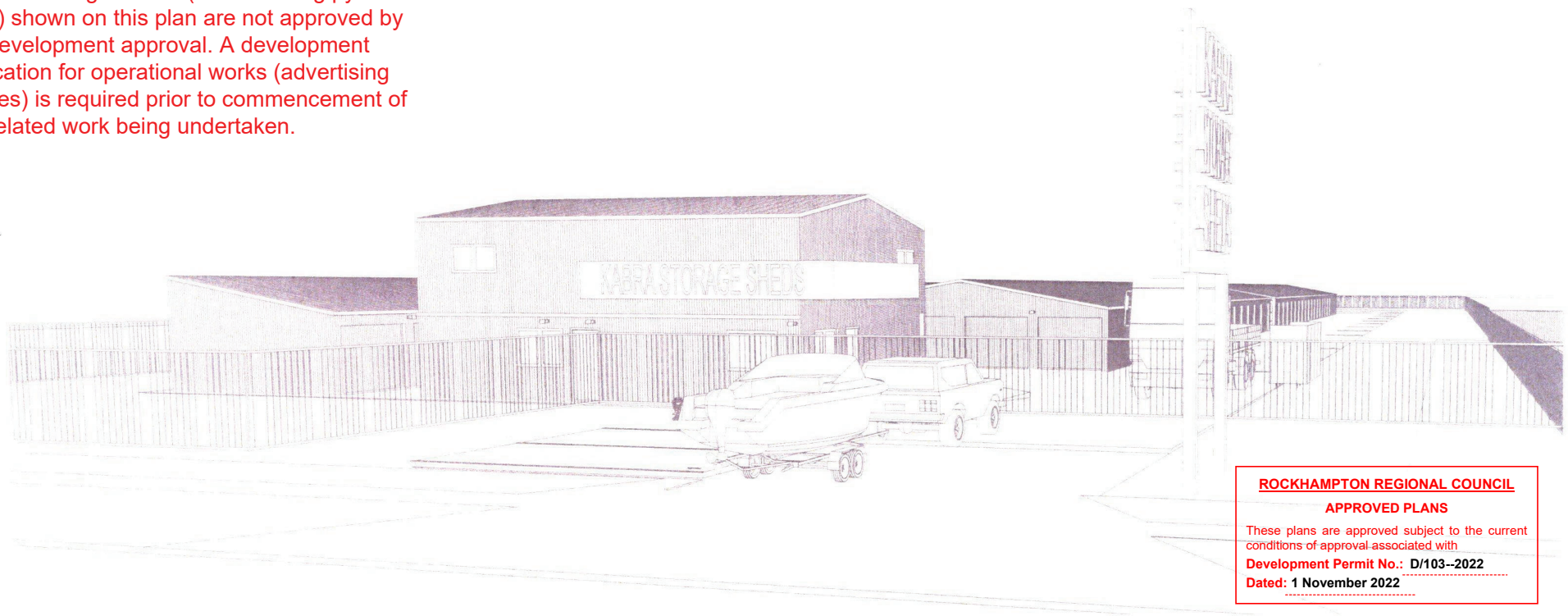
KABRA STORAGE UNITS

AT 14 KABRA ROAD, KABRA QLD 4702 AUST

for

KAZUMI HOLDINGS PTY. LTD.

The advertising devices (free-standing pylon signs) shown on this plan are not approved by this development approval. A development application for operational works (advertising devices) is required prior to commencement of any related work being undertaken.



ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/103--2022

Dated: 1 November 2022

DIMENSIONS
USE FIGURED DIMENSIONS. DO NOT SCALE FROM THE DRAWINGS. CONFIRM ALL DIMENSIONS ON SITE PRIOR TO CONSTRUCTION OR FABRICATION. IT REMAINS THE CONTRACTORS RESPONSIBILITY TO ENSURE COMPLIANCE WITH ALL RELEVANT CODES AND REGULATIONS IS MAINTAINED AT ALL TIMES

File: AMF 22480 /22480 Kabra Storage Shed_SKD_p2

REV	Date	DESCRIPTION
B	15/09/2022	RRC PLANNING - RFI SEPT 2022
A	19/07/2022	RRC PLANNING APPLICATION
P3	22/06/2022	RRC PLANNING MEETING

