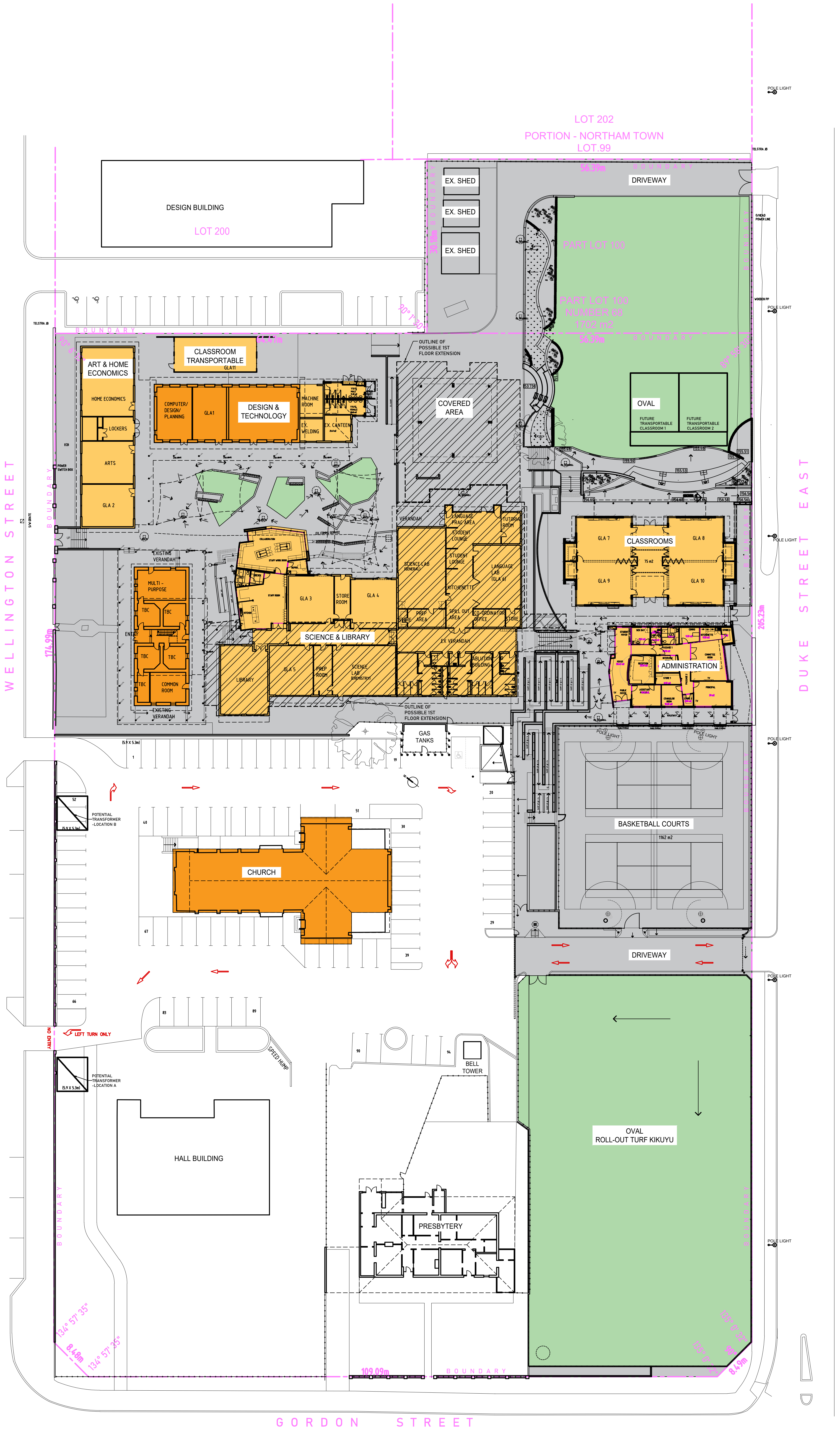
Appendix A WAPC Individual Development TIS Checklist

ITEM	PROVIDED	COMMENTS/PROPOSALS
Proposed Development	☑ Section 3	
Existing Land Uses	☑ Section 2.1	
Proposed Land Use	☑ Section 3.2	
Context With Surrounds	☑ Section 5	
Vehicular Access and Parking	☑ Section 2.2	
Access Arrangements	☑ Section 2.2	
Public, Private, Disabled Parking Set Down/Pick Up	☑ Section 2.2	
Service Vehicles (Non-Residential)	☑ Section 2.3	
Access Arrangements	☑ Section 2.3	
On/Off-Site Loading Facilities	☑ Section 2.3	
Service Vehicles (Residential)	N/A	
Rubbish Collection and Emergency Vehicle Access	N/A	
Hours Of Operation (Non-Residential Only)	☑ Section 3.3	
Traffic Volumes	☑ Section 6	
Daily Or Peak Traffic Volumes	☑ Section 6.1	
Type Of Vehicles (For Example, Cars, Trucks)	☑ Section 6.1	
Traffic Management on Frontage Streets	☑ Section 2.6	
Public Transport Access	☑ Section 2.9	
Nearest Bus/Train Routes	☑ Section 2.9	
Nearest Bus Stops/Train Stations	☑ Section 2.9	
Pedestrian/Cycle Links to Bus Stops/Train Station	☑ Section 2.9	
Pedestrian Access/Facilities	☑ Section 2.8	
Existing Pedestrian Facilities Within the Development (If Any)	☑ Section 2.8	
Proposed Pedestrian Facilities Within Development	☑ Section 2.8	
Existing Pedestrian Facilities on Surrounding Roads	☑ Section 2.8	
Proposals To Improve Pedestrian Access	☑ Section 4.1	
Cycle Access/Facilities	☑ Section 2.8	
Existing Cycle Facilities Within the Development (If Any)	☑ Section 2.8	
Proposed Cycle Facilities Within Development	☑ Section 2.8	
Existing Cycle Facilities on Surrounding Roads	☑ Section 2.8	
Proposals To Improve Cycle Access	☑ Section 4.2	
Site Specific Issues	☑ Section 8	
Safety Issues	☑ Section 2.10	
Identify Issues	☑ Section 2.10	
Remedial Measures	☑ Section 2.10	

Appendix B

Development Application Plans





LEGEND

▨	POTENTIAL 1ST FLOOR EXTENSIONS (OVER 2 TO 3 STAGES)

REV	Date	Drawn	Description
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B	02.12.2024	JD	DD COSTING ISSUE
A	19.11.2024	JD	BCA & SECTION J CONSULTANTS ISSUE
A	22.10.24	CC	ISSUE TO CONSULTANTS - START OF DD

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ST. JOSEPH'S SCHOOL

77, WELLINGTON ST, NORTHAM.

ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
-
EXISTING OVERALL SITE PLAN PLAN

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Project Phase DESIGN DEVELOPMENT

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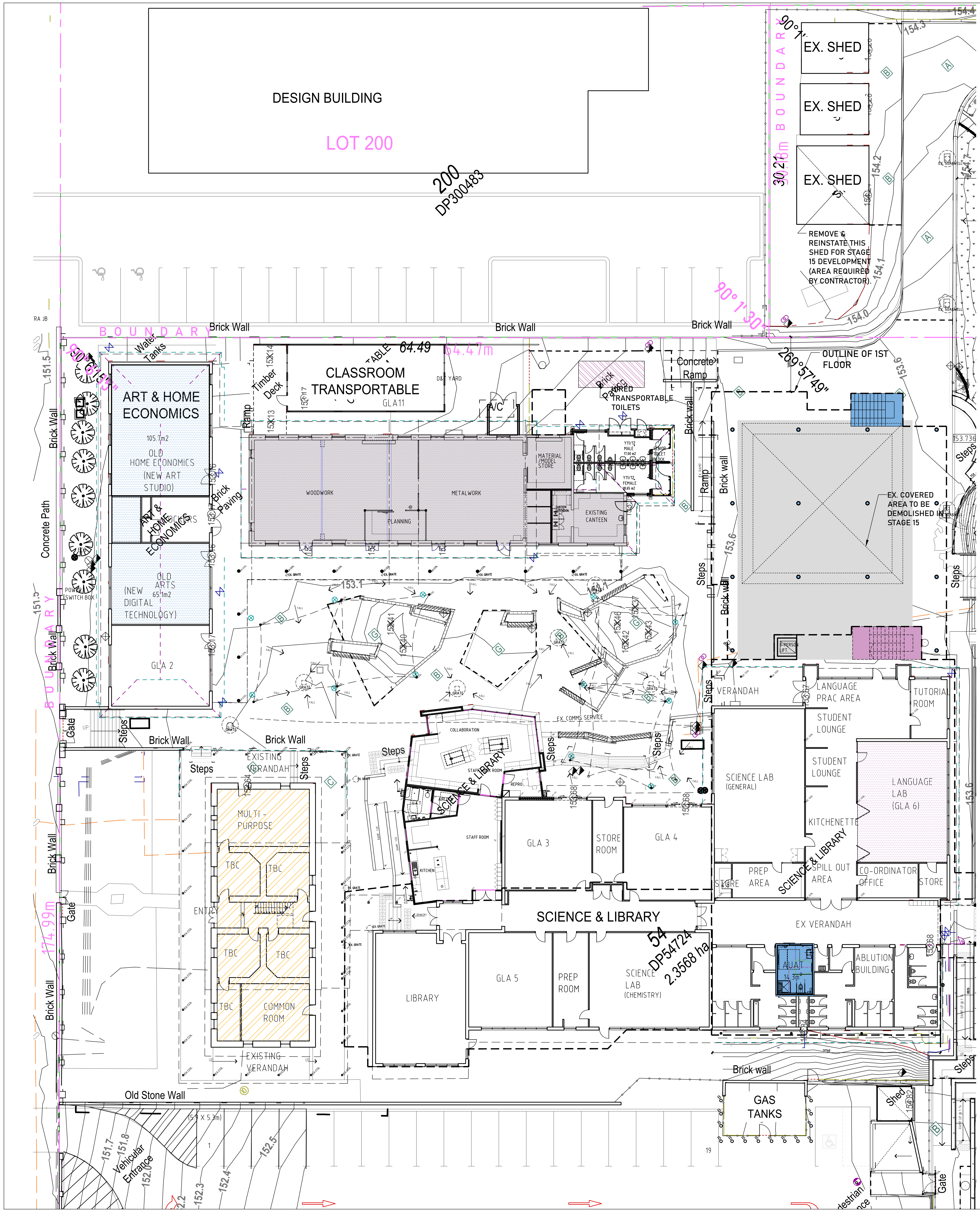

ST. JOSEPH'S SCHOOL (NORTHAM) - SECONDARY CAMPUS

PROPOSED SITE PLAN (GROUND FLOOR)

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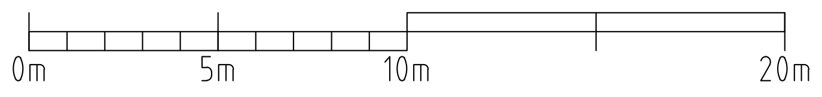

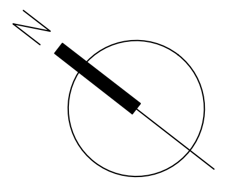

LEGEND

🟪	STAGE 14 - NEW BUILDING WORK
🟦	STAGE 15 - NEW BUILDING WORK
⬜	STAGE 14 & 15 - NEW EXTERNAL WORK
▨	STAGE 14 RENOVATION WORK
▨	STAGE 15 RENOVATION WORK
▨	HERITAGE RENOVATION WORK (STAGE 13)
🟨	POSSIBLE FUTURE 1ST FLOOR EXTENSION

LEGEND

▨	POTENTIAL 1ST FLOOR EXTENSIONS (OVER 2 TO 3 STAGES)

REV	Date	Drawn	Description
B	10.12.2024	JD	ISSUE FOR TIA REPORT
B	02.12.2024	JD	DD COSTING ISSUE
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ST. JOSEPH'S SCHOOL

77, WELLINGTON ST, NORTHAM.

ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
PROPOSED PART SITE PLAN
- GROUND FLOOR

Drawn: JDV
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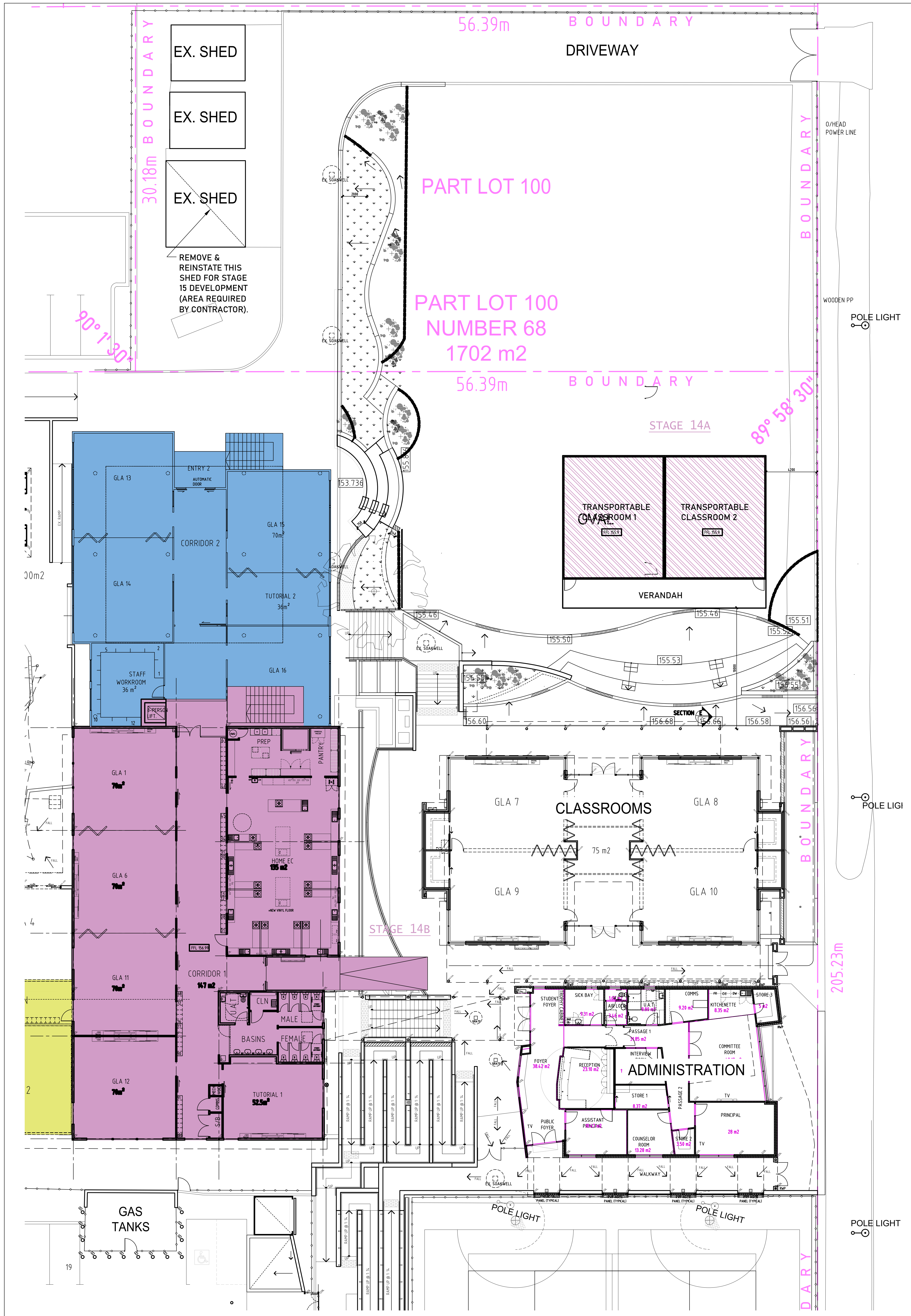
Project Phase: DESIGN DEVELOPMENT

Project Number: 24004
Drawing Number: WD.0SP.02
Revision: B



ST. JOSEPH'S SCHOOL (NORTHAM) - SECONDARY CAMPUS

PROPOSED SITE PLAN (1ST FLOOR)

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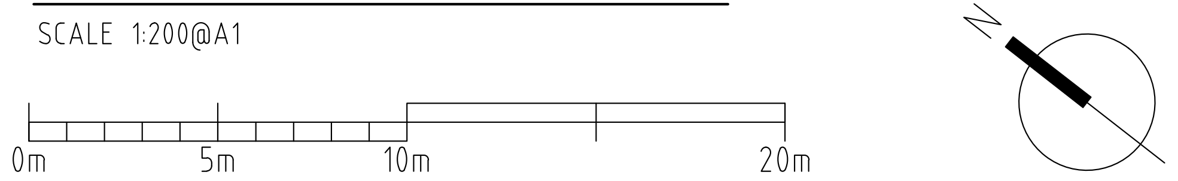

LEGEND

- 🟪 STAGE 14 - NEW BUILDING WORK
- 🟦 STAGE 15 - NEW BUILDING WORK
- ⬜ STAGE 14 & 15 - NEW EXTERNAL WORK
- ▦ STAGE 14 RENOVATION WORK
- ▦ STAGE 15 RENOVATION WORK
- ▨ HERITAGE RENOVATION WORK (STAGE 13)
- 🟨 POSSIBLE FUTURE 1ST FLOOR EXTENSION

LEGEND

- ▨ POTENTIAL 1ST FLOOR EXTENSIONS (OVER 2 TO 3 STAGES)

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B	02.12.2024	JD	DD COSTING ISSUE
A	19.11.2024	JD	BCA & SECTION J CONSULTANTS ISSUE
A	22.10.24	CC	ISSUE TO CONSULTANTS - START OF DD
REV	Date	Drawn	Description

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ST. JOSEPH'S SCHOOL
77, WELLINGTON ST, NORTHAM.
ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
PROPOSED PART SITE PLAN
- 1ST FLOOR AND UPPER CAMPUS

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Project Phase DESIGN DEVELOPMENT

Project Number	Drawing Number	Revision
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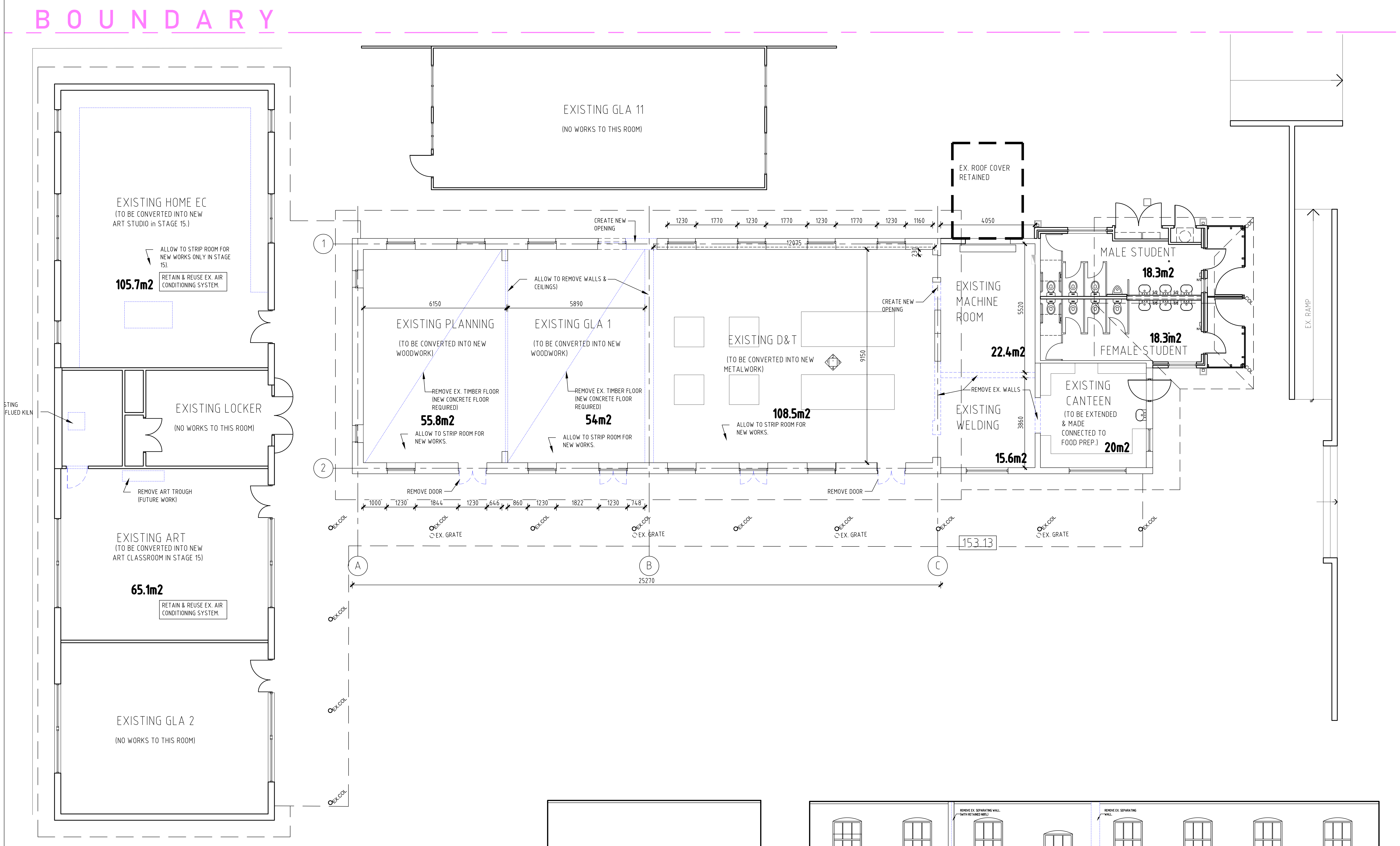

HOME EC, ART AND D&T EXISTING FLOOR PLAN

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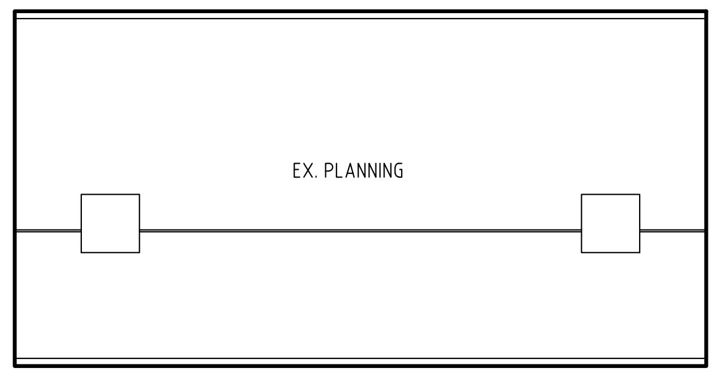

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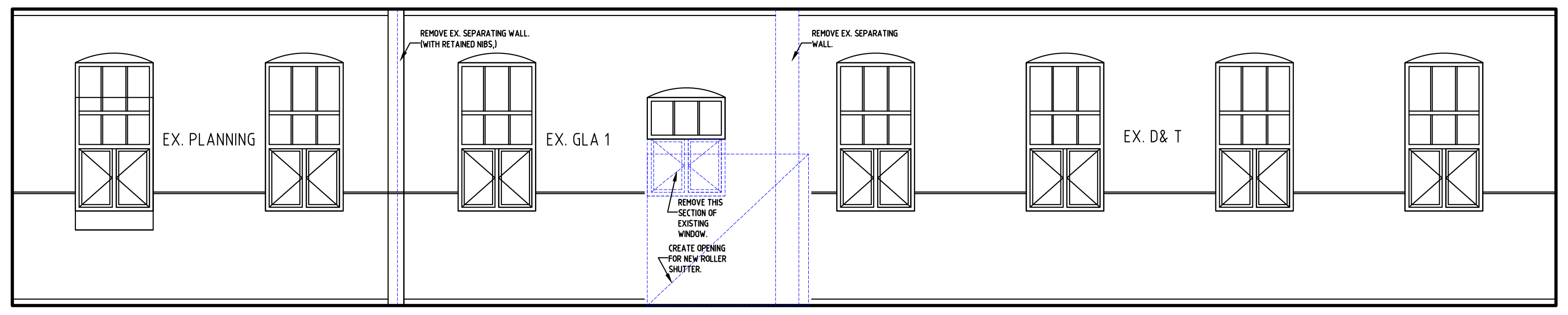

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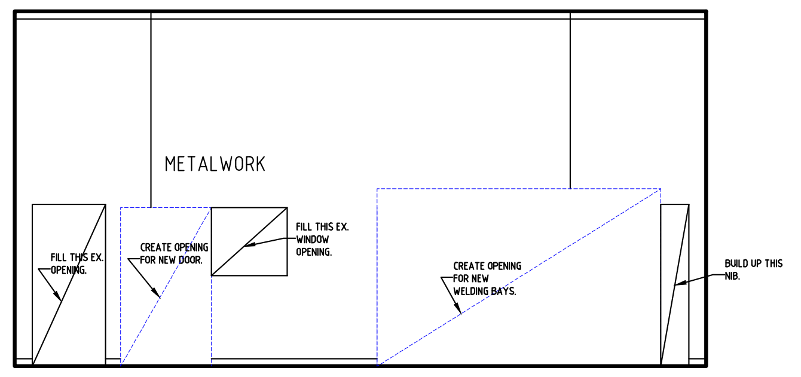

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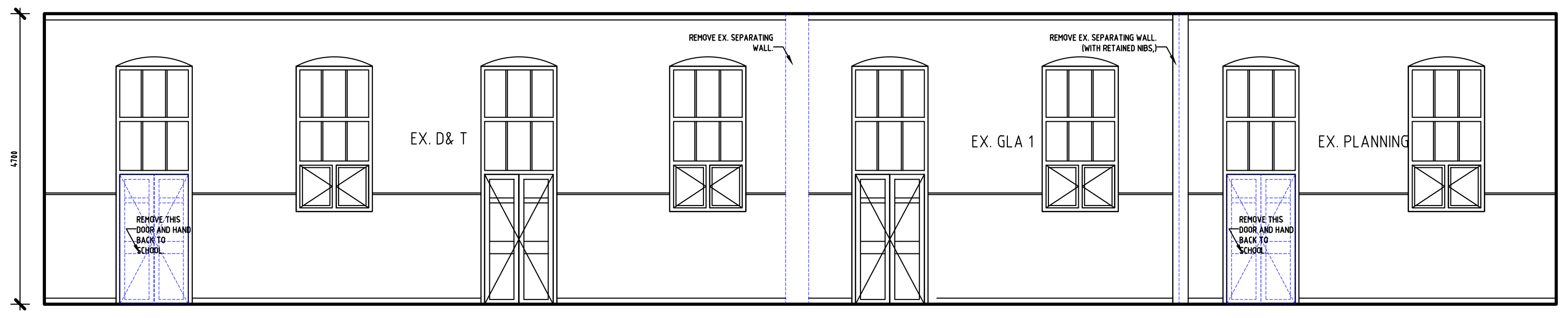

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77 WELLINGTON STREET, NORTHAM WA 6401
ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
DESIGN AND TECHNOLOGY REFURBISHMENT
EXISTING FLOOR PLAN

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Project Phase
DESIGN DEVELOPMENT