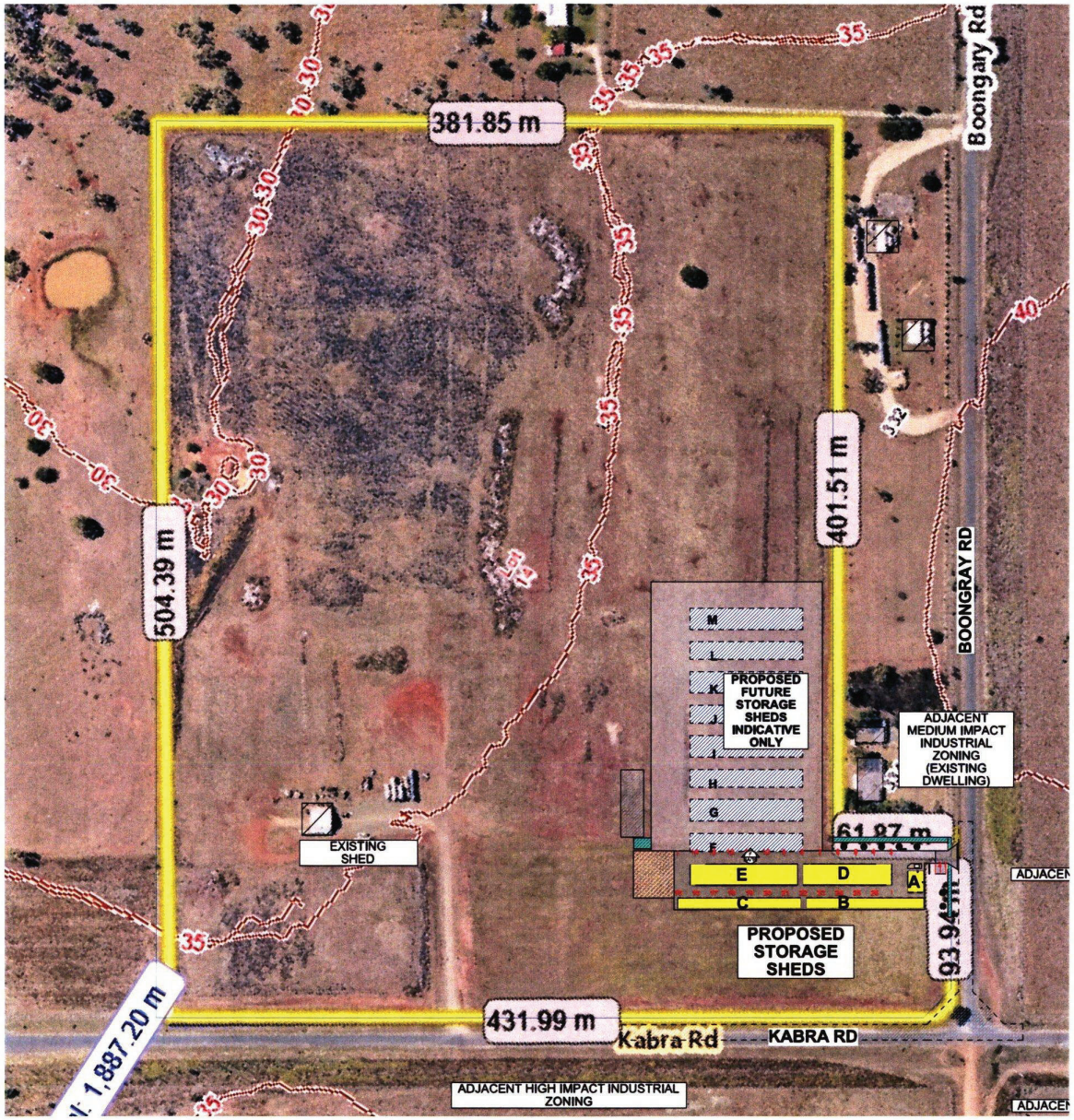
SK Drafting Building Designs

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: **Building Plans**
Cover Sheet

Scale: As shown	Date: JULY 2022
Status: SD	Checked By: SM
Project No: SKD 22-011	Drawing No.: BA/01/B

38842591 - 16/09/2022



FLOOR AREA	
NAME	Measured Area
A1 CARETAKER (FF)	108.00
A1 C'TAKER PARK	15.39
A1 OFFICE (GRD)	34.06
A1 SHED	57.60
B SHED	397.80
C SHED	414.00
D SHED	600.00
E SHED	720.00
	2346.85 m²

FUTURE AREA	
NAME	Measured Area
STAGE 2	630.00
STAGE 2	630.00
STAGE 2	630.00
STAGE 2	630.00
STAGE 2	756.00
STAGE 2	756.00
STAGE 2	756.00
STAGE 2	756.00
	5544.00 m²

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1 SITE MASTER PLAN
Scale 1:1250

DIMENSIONS:
USE FIGURED DIMENSIONS. DO NOT SCALE FROM THE DRAWINGS. CONFIRM ALL DIMENSIONS ON SITE PRIOR TO CONSTRUCTION OR FABRICATION. IT REMAINS THE CONTRACTORS RESPONSIBILITY TO ENSURE COMPLIANCE WITH ALL RELEVANT CODES AND REGULATIONS IS MAINTAINED AT ALL TIMES

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P3	22/06/2022	RRC PLANNING MEETING

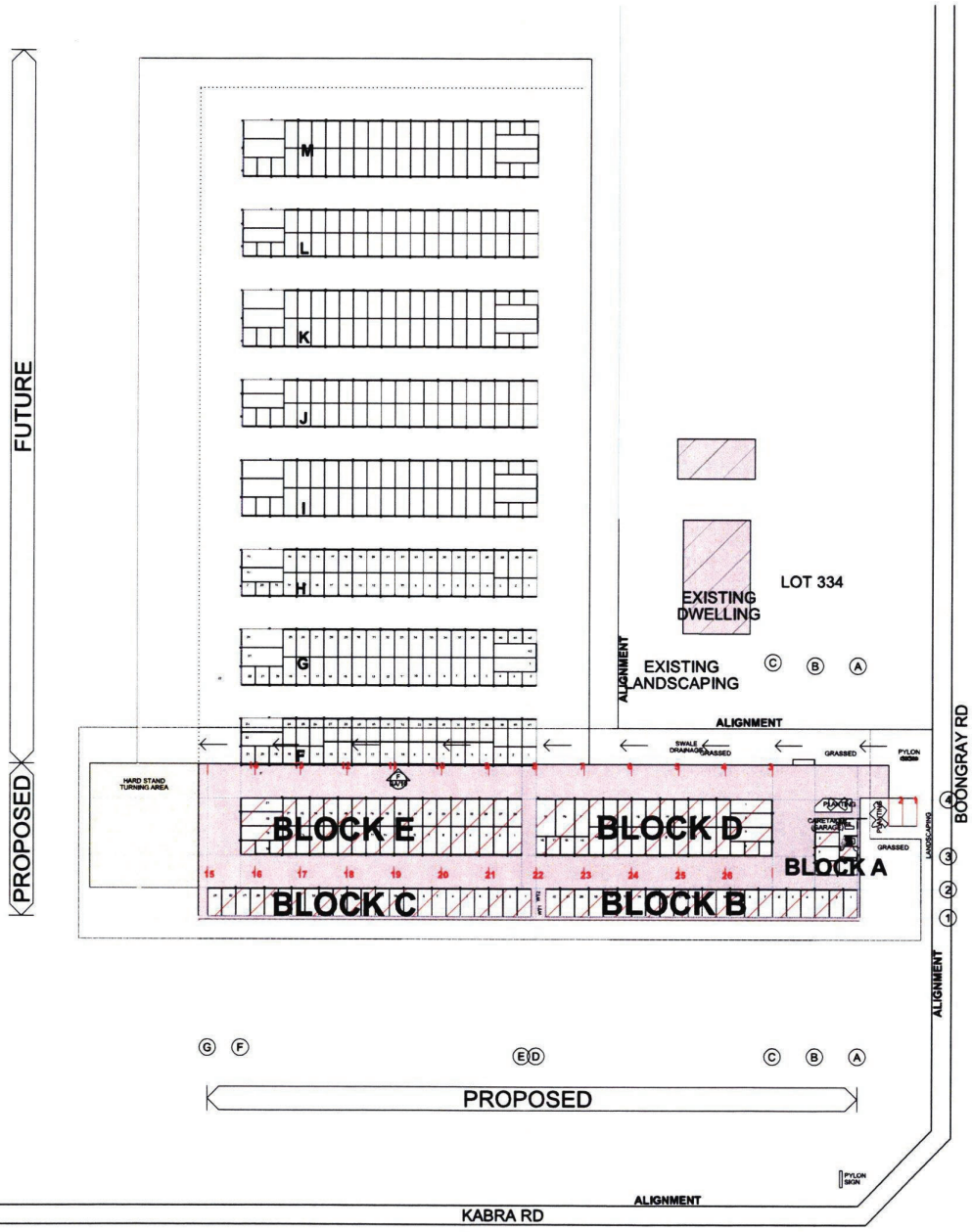
SK Drafting

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
MASTER SITE PLAN

Scale: As shown
Date: JULY 2022
Status: SD
Checked By: SM
Project No: SKD 22-011
Drawing No.: BA/02/B