Project Number	Drawing Number	Revision
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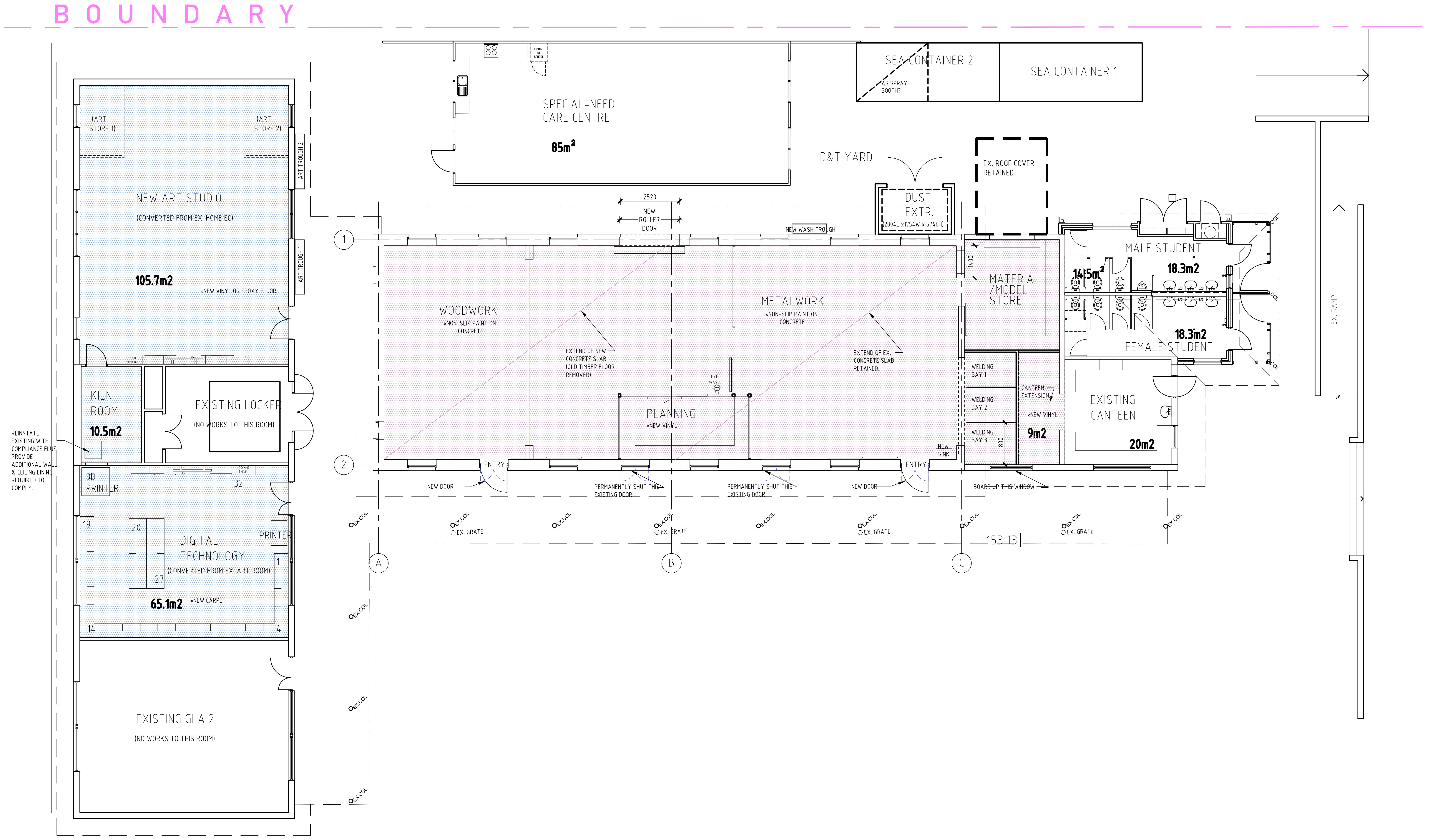

D&T
PROPOSED FLOOR PLAN

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ST. JOSEPH'S SCHOOL
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ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
DESIGN AND TECHNOLOGY REFURBISHMENT
PROPOSED OVERALL FLOOR PLAN

Drawn	Checked	Scale
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Project Phase
DESIGN DEVELOPMENT

Project Number	Drawing Number	Revision
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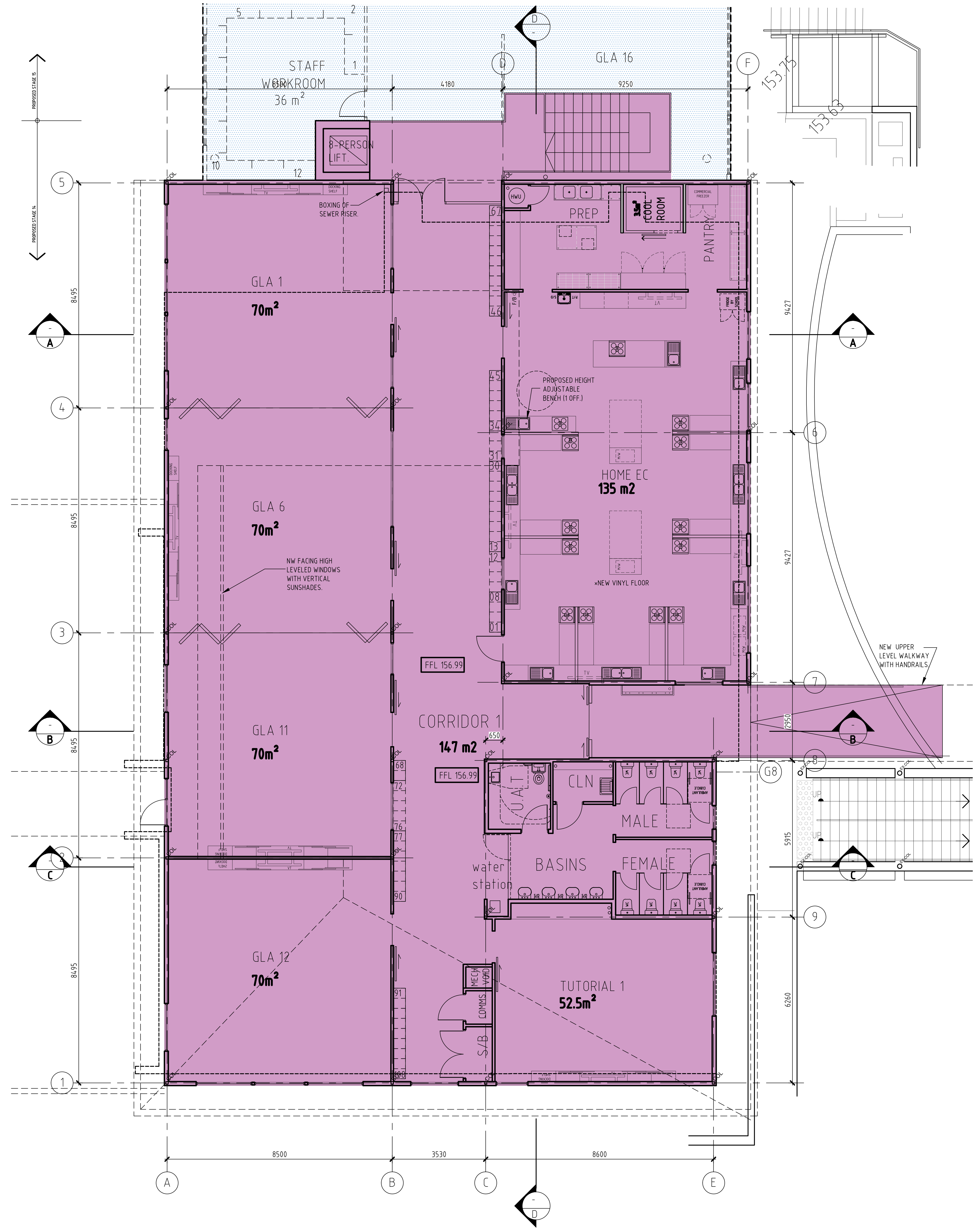

PROPOSED STAGE 14
1ST FLOOR FLOOR PLAN

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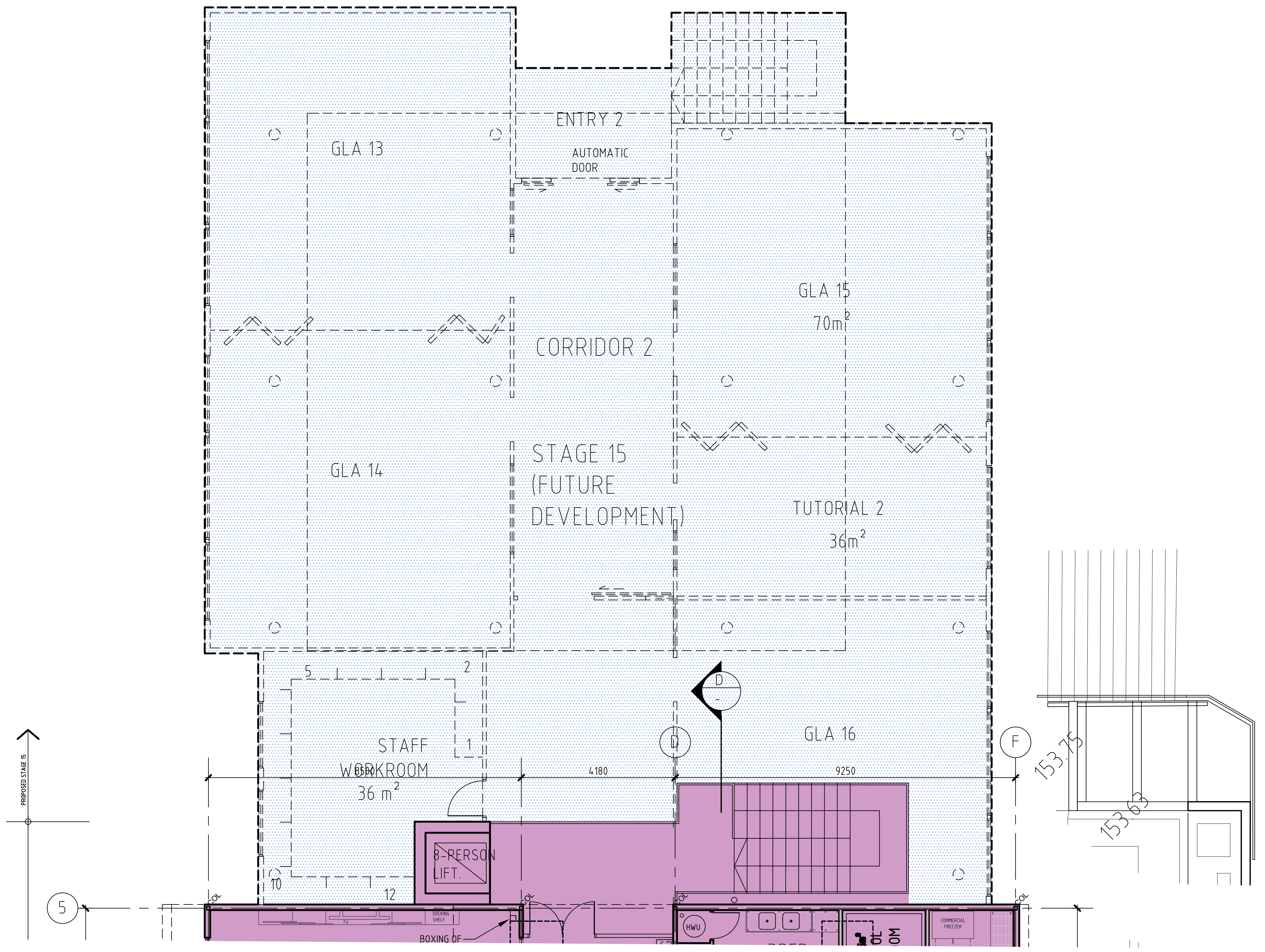

INDICATIVE STAGE 15
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B	02.12.2024	JD	DD COSTING ISSUE
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A	22.10.2024	JD	GENERAL ISSUE - START OF DESIGN DEVELOPMENT

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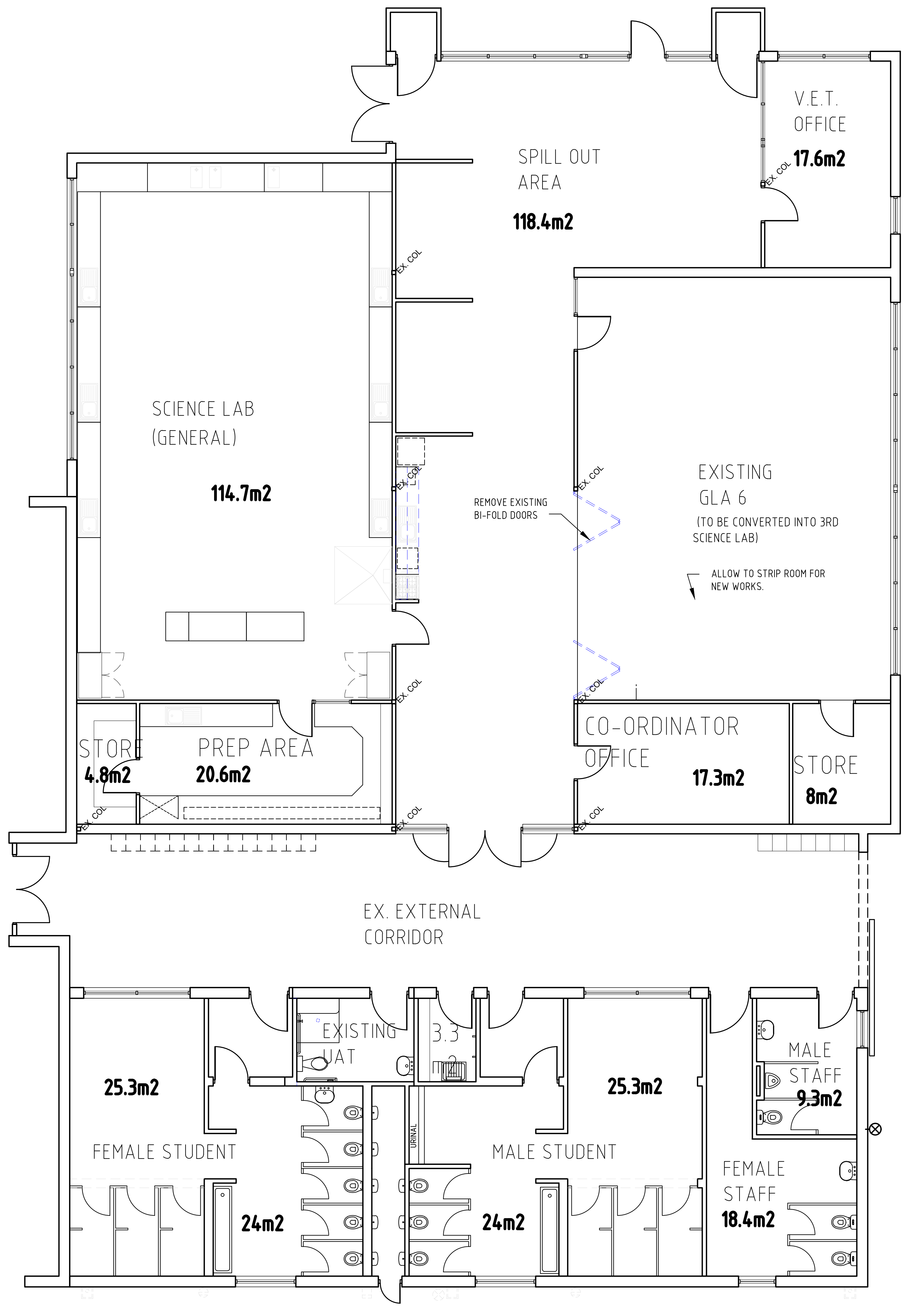
- ALL MATERIALS ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS UNLESS NOTED OTHERWISE