38842591 - 16/09/2022



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A1 SHED	57.60
B SHED	397.80
C SHED	414.00
D SHED	600.00
E SHED	720.00
	2346.85 m²

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2 MASTER GROUND FLOOR PLAN
Scale 1:500

DIMENSIONS
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REV	Date	DESCRIPTION
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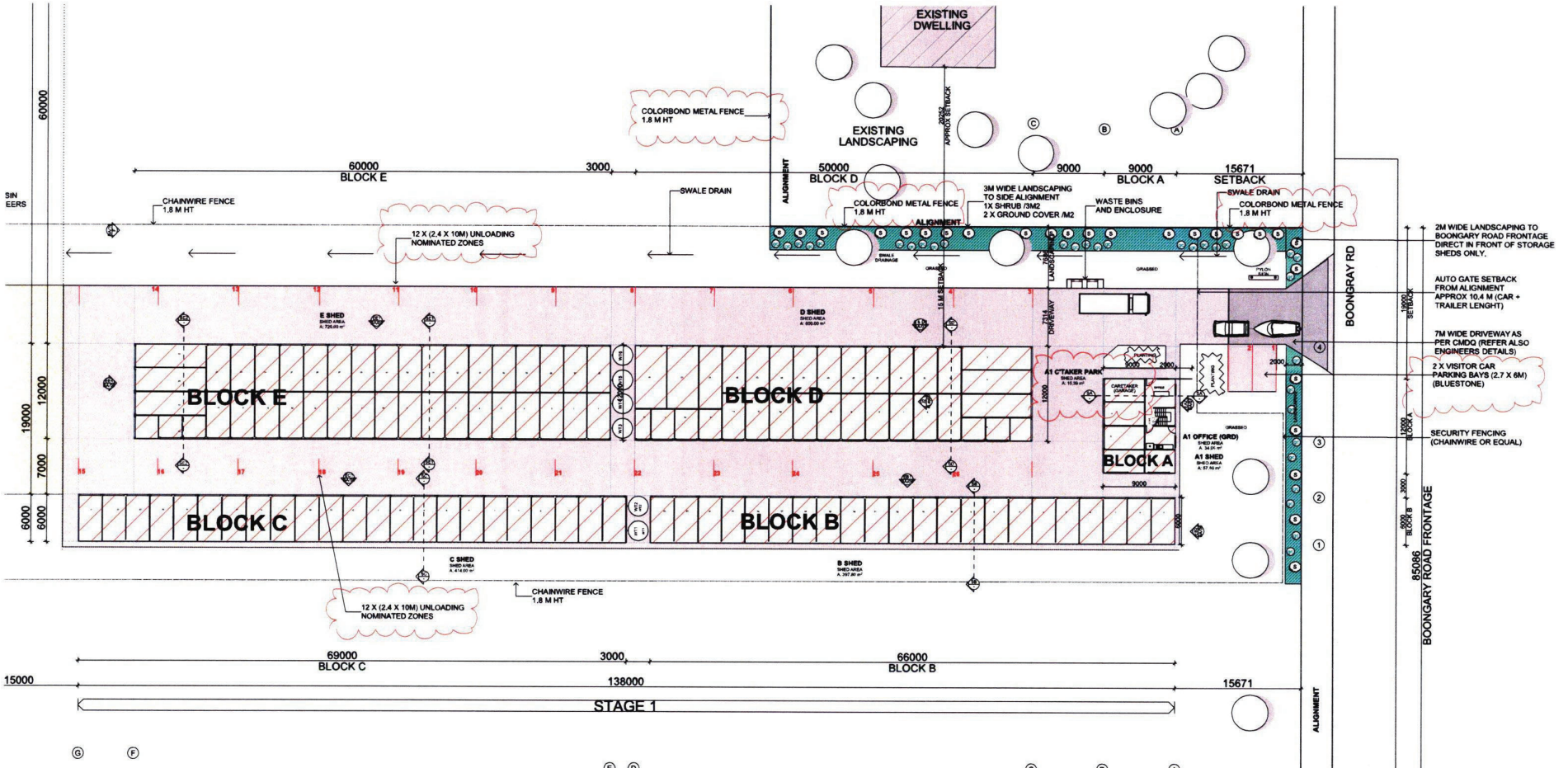
P3	22/06/2022	RRC PLANNING MEETING

SK Drafting

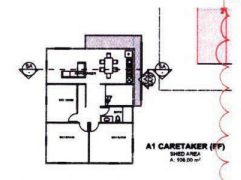
Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
MASTER GROUND FLOOR PLAN

Scale: As shown | Date: JULY 2022
Status: SD | Checked By: SM
Project No: SKD 22-011
Drawing No.: BA/03/B



3 GROUND FLOOR PLAN
Scale 1:250



FIRST FLOOR PLAN
Scale 1:250

FLOOR AREA	
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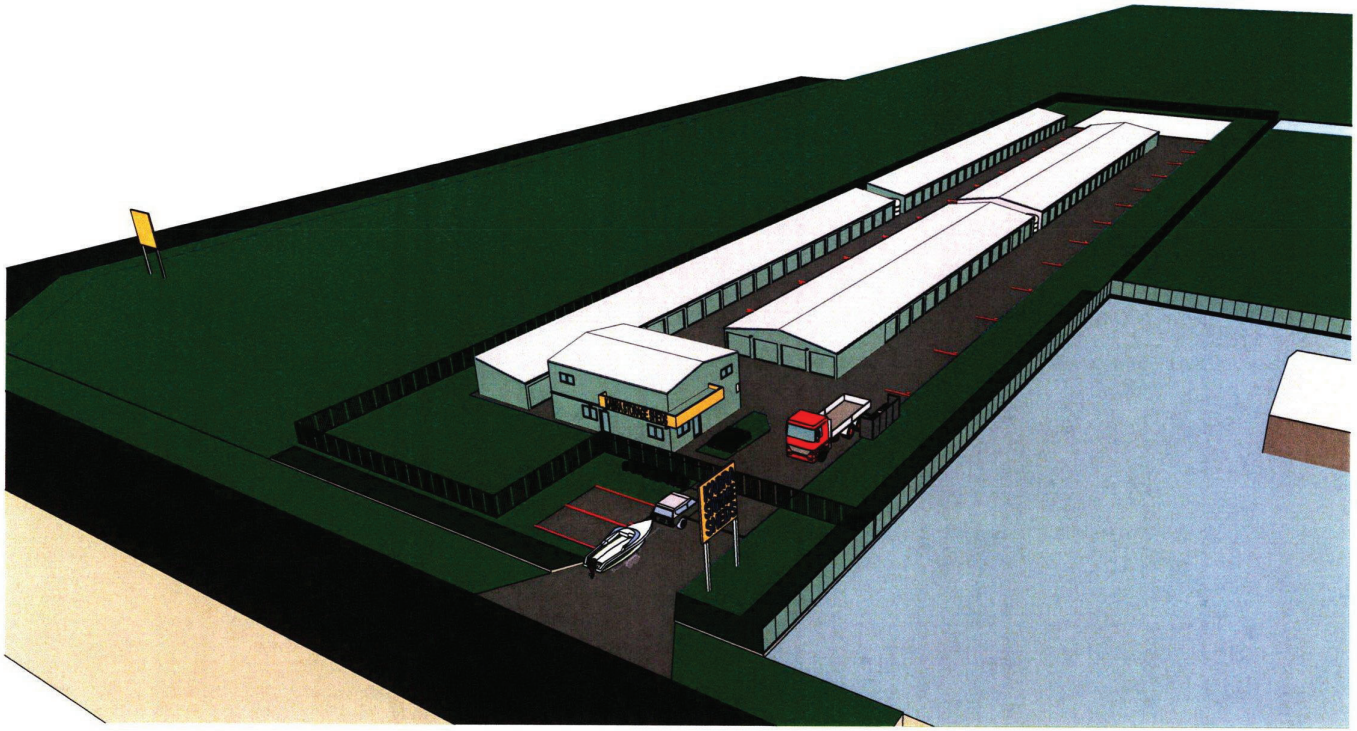
SK Drafting

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
STAGE 1 PLAN

Scale: As shown
Date: JULY 2022
Status: SD
Checked By: SM
Project No.: SKD 22-011
Drawing No.: BA/04/B



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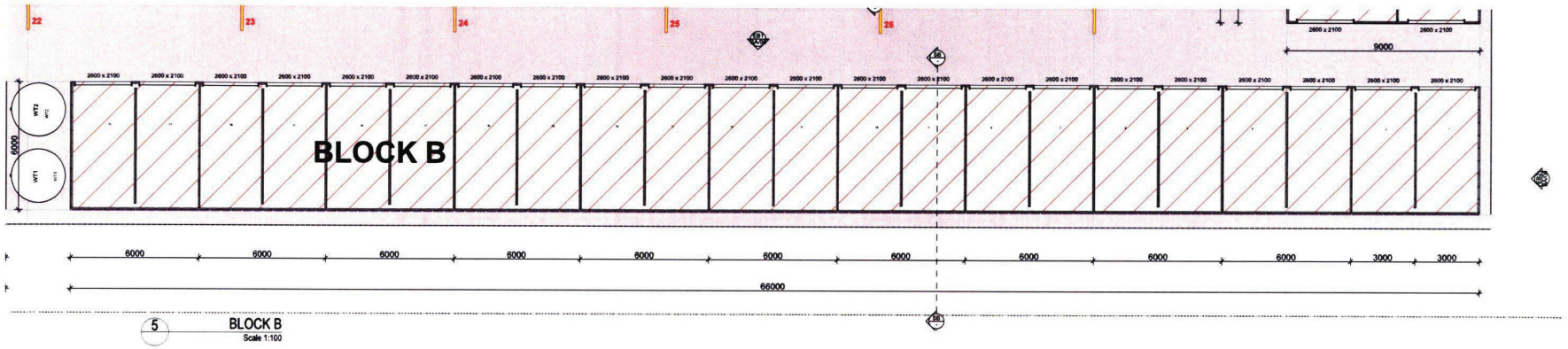
SK Drafting building design

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
Overall View

Scale: As shown | Date: JULY 2022
Status: SD | Checked By: SM
Project No: SKD 22-011 | Drawing No.: BA/05/B



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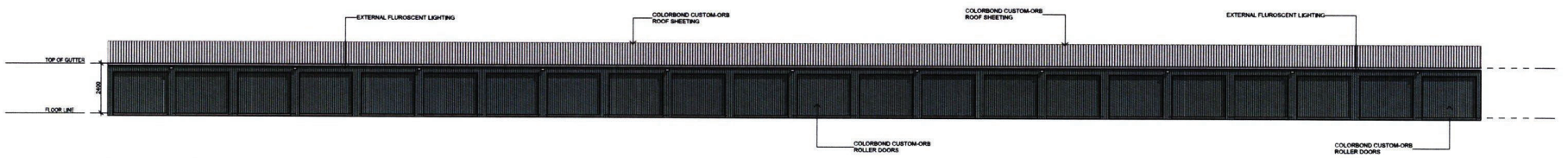

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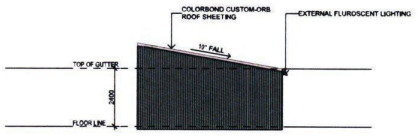

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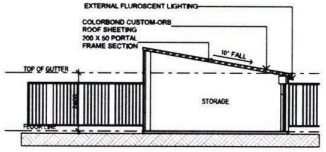
Scale 1:100



SB B BLOCK SECTION B
Scale 1:100

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E SHED	720.00
	2346.85 m²

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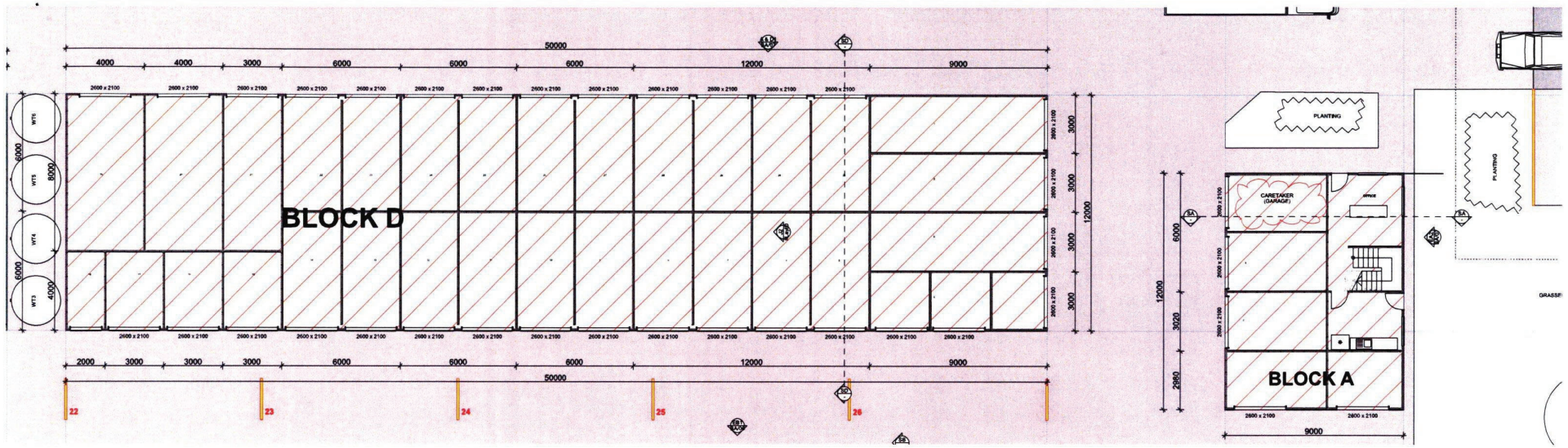
SK Drafting