ST. JOSEPH'S SCHOOL
77 WELLINGTON STREET, NORTHAM WA 6401
ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
1ST FLOOR EXTENSION
PROPOSED 1ST FLOOR FLOOR PLAN

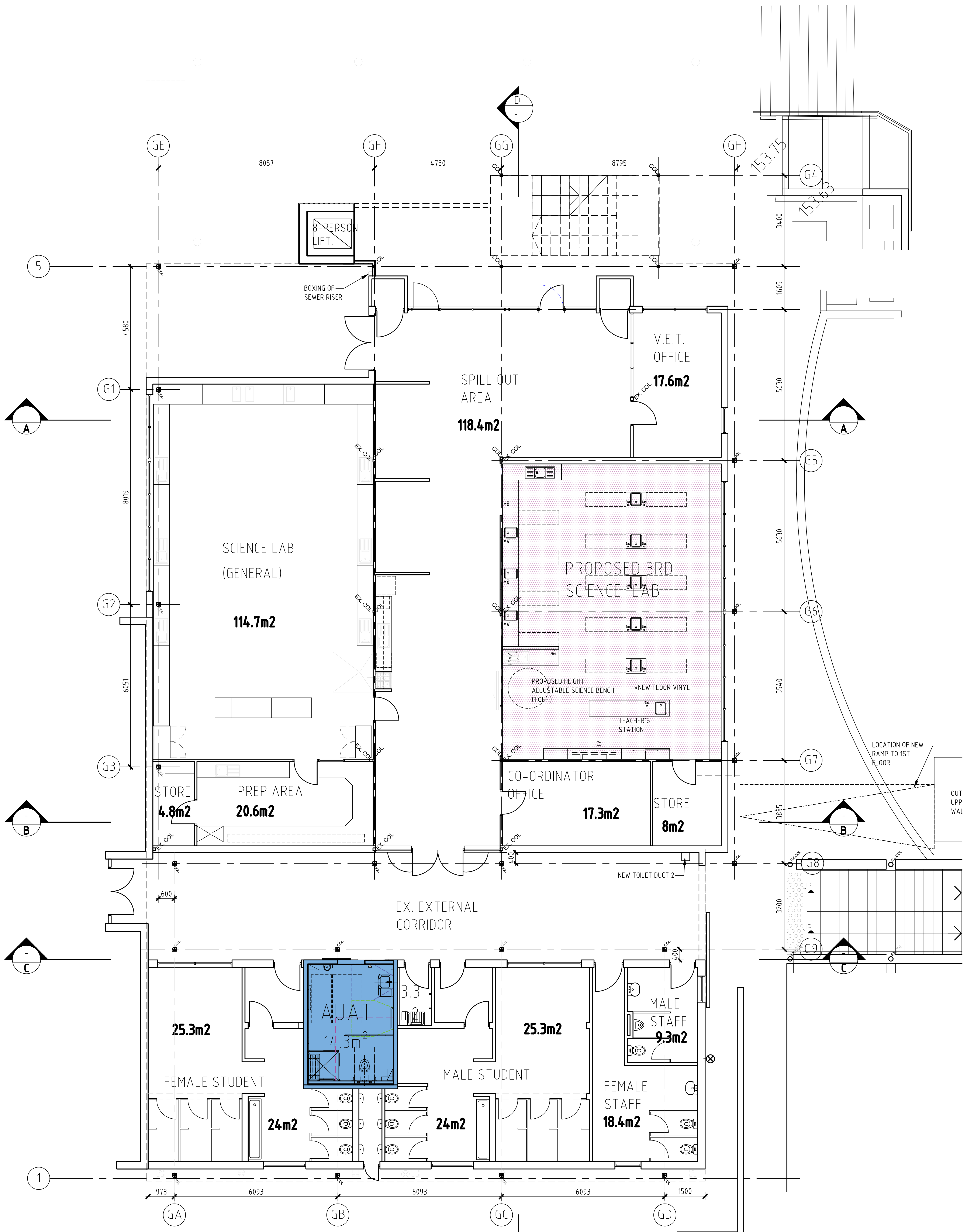
Drawn: JDV
Checked: CC
Scale: 1:100 @ A1
Project Phase: DESIGN DEVELOPMENT
Project Number: 24004
Drawing Number: WD.1FE.1PL.1
Revision: B



SCIENCE & UAT/AUAT
EXISTING FLOOR PLAN

SCALE 1:100@A1

0m 1m 2m 3m 4m 5m 10m



SCIENCE & UAT/AUAT
PROPOSED FLOOR PLAN

SCALE 1:100@A1

0m 1m 2m 3m 4m 5m 10m

REV	Date	Drawn	Description
B	10.12.2024	JD	ISSUE FOR TIA REPORT
B	02.12.2024	JD	DD COSTING ISSUE
A	19.11.2024	JD	BCA & SECTION J CONSULTANTS ISSUE
A	22.10.2024	JD	GENERAL ISSUE - START OF DESIGN DEVELOPMENT

santelli chong ARCHITECTS

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- DO NOT SCALE DRAWING - DIMENSIONS TO GOVERN SCALE
- ALL DIMENSIONS ARE TO BE CHECKED ON SITE PRIOR TO THE COMMENCEMENT OF ANY WORK OR THE FABRICATION OF ANY ITEMS
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ST. JOSEPH'S SCHOOL
77 WELLINGTON STREET, NORTHAM WA 6401
ALTERATIONS & ADDITIONS - STAGE 14