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans B BLOCK

Scale: As shown | Date: JULY 2022
Status: SD | Checked By: SM
Project No: SKD 22-011 | Drawing No.: BA/06/B

38842591 - 16/09/2022



6 BLOCK A & D
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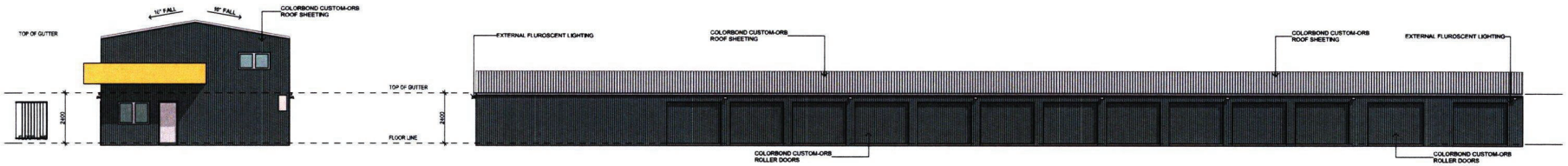

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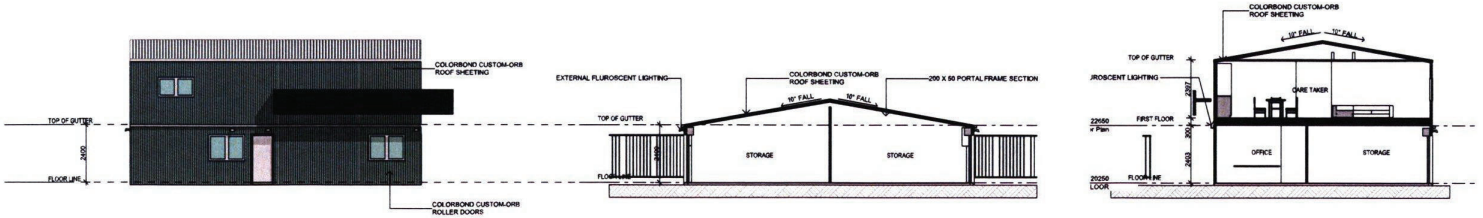
Scale 1:100



EA2 BLOCK A NORTH ELEVATION
Scale 1:100

3 BLOCK D S1 SECTION
Scale 1:100

4 BLOCK A S1 SECTION
Scale 1:100

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E SHED	720.00
	2346.85 m²

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SK Drafting

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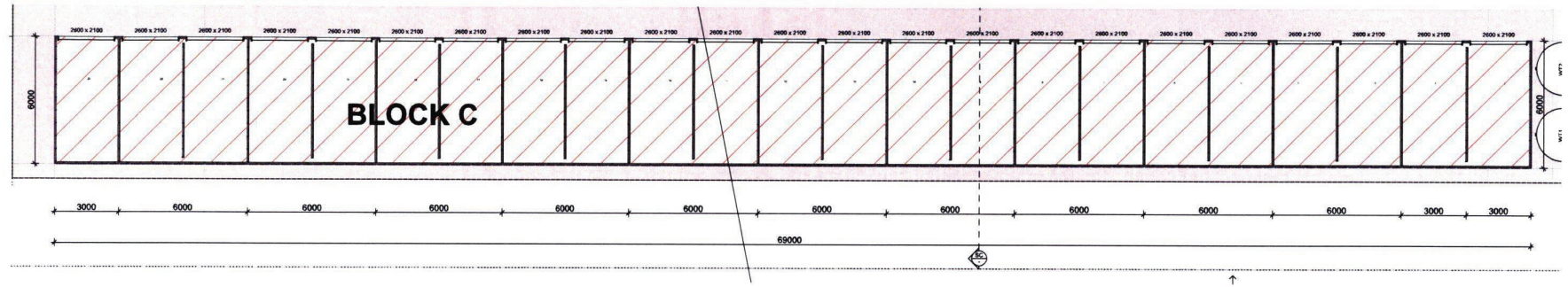
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
A & D BLOCK

Scale: As shown | Date: JULY 2022
Status: SD | Checked By: SM
Project No: SKD 22-011 | Drawing No.: BA/07/B



7 BLOCK C
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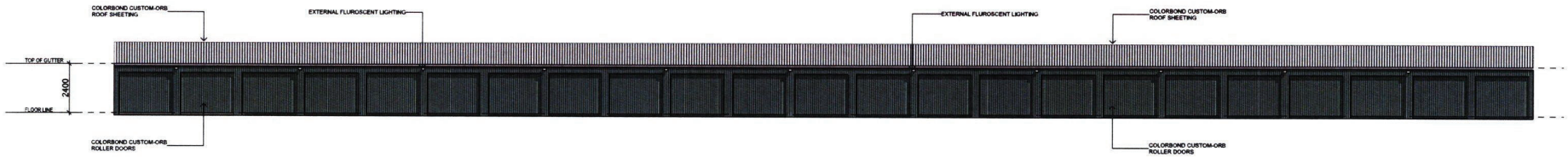
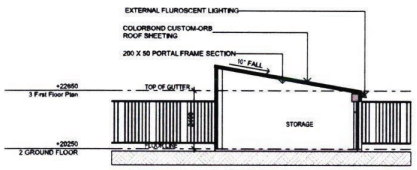


EC1 BLOCK C NORTH ELEVATION
Scale 1:100



SC BLOCK C SECTION
Scale 1:100

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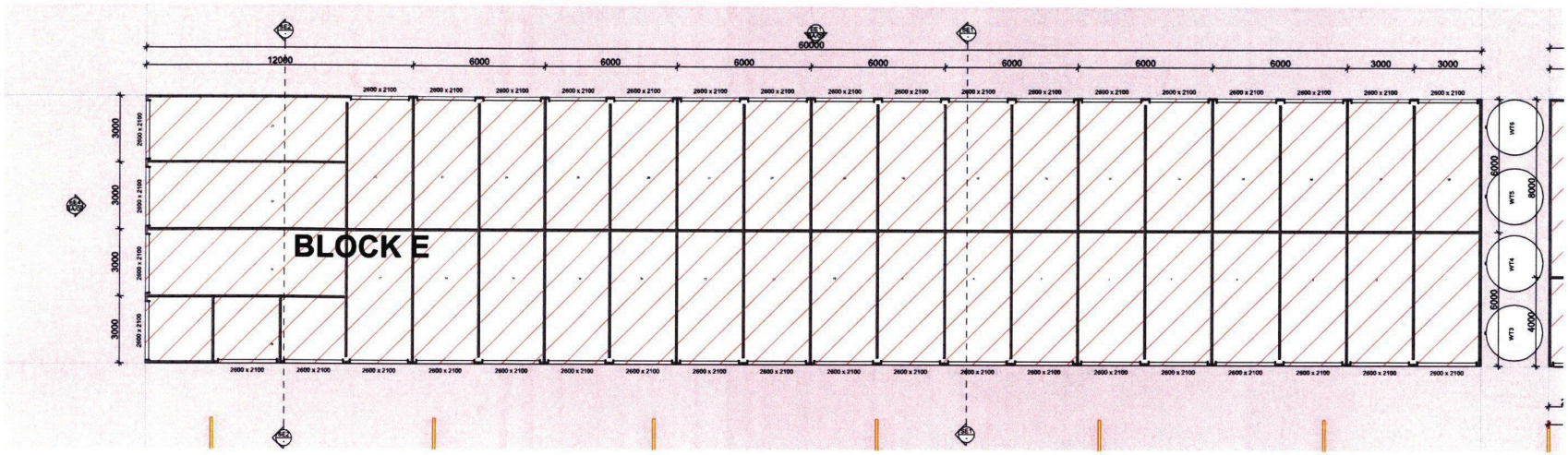
SK Drafting Building Designers

Project Name: KABRA STORAGE UNITS
Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
C BLOCK

Scale: As shown | Date: JULY 2022
Status: SD | Checked By: SM
Project No: SKD 22-011 | Drawing No.: BA/08/B



8 BLOCK E
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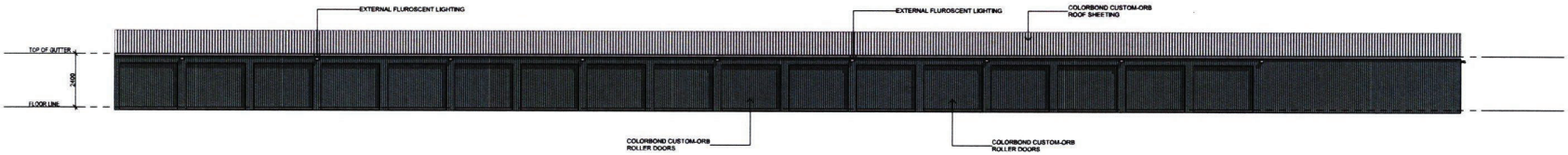

EE1 BLOCK 3 NORTH ELEVATION
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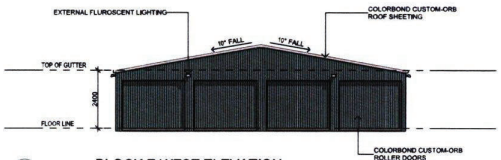

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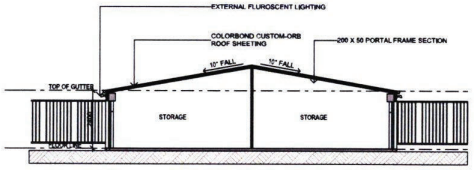

SE BLOCK E SECTION S1
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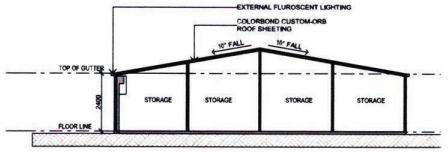

SE2 BLOCK E SECTION E2
Scale 1:100

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SK Drafting building designers

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Client: KAZUMI HOLDINGS PTY. LTD.
ADDRESS: AT 14 KABRA ROAD, KABRA QLD 4702 AUST

Drawing Title: Building Plans
E BLOCK

Scale: As shown
Date: JULY 2022
Status: SD
Checked By: SM
Project No: SKD 22-011
Drawing No.: BA/09/B

MMCE
McMurtrie Consulting Engineers

20 years of reimagining engineering
2002–2022

Engineering reimagined.

Self-Storage Units Facility - Kabra

Stormwater Management Plan

DATE
22 July 2022

REF
R002-22-23/001

CLIENT
Kazumi Holdings Pty Ltd

COMMERCIAL IN CONFIDENCE

Engineering reimagined.

Contact Information

McMurtrie Consulting Engineers Pty Ltd
ABN 25 634 181 294

Rockhampton Office
63 Charles Street
North Rockhampton, QLD 4701

www.mcmengineers.com
(07) 4921 1780
mail@mcmengineers.com

Document Information

Prepared for	Kazumi Holdings Pty Ltd
Document Name	Stormwater Management Plan
Job Reference	R002-22-23/001
Revision	A

Document History

Revision	Date	Description of Revision	Prepared by	Checked by		
				Name	Signature	RPEQ No
A	22/07/2022	Issued for approval	M. Mathev	C. Hewitt		5141

Contents

Appendices

1 Introduction and Approach

1.1 Project Overview

McMurtrie Consulting Engineers (MCE) have been commissioned by Kazumi Holdings Pty Ltd to undertake a site-based Stormwater Management Plan (SMP) for a proposed self-storage unit facility located at 14 Kabra Road, Kabra, Queensland. The aim of this SMP is to demonstrate that the proposed development will comply with Queensland Urban Drainage Manual (QUDM 2016), Australian Rainfall and Runoff 2019 (ARR'19) and State Planning Policy (SPP 2017).

1.2 Methodology

The assessment methodology adopted for this SMP is summarised below;

- Broadly identify the contributing catchments to the project
- Identify Lawful Point of Discharge (LPOD) for the site stormwater runoff
- Identify the critical storm events for this project
- Estimate peak discharge runoff for pre-development and post-development scenarios.
- Identify potential mitigation and management strategies to ensure no worsening to downstream catchments and infrastructure.
- Assess the stormwater quality treatment requirements for the project

1.3 Data Sources

The background data used to undertake this assessment were collected from the following sources;

- Design Rainfall Data System (2016) – Bureau of Meteorology
- Elvis – Elevation and Depth – Foundation Spatial Data
- Rockhampton Regional Council Infrastructure Plan Maps
- Preliminary site layout from SK Drafting

2 Site Characteristics

2.1 Site Location

The proposed site is located on Lot 14 on SP209739. Site details have been summarised within Table 1.