Drawing Name
1ST FLOOR EXTENSION
EX. & PROPOSED GROUND FLOOR PLANS

Drawn: JDV
Checked: CC
Scale: 1:100 @ A1

Project Phase: DESIGN DEVELOPMENT

Project Number: 24004
Drawing Number: WD.1FE.1PL.2
Revision: B

Appendix C

Survey Data

Appendix C Survey Data

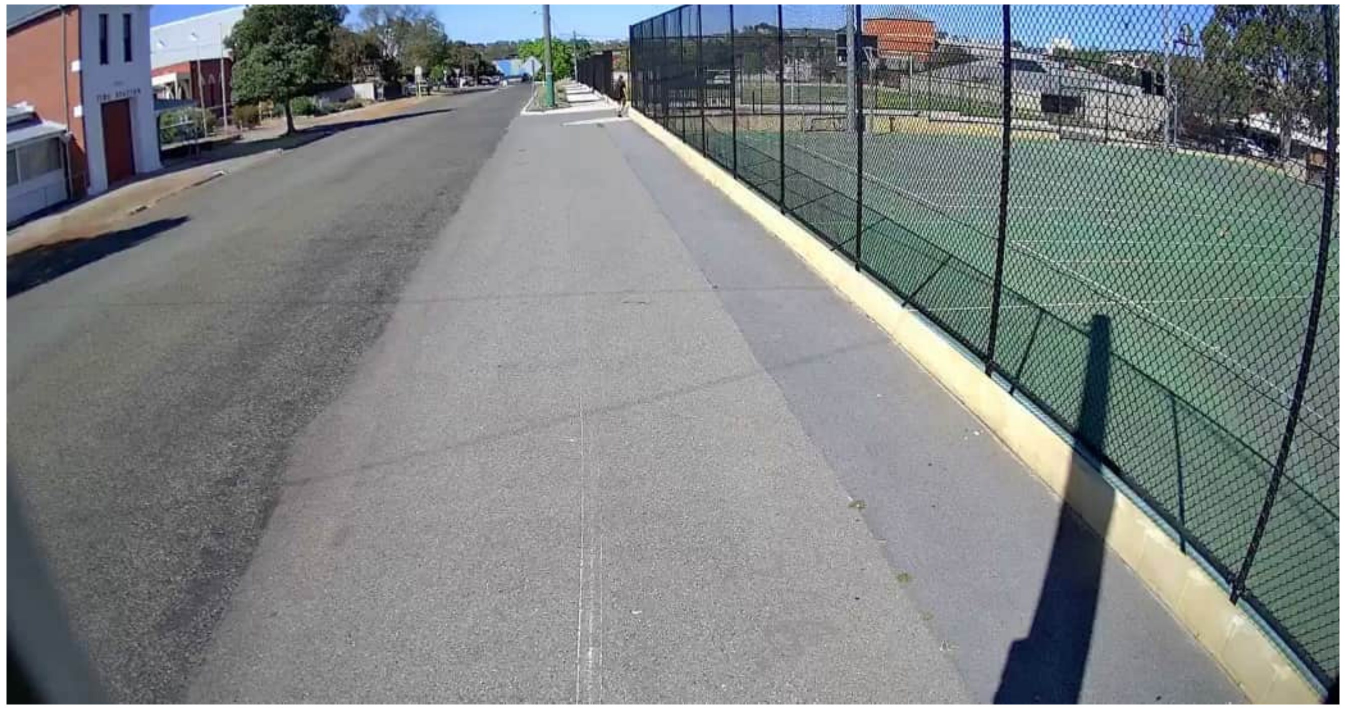
Camera 1

Camera 2

Camera 3

Camera 4

Camera 5

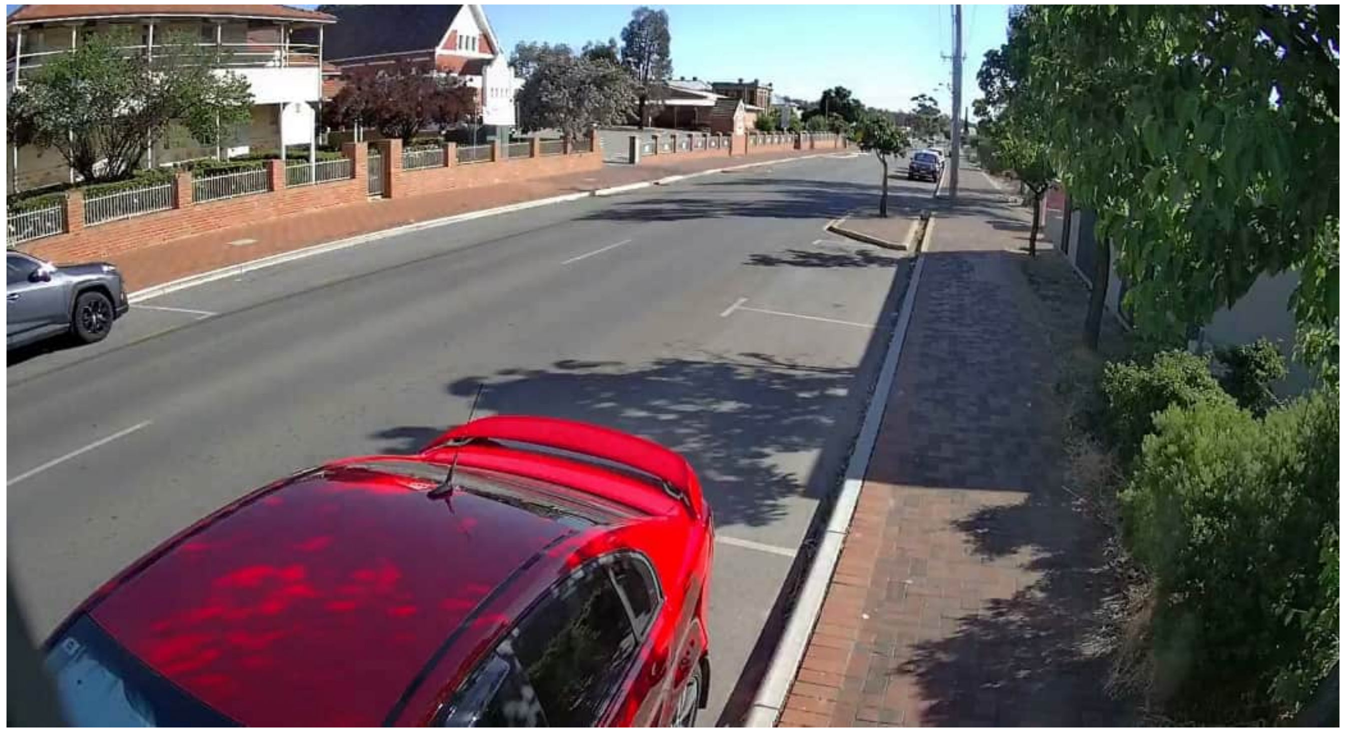


Camera 6

Camera 7

Camera 8

Camera 9



transport ● engineering ● placemaking

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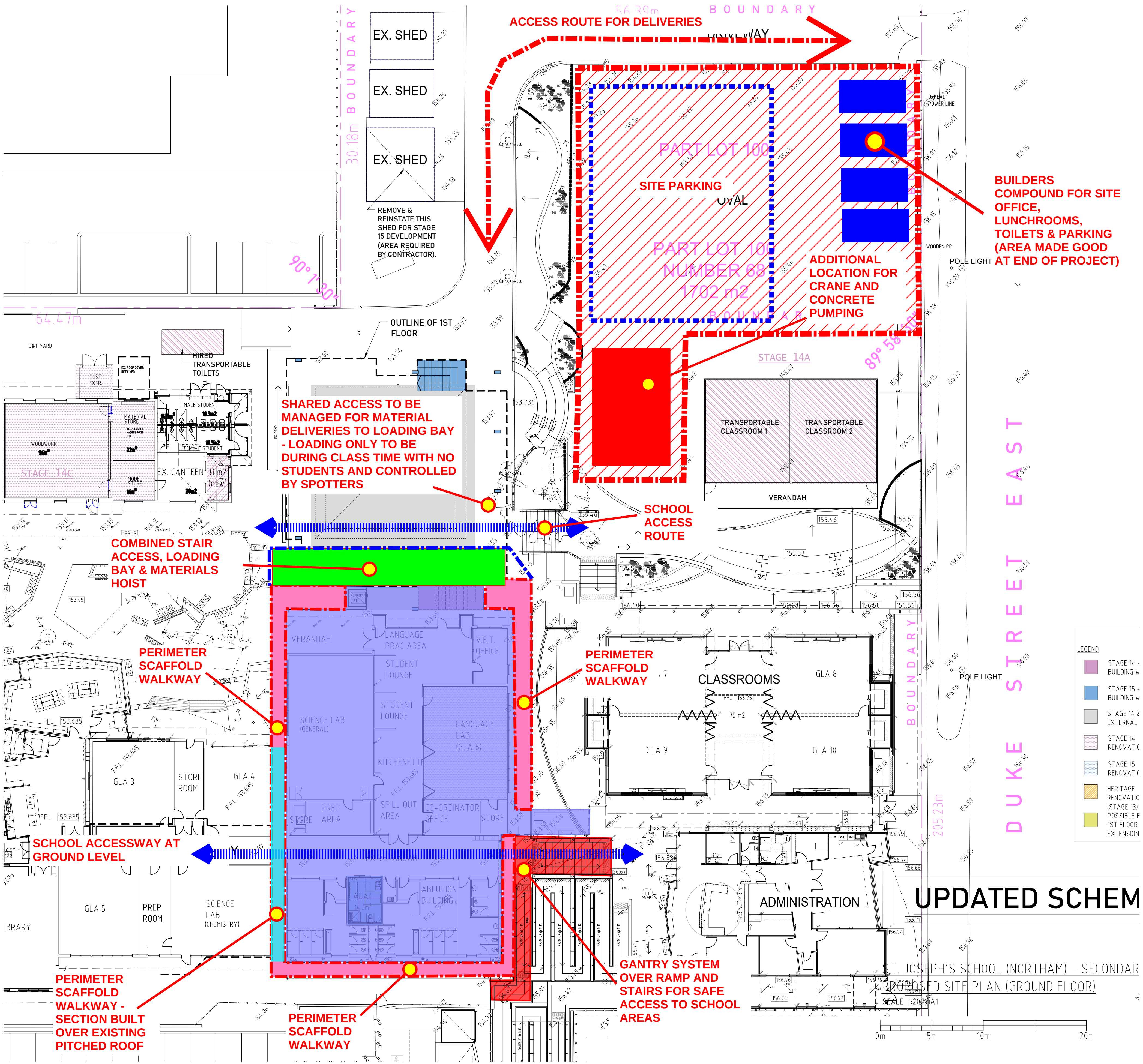
Appendix E

Site Establishment Plan

Cooper and Oxley



NOTE

Temporary site security fencing to be installed around the site to prevent unauthorised access

Warning signs and pedestrian access signage installed on pavement where applicable. Safe access to be provided for public on footpaths/access ways

Protected access ways for students and staff to be provided via scaffold gantry and hoarding systems.

Lifting activities and concrete pumping to be scheduled in conjunction with the school and planned for days with least impact on school.

COOPER & OXLEY

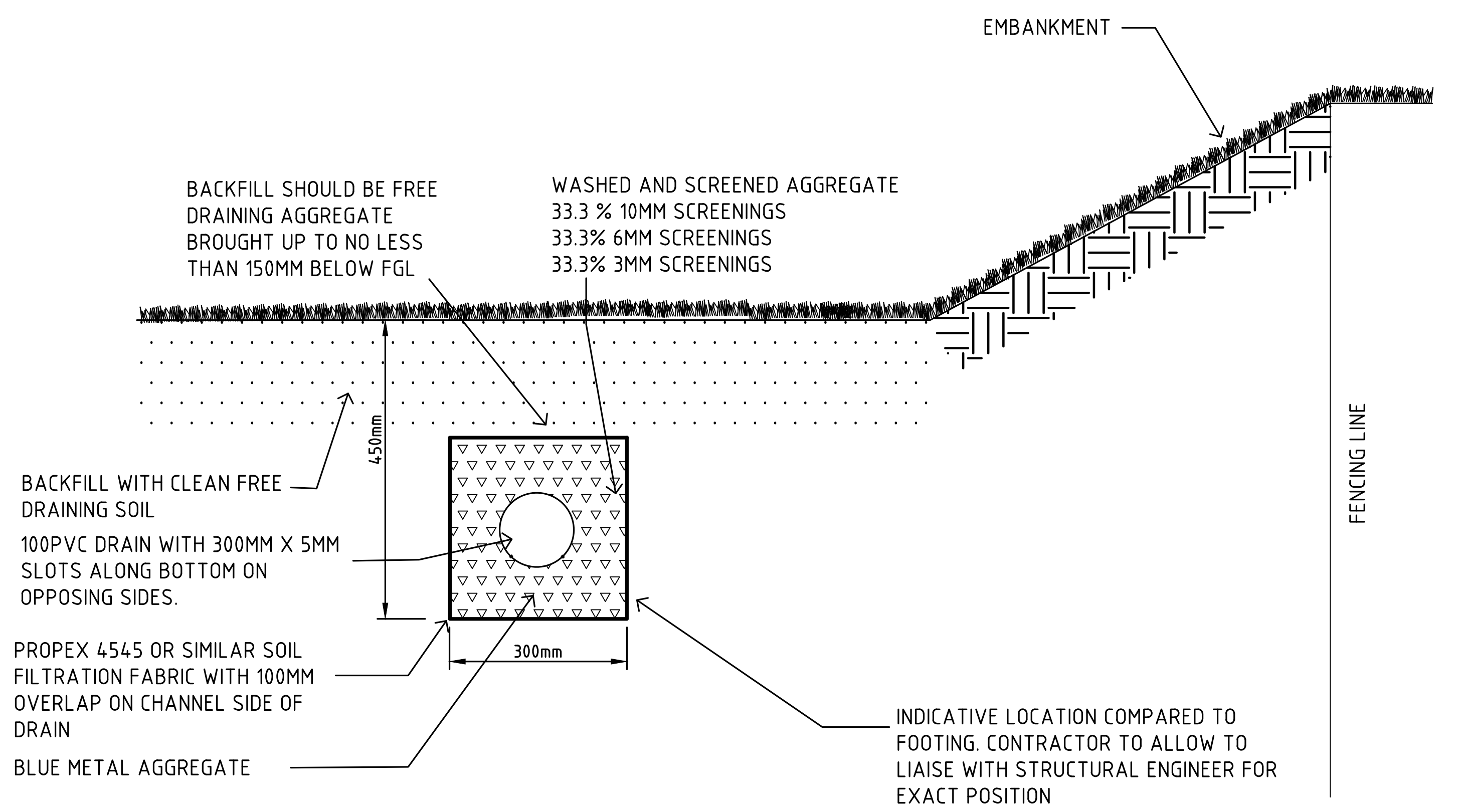
ST JOSEPHS SENIOR SCHOOL EXPANSION, NORTH

Proposed Site Establishment Plan

Appendix F

Stormwater Management Plan

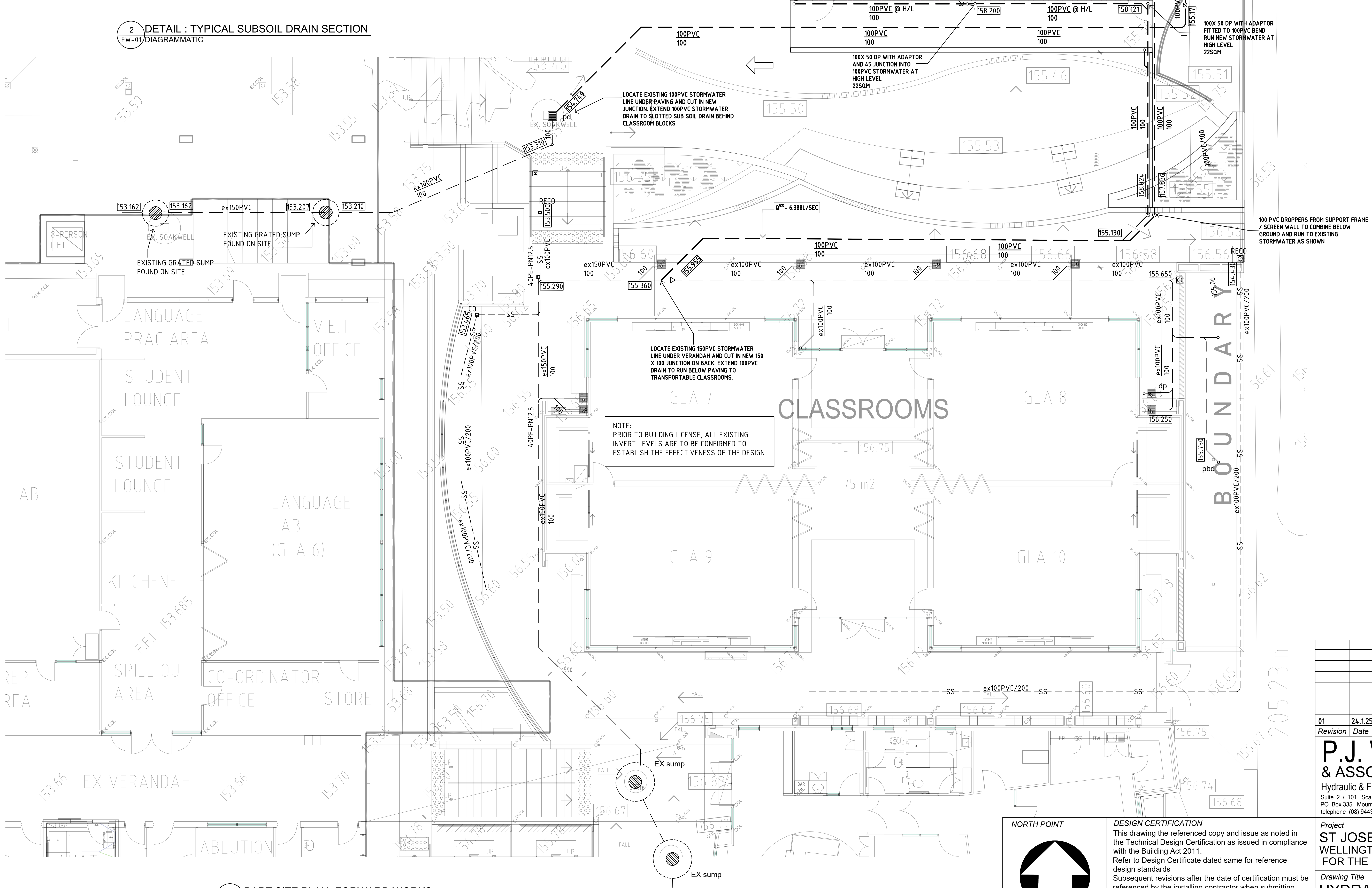
PJ Wright & Associates



2
FW-01

DETAIL : TYPICAL SUBSOIL DRAIN SECTION

DIAGRAMMATIC



LOCATE EXISTING 100PVC STORMWATER LINE UNDER PAVING AND CUT IN NEW JUNCTION. EXTEND 100PVC STORMWATER DRAIN TO SLOTTED SUB SOIL DRAIN BEHIND CLASSROOM BLOCKS

LOCATE EXISTING 150PVC STORMWATER LINE UNDER VERANDAH AND CUT IN NEW 150 X 100 JUNCTION ON BACK. EXTEND 100PVC DRAIN TO RUN BELOW PAVING TO TRANSPORTABLE CLASSROOMS.

100 PVC DROPPERS FROM SUPPORT FRAME / SCREEN WALL TO COMBINE BELOW GROUND AND RUN TO EXISTING STORMWATER AS SHOWN

NOTE:
PRIOR TO BUILDING LICENSE, ALL EXISTING INVERT LEVELS ARE TO BE CONFIRMED TO ESTABLISH THE EFFECTIVENESS OF THE DESIGN

1
FW-01

PART SITE PLAN- FORWARD WORKS

SCALE 1:100

DESIGN PRINCIPLES

THE STORMWATER DESIGN PRINCIPLE IS TO COLLECT ALL RUN OFF AND DISPOSE TO THE SHIRE OF NORTHAM STORMWATER SYSTEM VIA SUMPS AND A PIPED DRAINAGE SYSTEM TO THE GORDON STREET SYSTEM INSTALLED IN PREVIOUS STAGES.
THE GORDON SYSTEM HAS A SURPLUS STORAGE CAPACITY OF 1.61M^3
1% EVENTS OVERFLOW TO OVAL / GRASSED AREA.