Table 1: Site Description

Developer	Property and Location	
	Lot and Property Description	Address
Kazumi Holdings Pty Ltd	Lot 14 on SP209739	14 Kabra Road, Kabra , Queensland

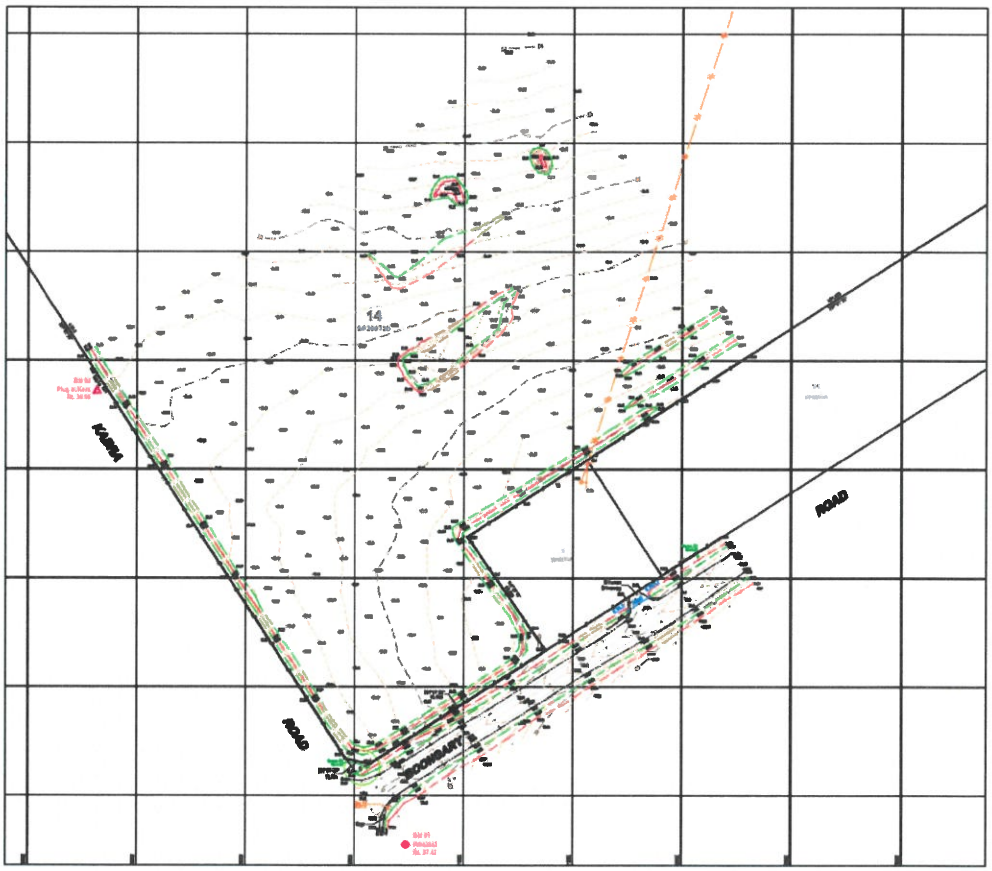

Figure 1: Existing Site Survey

The proposed site abuts Kabra Road on the Western side and Boongary Road on the Southern side. It shares a common boundary with the adjacent lots on Northern and Eastern sides.

2.2 Existing

The site is currently a vacant block with good grass cover and scattered trees. The existing site falls away from Boongary Road in a north-westerly direction towards the adjoining property.

Runoff from the existing site currently discharges on to the adjoining property due to the natural grade of the land with a grade of approximately 1%. The site is not impacted by any external catchments and the post development discharge will be assessed to ensure that there will be no adverse impacts on downstream properties and infrastructure.

2.3 Developed

The proposed consist of self-storage units, office and caretaker building, carparks and landscaped areas. It is assumed the that the proposed development generally be at existing ground levels with minor grading.

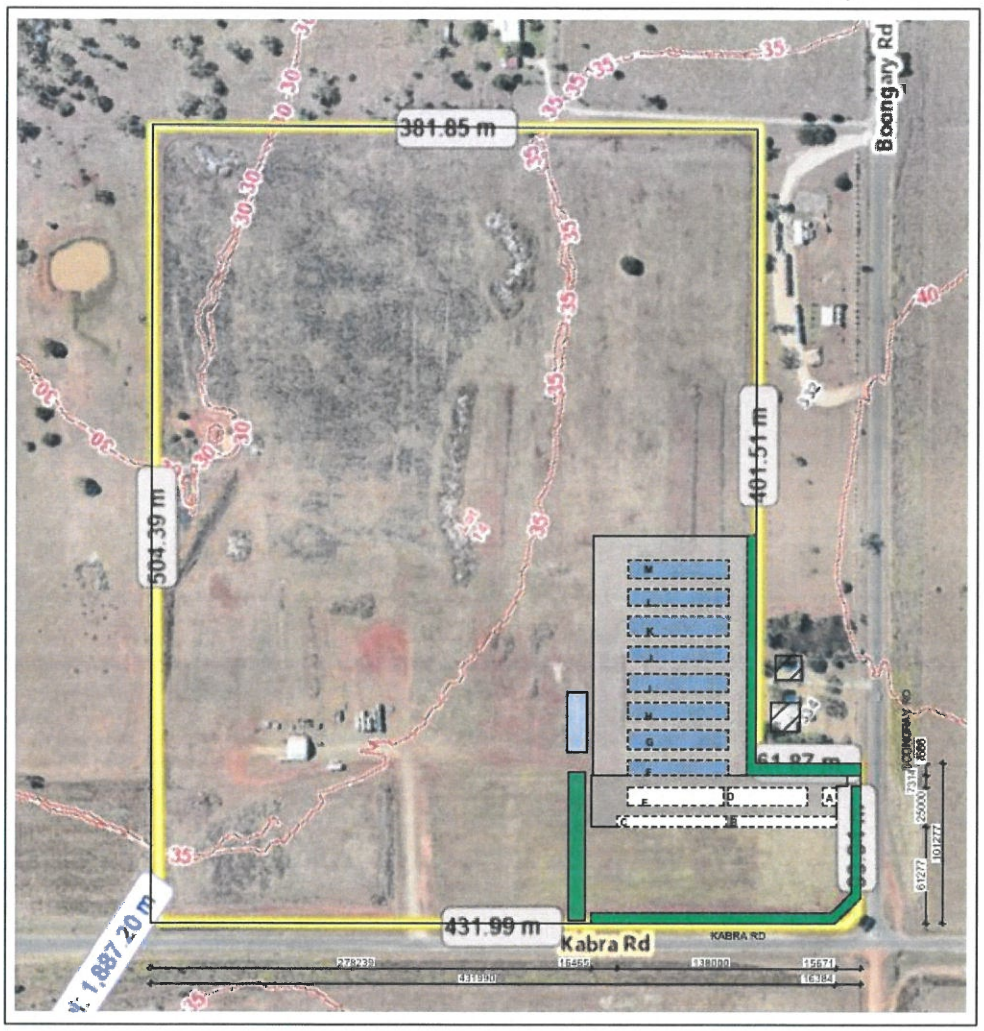

Figure 2: Proposed Layout

3 Hydrology Assessment

The hydrologic assessment flows were derived using the Rational Method and considered the following scenarios:

- Existing: The site in its current condition, as shown in Figure 1.
- Developed: Proposed development, as shown in Figure 2.