ROOF AREA 211 SQUARE METERS.
5 % AEP FOR FIVE MINUTES 109MM/HR.
1 % AEP FOR FIVE MINUTES 157MM/HR.

DESIGN VOLUMES
1.916M^3 OVER FIVE MINUTES PIPED TO EXISTING SYSTEM
0.855M^3 OVER FIVE MINUTES VIA OVERLAND FLOW FROM EAVE GUTTER OVERFLOW.

SUB SOIL DRAINAGE TO RUN THROUGH TO THE EXISTING WELLINGTON STREET SYSTEM.

STORMWATER DRAINAGE NOTES

ALLOW TO SUPPLY ALL DRAINAGE COMPONENTS INDICATED ON THIS DRAWING COMPLETE WITH ALL FIXINGS AND ANCILLARY ITEMS AS NOTED.
ALLOW TO MAKE ALL NECESSARY APPLICATIONS AND GAIN ALL APPROVALS PRIOR TO COMMENCING ON SITE. COMPLY WITH ALL STATUTORY AND LOCAL AUTHORITY REQUIREMENTS.
INSTALL STORMWATER DRAINAGE PIPE WORK TO GRADES AND LEVELS AS SHOWN.
ALL PVC SHALL BE INSTALLED TO AS 2032 AND AS/NZS 3500.3.2 AND TO SATISFACTION OF SHIRE OF NORTHAM ENGINEERING DEPARTMENT.
THE SIZES NOMINATED ON THE DRAWINGS SHALL NOT BE REDUCED WITHOUT THE CERTIFYING DESIGN CONSULTANTS WRITTEN APPROVAL.

ABOVE GROUND DRAINAGE LINES TO BE CLIPPED TO GALVANISED STEEL GALLOWS BRACKETS FIXED TO STRUCTURAL FARMING.
ALLOW TO PAINT ALL EXPOSED PVC PIPEWORK WITH TWO COATS OF UV RESISTANT PAINT (SOLAGUARD OR EQUAL. COLOUR DETERMINED BY PROJECT ARCHITECT.

EXCAVATION AND DEWATERING

ALLOW TO EXCAVATE TO PERMIT INSTALLATION OF DRAINAGE LINES AND SUPPORT EXCAVATION.
ALLOW TO OVER EXCAVATE AND INSTALL A 100MM THICK BLUE METAL AGGREGATE BED (14MM AGGREGATE) TO ALL NEW DRAINAGE STRUCTURES AND A 100MM THICK AGGREGATE BED UNDER NEW DRAINAGE LINES.
COMPACTED TO PROVIDE STABLE AND TRUE BASE FOR STRUCTURES. ALLOW TO STORE ALL SPOIL ON SITE.
ALLOW TO CONTINUOUS DEWATERING OF EXCAVATIONS FROM WHATEVER CAUSE AND MAINTAIN A DRY EXCAVATION UNTIL BACKFILLING IS COMPLETED.

BACKFILL AND COMPACTION.

THE INITIAL 300MM OF BACKFILL OVER DRAINS SHALL BE WITH CLEAN SHARP SAND FREE FROM CLAY, ROCKS OR VEGETABLE MATTER, IN LAYERS NOT EXCEEDING 300MM.
COMPACT WITH TWO PASSES WITH A 50 KG VIBRATORY PLATE COMPACTOR. TO OBTAIN 95% OF EXISTING NATURAL DENSITY.
THE FINAL 300MM OF BACKFILL CAN BE CARRIED OUT USING THE ORIGINAL EXCAVATED MATERIAL FREE FROM ROCK OR CLAY LUMPS AND COMPACTED TO ORIGINAL DENSITY OF SURROUNDING SITE AREA.

NOTE:
ENSURE THAT FINAL INVERT LEVEL OF SUBSOIL DRAINAGE IS AT OR BELOW FINISHED CUT LEVEL OF NATURAL CLAY GROUND

Revision	Date	Description
01	24.1.25	ISSUED FOR STORMWATER APPROVAL

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AHSCA
THE ASSOCIATION OF HYDRAULIC SERVICES CONSULTANTS AUSTRALIA INCORPORATED

NORTH POINT

DESIGN CERTIFICATION
This drawing the referenced copy and issue as noted in the Technical Design Certification as issued in compliance with the Building Act 2011.
Refer to Design Certificate dated same for reference design standards
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Authorized Engineering Staff For PJ Wright& Assoc. Date

Project
ST JOSEPH'S SCHOOL - SECONDARY STAGE 14
WELLINGTON STREET, NORTHAM
FOR THE CATHOLIC EDUCATION OFFICE

Drawing Title
HYDRAULIC SERVICES
PART SITE PLAN - FORWARD WORKS

Date SEPT 24
Scale 1:100@A1
Drawn TRS
Drawing Number FW-01
Revision 01

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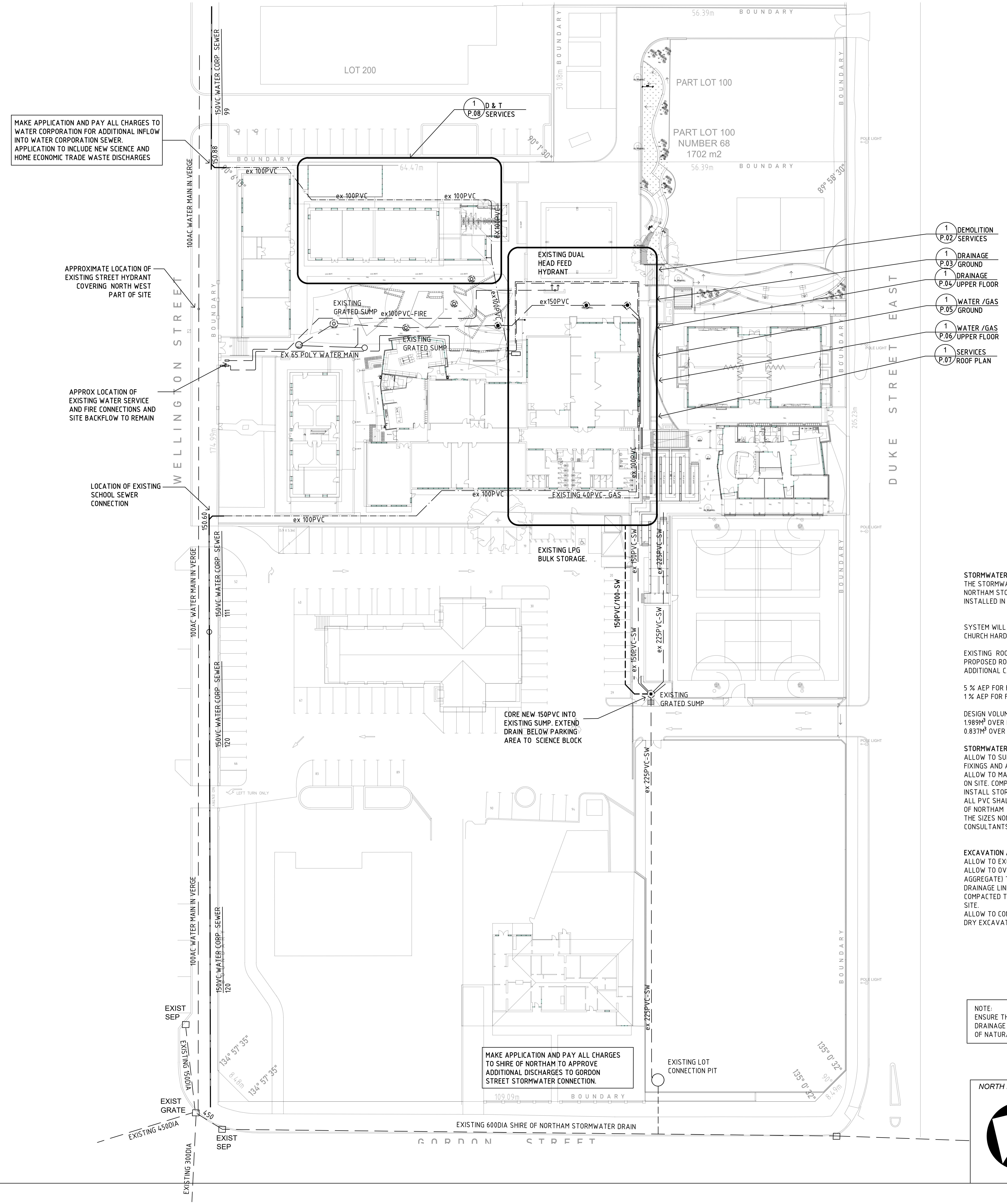

LINEWORK LEGEND (APPLICABLE TO DRAINAGE SHEETS)

SOIL DRAINAGE
INDUSTRIAL WASTES
STORMWATER
FLOOR WASTE — — —FW— — — — — — — — FW — — — — —
REDUNDANT SERVICE
COLD WATER
HOT WATER
FIRE HYDRANT — — —FH— — — — —FH— —
NATURAL GAS SERVICE

GENERAL NOTES

- ALL WORKS SHALL BE UNDERTAKEN BY LICENSED TRADES PERSONS UNDER THE DIRECT SUPERVISION OF THE LICENSED PLUMBING CONTRACTOR RESPONSIBLE FOR THE PROJECT.
- ALL WORKS SHALL BE CARRIED OUT IN A TRADESMEN LIKE MANNER WITH THE STANDARD OF WORKMANSHIP ACCEPTABLE TO THE PLB INSPECTOR AND THE MASTER PLUMBING ASSOCIATION.
- ALLOW TO COORDINATE THE INSTALLATION OF ALL PLUMBING SERVICES WITH OTHER TRADES AND SERVICES PRIOR TO COMMENCING WORKS ON SITE.

ABBREVIATIONS APPLICABLE TO SERVICE DRAWINGS

AAV	AIR ADMITTANCE VALVE
AFFL	ABOVE FINISHED FLOOR LEVEL
A/C	AIR CONDITIONING
AP	ACCESS PANEL
BS	BRASS
BV	BALL VALVE
C	COPPER
CI	CAST IRON
CP	CHROME PLATED
CV	CHECK VALVE
CW	COLD WATER
DCV	DOUBLE CHECK VALVE (TESTABLE U.O.N.)
DP	DOWNPIPE
DPO	DOWNPIPE ON LEVEL OVER
DHB	DISABLED HAND BASIN
Dwc	DISABLED WATER CLOSET
FA	FROM LEVEL ABOVE (DROPPER)
FB	FROM LEVEL BELOW (RISER)
FFL	FINSIHED FLOOR LEVEL
FG	FLOOR WASTE GULLY
FW	FLOOR WASTE
FWST	FLOOR WASTE STACK
GSP	GAVLANISED STEEL PIPE
GV	GATE VALVE
GAVL'D	GALVANISED
HB	HAND BASIN
HW	HOT WATER
HWU	HOT WATER UNIT
I.O.	INPSECTION OPENING OR INSPECTION GATE
IWSP	INDUSTRIAL WASTE SAMPLING POINT
IWT	INDUSTRIAL WASTE TRAP
LIT	LEVEL INVERT TAPER
NRV	NON RETURN VALVE
PE	POLYETHYLENE (HD- HIGH DENSITY MD MEDIUM DENSITY)
PP	POLYPROPYLENE
PVC	POLY VINYL CHLORIDE (UNPLASTICISED U.O.N.)
RE	ROD END
RS	RISING SHAFT
RPZD	REDUCED PRESSURE ZONE DEVICE
SC	STOPCOCK
sk	SINK
SS	STAINLESS STEEL
SST	SOIL STACK
ST#	STACK (# = DESIGNATION/ NUMBER)
SW	STORMWATER
TA	TO LEVEL ABOVE (RISER)
TB	TO LEVEL BELOW (DROPPER)
TD	TUNDISH
TCV	TEMPERING VALVE
TMV	THERMOSTATIC CONTROL VALVE
wc	WATER CLOSET - (TOILET PAN)
VPR	VENT PIPE RISER

X / P.xx	DETAIL NUMBER / DWG NUMBER
xxx / xx	SERVICE TYPE / NOMINAL BORE
FU / X	NOMINAL FIXTURE UNITS

STORMWATER DESIGN PRINCIPLES

THE STORMWATER DESIGN PRINCIPLE IS TO COLLECT ALL RUN OFF AND DISPOSE TO THE SHIRE OF NORTHAM STORMWATER SYSTEM VIA EXISTING SUMPS AND A PIPED DRAINAGE SYSTEM TO THE INSTALLED IN PREVIOUS STAGES.

SYSTEM WILL OVERFLOW IN MAJOR STORM EVENTS VIA THE EXISTING GRATED SUMP ONTO THE CHURCH HARDSTANDING WITH OVERLAND FLOW TO WELLINGTON STREET.

EXISTING ROOF CATCHMENT 663 SQUARE METERS
PROPOSED ROOF CATCHMENT 882 SQUARE METERS.
ADDITIONAL CATCHMENT OF 219 SQUARE METRES HAS BEEN DIRECTED TO GORDON STREET

5 % AEP FOR FIVE MINUTES 109MM/HR.
1 % AEP FOR FIVE MINUTES 157MM/HR.

DESIGN VOLUMES
1.989M^3 OVER FIVE MINUTES PIPED TO EXISTING SYSTEM
0.837M^3 OVER FIVE MINUTES VIA OVERLAND FLOW FROM EAVE GUTTER OVERFLOW.

STORMWATER DRAINAGE NOTES

ALLOW TO SUPPLY ALL DRAINAGE COMPONENTS INDICATED ON THIS DRAWING COMPLETE WITH ALL FIXINGS AND ANCILLARY ITEMS AS NOTED.
ALLOW TO MAKE ALL NECESSARY APPLICATIONS AND GAIN ALL APPROVALS PRIOR TO COMMENCING ON SITE. COMPLY WITH ALL STATUTORY AND LOCAL AUTHORITY REQUIREMENTS.
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ALL PVC SHALL BE INSTALLED TO AS 2032 AND AS/NZS 3500.3.2 AND TO SATISFACTION OF SHIRE OF NORTHAM ENGINEERING DEPARTMENT.
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ALLOW TO OVER EXCAVATE AND INSTALL A 100MM THICK BLUE METAL AGGREGATE BED (14MM AGGREGATE) TO ALL NEW DRAINAGE STRUCTURES AND A 100MM THICK AGGREGATE BED UNDER NEW DRAINAGE LINES.
COMPACTED TO PROVIDE STABLE AND TRUE BASE FOR STRUCTURES. ALLOW TO STORE ALL SPOIL ON SITE.
ALLOW TO CONTINUOUS DEWATERING OF EXCAVATIONS FROM WHATEVER CAUSE AND MAINTAIN A DRY EXCAVATION UNTIL BACKFILLING IS COMPLETED.

NOTE:
ENSURE THAT FINAL INVERT LEVEL OF SUBSOIL DRAINAGE IS AT OR BELOW FINISHED CUT LEVEL OF NATURAL CLAY GROUND

Revision	Date	Description
02	24.1.25	ISSUED FOR STORMWATER APPROVAL
01	22.11.24	PRELIMINARY ISSUED FOR COORDINATION

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Authorized Engineering Staff For PJ Wright& Assoc. Date

Project
REFURBISHMENT OF ST. JOSEPH SCHOOL-STAGE 14
1 ISDELL PLACE
GONSNELLS WA 6110.

Drawing Title
HYDRAULIC SERVICES
PROPOSED SITE PLAN

Date	Scale	Drawn	Drawing Number	Revision
22.10.2024	A1@1:500	TRS	P.01	02

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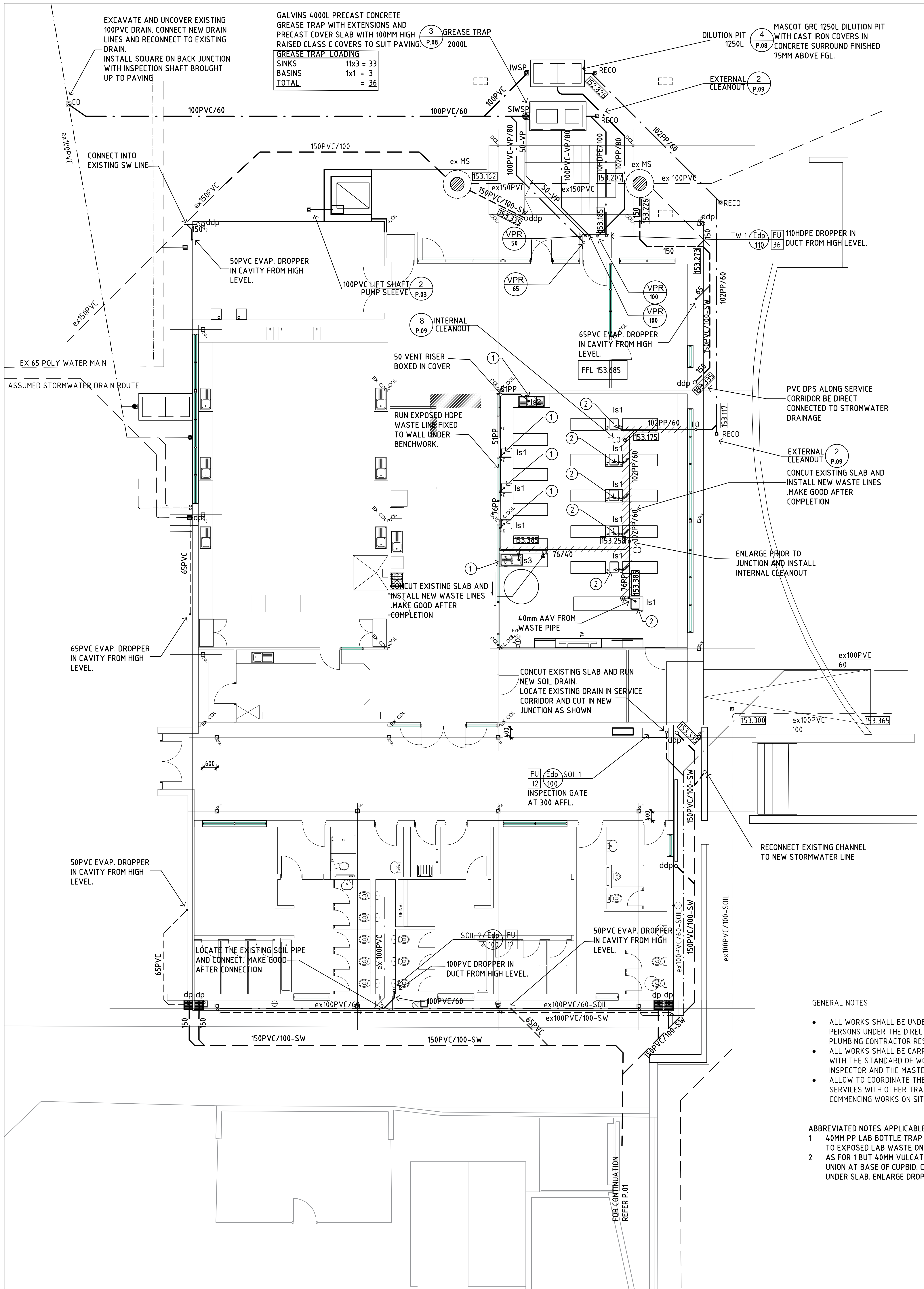
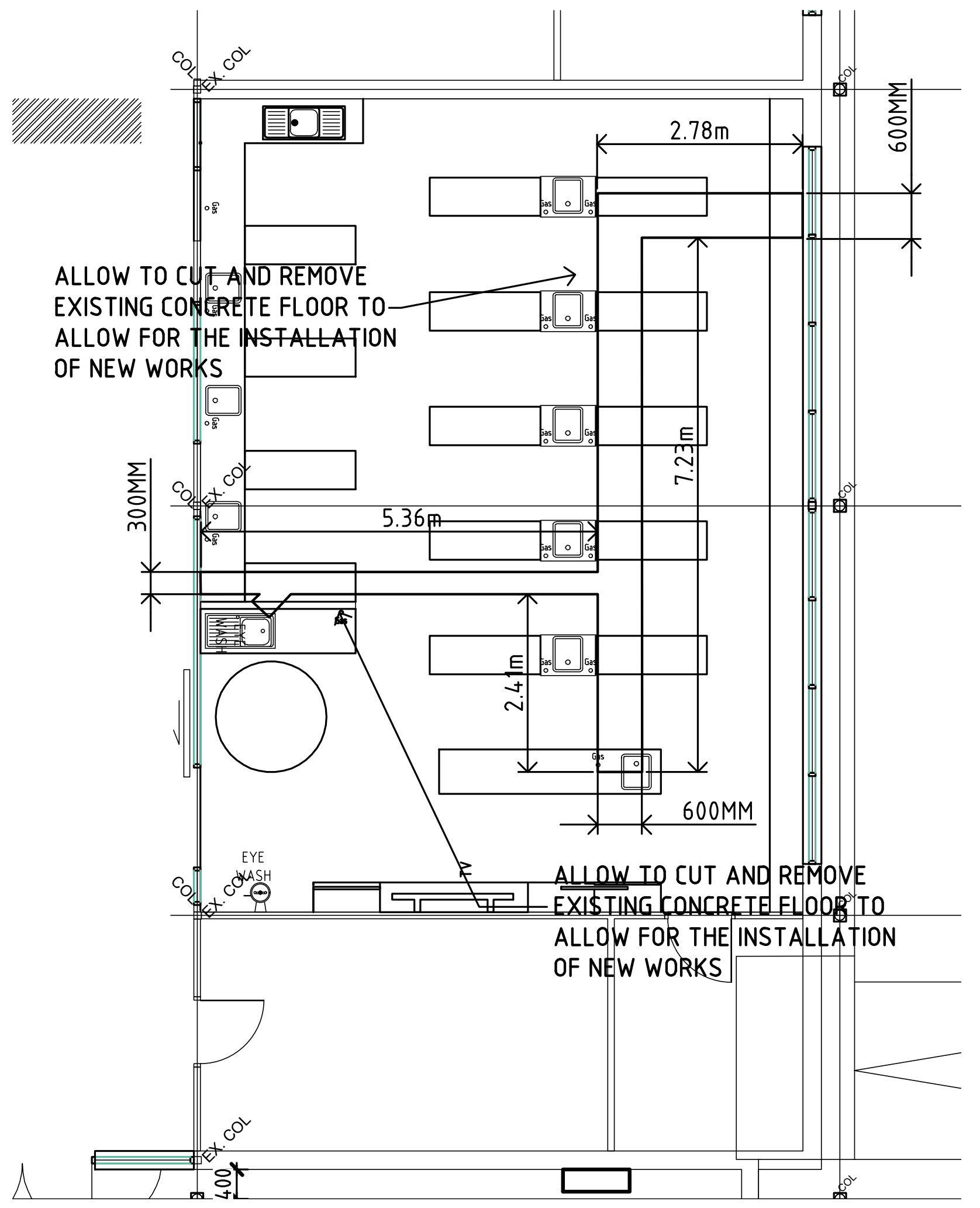
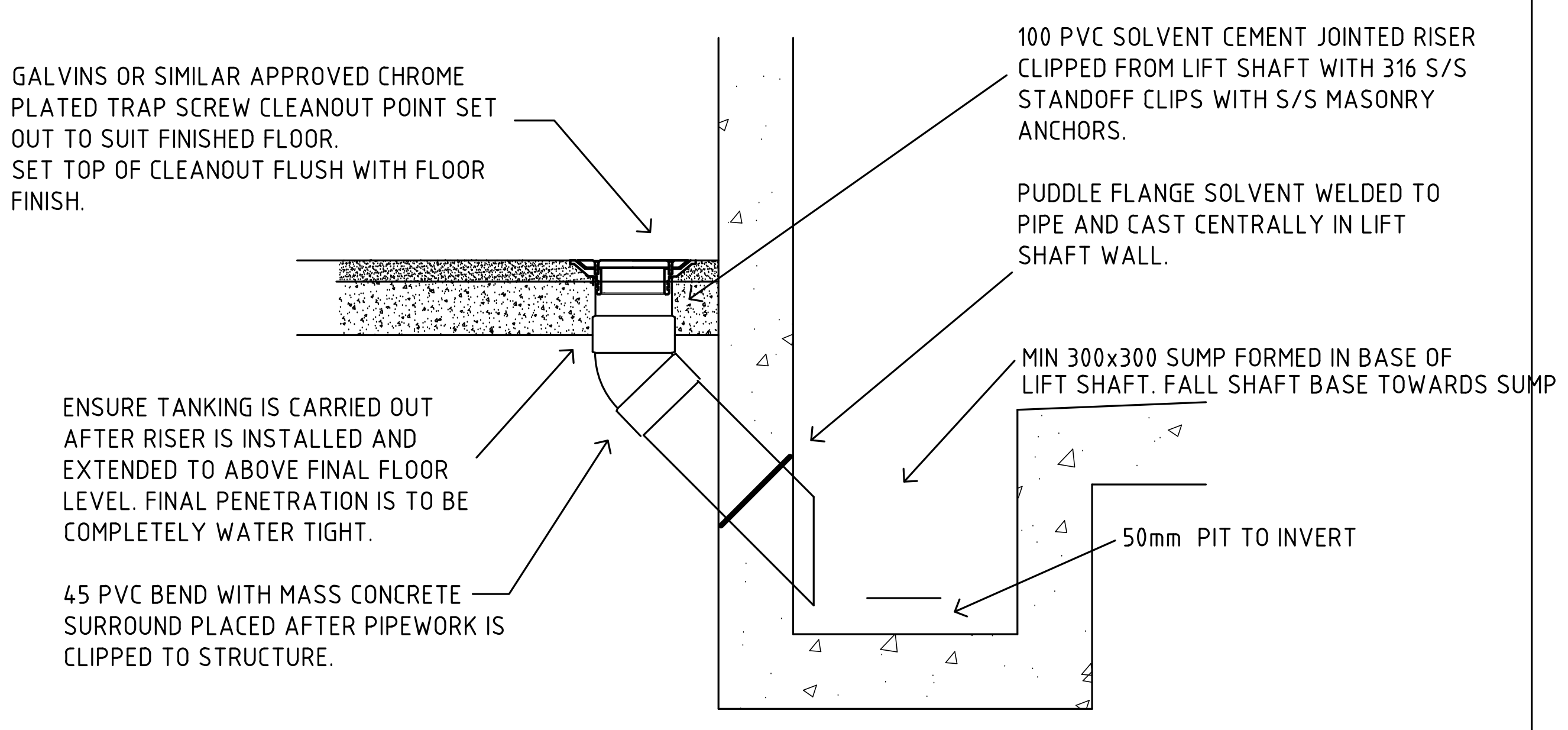


1 P.03 GROUND FLOOR PLAN: DRAINAGE
SCALE 1:100



INSET FLOOR PLAN SLAB REMOVAL
Scale 1:100



2 P.03 DETAIL : LIFT SHAFT PUMP SLEEVE
DIAGRAMMATIC

GENERAL NOTES

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- ALLOW TO COORDINATE THE INSTALLATION OF ALL PLUMBING SERVICES WITH OTHER TRADES AND SERVICES PRIOR TO COMMENCING WORKS ON SITE.

ABBREVIATED NOTES APPLICABLE TO DRAINAGE SERVICES LAYOUT
1 40MM PP LAB BOTTLE TRAP WITH 40MM VULCATHENE WASTE TO EXPOSED LAB WASTE ON WALL.
2 AS FOR 1 BUT 40MM VULCATHENE WASTE DROPPER WITH UNION AT BASE OF CUPBID. CONNECT INTO LAB WASTE DRAIN UNDER SLAB. ENLARGE DROPPER TO 51PP IN VERTICAL

Revision	Date	Description
02	24.1.25	ISSUED FOR STORMWATER APPROVAL
01	22.11.24	PRELIMINARY ISSUED FOR COORDINATION

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Authorized Engineering Staff For PJ Wright& Assoc. Date

Project
REFURBISHMENT OF ST. JOSEPH SCHOOL-STAGE 14
1 ISDELL PLACE
GONSNELLS WA 6110.

Drawing Title
HYDRAULIC SERVICES
GROUND FLOOR DRAINAGE

Date 22.10.2024
Scale A1@1:100
Drawn TRS
Drawing Number P.03
Revision 02

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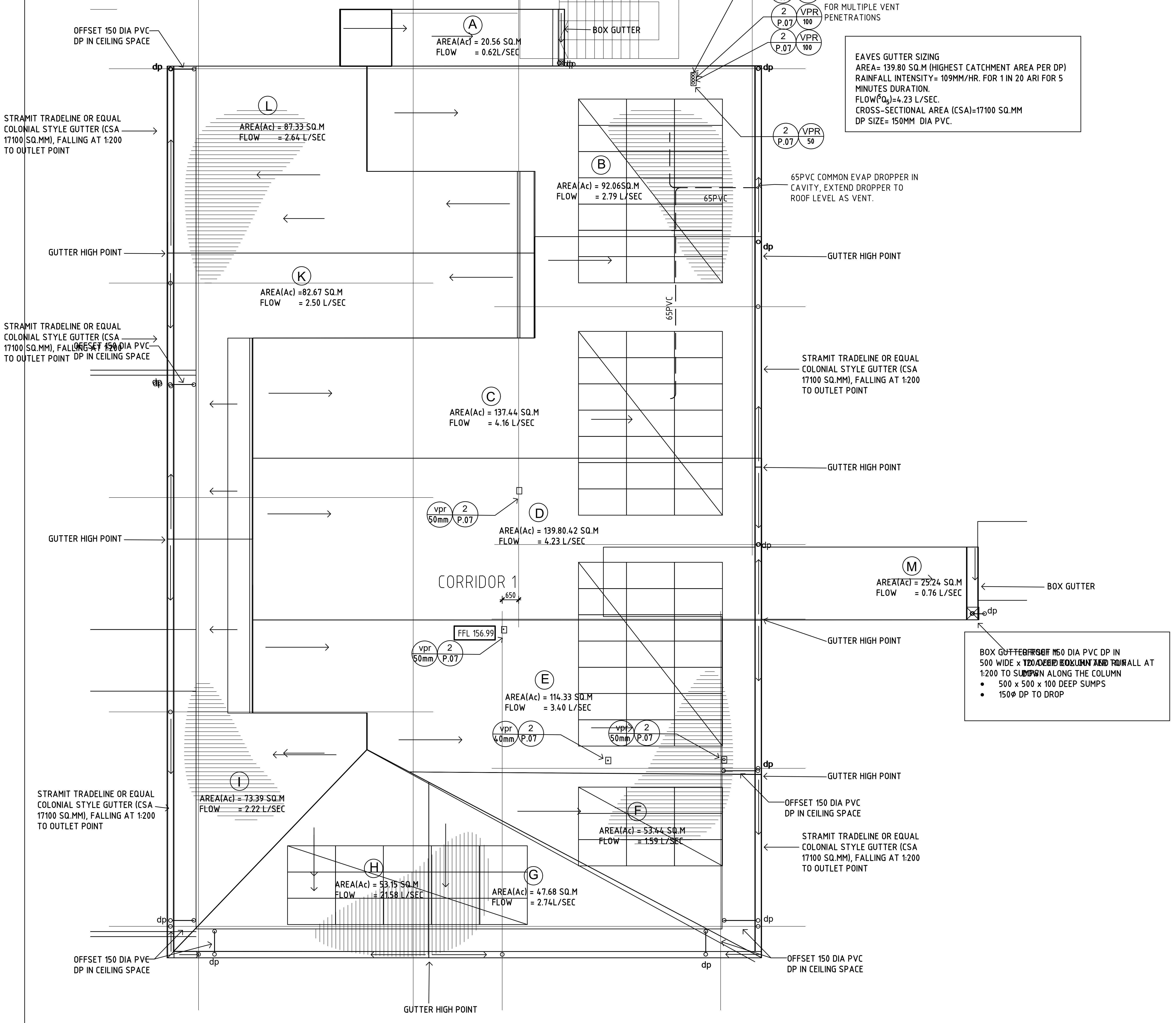
BOX GUTTER ROOF A
250 WIDE x 95 DEEP BOX GUTTER TO FALL AT 1:200 TO SUMPS
- 250 x 250 x 70 DEEP SUMPS
- 150ϕ DP TO DROP

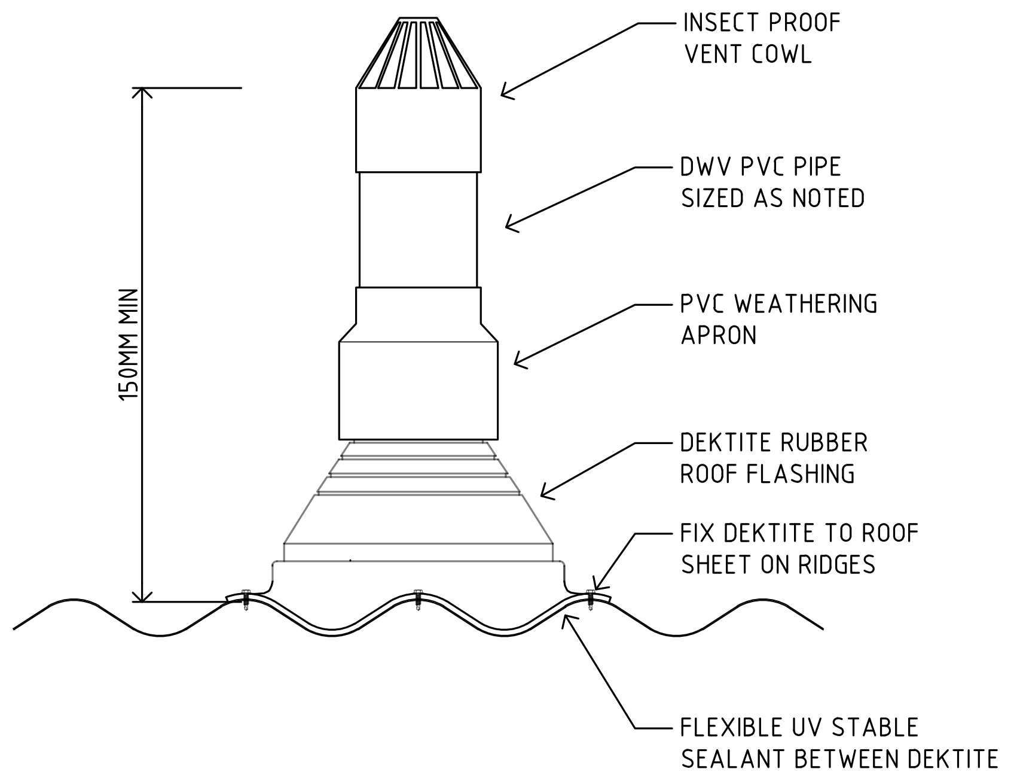
EAVES GUTTER SIZING
AREA= 139.80 SQ.M (HIGHEST CATCHMENT AREA PER DP)
RAINFALL INTENSITY= 109MM/HR. FOR 1 IN 20 ARI FOR 5 MINUTES DURATION.
FLOW(Q_0)=4.23 L/SEC.
CROSS-SECTIONAL AREA (CSA)=17100 SQ.MM
DP SIZE= 150MM DIA PVC.

BOX GUTTER ROOF M
500 WIDE x 120 DEEP BOX GUTTER TO FALL AT
1:200 TO SUMPS
- 500 x 500 x 100 DEEP SUMPS
- 150ϕ DP TO DROP

OFFSET 150 DIA PVC DP IN
TO ADJACENT COLUMN AND RUN
DOWN ALONG THE COLUMN

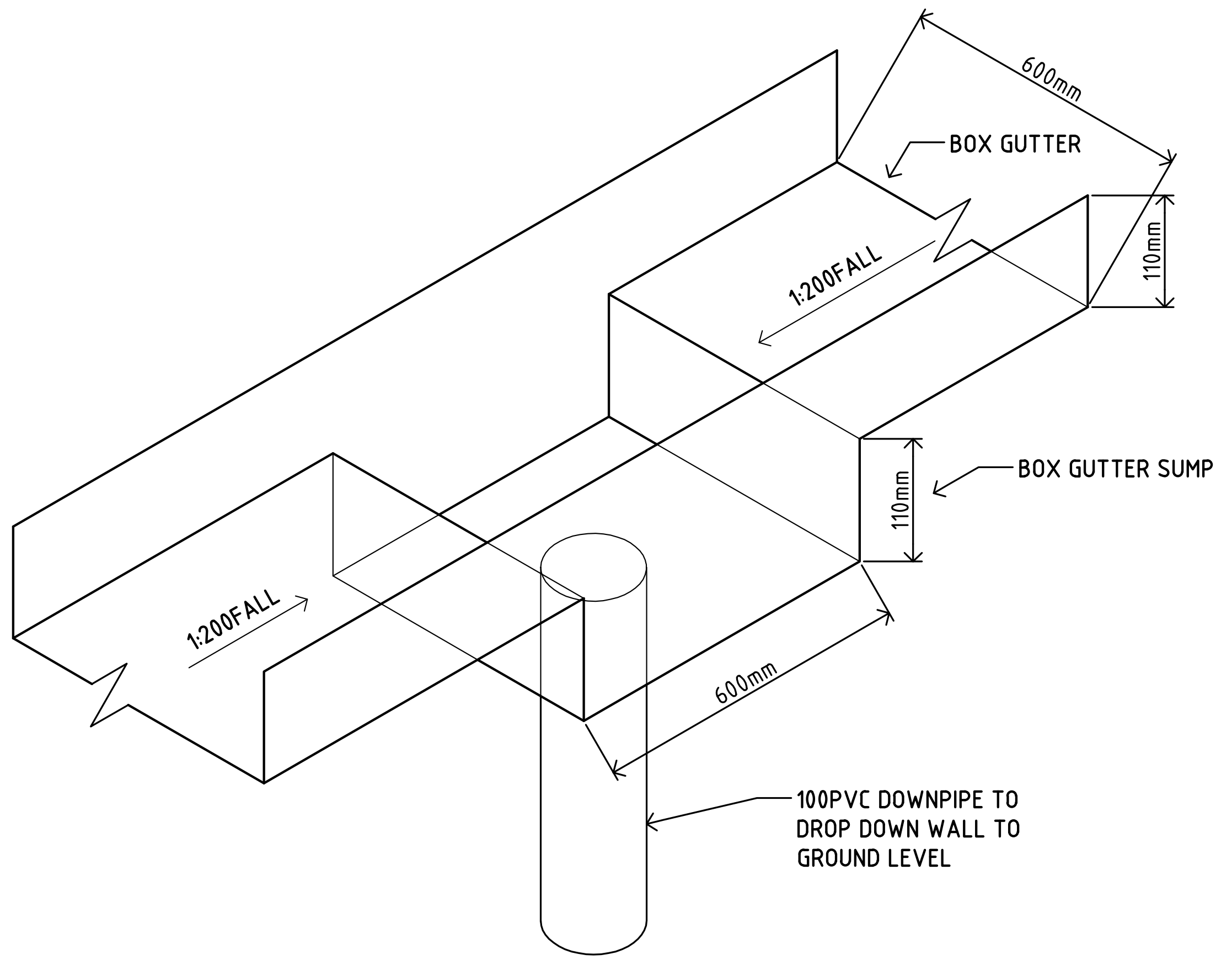


1 P.07 ROOF PLAN: SERVICES
SCALE 1:100



2 P.07 DETAIL : VENT PENETRATION
DIAGRAMMATIC

TERMINATE VENT IN COMPLIANCE WITH THE REQUIREMENTS OF AS3500.2.
COORDINATE TERMINATION POINTS WITH MECHANICAL INTAKES AND EXHAUSTS.
ALLOW TO OFFSET IN ROOF SPACE TO ENSURE TERMINATIONS ARE COMPLAINT AT 150MM ABOVE ROOF LINES.



3 P.07 DETAIL: BOX GUTTER SUMP
NTS

ALL BOX GUTTER AND SUMP COMPONENTS ARE TO COMPLY WITH AS3500.3:2003 AND ARCHITECTURAL DETAILS. ALL MEASUREMENTS ARE TO BE EQUAL TO OR GREATER THAN THE SIZING REQUIREMENTS OF AS3500.3 FIGURE 3.10.

Revision	Date	Description
02	24.1.25	ISSUED FOR STORMWATER APPROVAL
01	22.11.24	PRELIMINARY ISSUED FOR COORDINATION

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Authorized Engineering Staff For PJ Wright& Assoc. Date

Project
ST. JOSEPH SECONDARY SCHOOL-STAGE 14
77 WEILINGTON STREET-EAST
NORTHAM WA 6401

Drawing Title
HYDRAULIC SERVICES
ROOF PLAN

Date 22.10.2024
Scale A1@1:100
Drawn TRS
Drawing Number P.07
Revision 02

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