3.1 Existing

Runoff from the existing site will be discharging on to adjoining property.

Table 2: Rational Method Parameters - Existing

Parameter	Value
Area (ha)	19.97
Fraction Impervious (%)	0.0
Run-off Coefficient C_{10}	0.59
Time of Concentration (min)	25

3.2 Developed

Table 3 details the Rational Method Parameters used for the developed scenario

Table 3: Rational Method Parameters - Developed

Parameter	Value
Area (ha)	19.97
Fraction Impervious (%)	0.1
Run-off Coefficient C_{10}	0.59
Time of Concentration (min)	24

3.3 Results

The predicted peak discharge from the site for the existing and developed scenarios are detailed in Table 4. The table indicates that the total post development discharge is slightly higher than the total pre development for minor and major storm events. The negligible increase in stormwater discharge will not alter the site's stormwater discharge characteristics in a manner that may substantially damage the adjoining property.

Table 4: Peak Discharge

Storm Event (AEP %)	Existing Discharge (m^3/s)	Developed Discharge (m^3/s)	Difference (%)
39	2.147	2.197	+2.3
1	6.250	6.407	+2.5

4 Quality Assessment

4.1 Operational Phase

In accordance with the State Planning Policy (SPP) (DILGP, July 2017), the site is situated within the Western Queensland climatic region. SPP water quality objectives apply to population centres greater than 25,000 persons. Dalby has a population (421 persons, ABS 2016) less than 25,000 persons and therefore, site specific operational phase water quality treatment is not required for this development.

4.2 Construction Phase

4.2.1 Key Pollutants

During the construction phase a number of key pollutants have been identified for this development. Below table illustrates the key pollutants that have been identified.

Table 5: Key Pollutants - Construction phase

Parameter	Sources
Litter	Paper, construction packaging, food packaging, cement bags, material off cuts.
Sediment	Exposed soils and stockpiles during earthworks and building works.
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary car park areas.

4.2.2 Key Pollutants

Erosion and Sediment Control (ESC) devices employed on the site shall be designed and constructed in accordance with Council's guidelines.

PRE-CONSTRUCTION

- Stabilised site access/exit locations.
- Sediment fences to be located along the contour lines downstream of disturbed areas.
- Diversion drains to divert clean runoff around the construction site.
- Educate site personnel to the requirements of the Sediment and Erosion Control Plan.

CONSTRUCTION

- Maintain construction access/exit, sediment fencing, catch drains and all other existing controls as required.
- Progressively surface and revegetate finished areas as appropriate.
- During construction, all areas of exposed soils allowing dust generation are to be suitably treated. Treatments will include mulching the soil and watering.
- Road access is to be regularly cleaned to prevent the transmission of soil on vehicle wheels and eliminate any build-up of typical road dirt and tyre dusts from delivery vehicles.
- Adequate waste disposal facilities are to be provided and maintained on the site to cater for all waste materials such as litter hydrocarbons, toxic materials, acids or alkaline substances.

5 Conclusion and Qualifications

This SMP has been prepared by MCE for the proposed development of the self-storage unit facility located at 14 Kabra Road, Kabra, Queensland. Stormwater discharge from the proposed development will not result in any actionable nuisance external to the site. The above analysis indicates the increase in post development discharge is negligible compared to the pre development. The proposed site is Western Queensland climatic region with population less than 25,000 person and as such SPP water quality objectives do not apply.

The analysis and overall approach were specifically catered for the particular project requirements and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from MCE.

Whilst this report accurately assesses the catchment hydrology performance using industry standard theoretical techniques and engineering practices, actual future observed catchment flows may vary from those predicted herein.

It is acknowledged that there may be some minor discrepancies between the architectural layouts provided in this report. Whilst not ideal, the minor layout discrepancies should form no material impact to the proposed development from an engineering assessment perspective. Conservative engineering principals have been applied to the afforded stormwater intent and servicing. As such, any concern should be suitable for conditioning as part of the detailed design process (i.e., finalised in Operational Works stage).

Appendix A: Catchment Hydrology (Rational Method)

Stormwater Design
Rational Method

Project No:	**R002-22-23 / 001**
Project Descrption:	**Self Storage Unit Facility - Kabra**
Design Details:	**39% AEP, Pre-Development**

Coefficient of Discharge Section

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Fractions Impervious	f_i		0.000		***Vaccant Land***
1 hour ARI 10 rainfall intensity	$^{1hr}i_{10}$	mm/hr	62.7	2016 IFD	
Frequency Factor	F_y		0.85	QUDM 2016, Table 4.5.2	***39% AEP***
10yr Coefficient of Discharge	C_{10}		0.59	QUDM 2016, Table 4.5.3	
"y' yr Coefficient of Discharge	C_y		0.50	QUDM 2016, Equ 4.3 $= F_y \times C_{10}$	

Adopted Coefficient of Discharge is: C_y **0.50**

Where a coefficient of discharge calculated from Equation 4.3 for an urban catchment exceeds 1.00, it should be arbitrarily set to 1.0 in accordance with 'the recommendations of Australian Rainfall and Runoff (2016).

Time of Concentration - Overland Sheet Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Flow path Length	*L*	m	200		

Breakdown of Horton's Surface Areas

	n	*m2*	*%*	
Grass	0.035	199700	100%	0.035
Road	0.016	0	0%	0.000
Roof	0.012	0	0%	0.000
Total		**199700**		**0.035**

Pre Development

Horton's surface roughness factor	*n*		0.035		***Refer above for breakdown of areas***
Slope of surface	*S*	%	1.0		
Overland sheet flow travel time	*t*	min	21.86	QUDM 2016, Equ 4.5 $= (107\ n\ L^{0.333}) / S^{0.2}$	*Friend's Equation (QUDM 2016, 4.5)*

Time of Concentration - Concentrated Channel Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*
Flow distance		m	180	
Fall of channel		m	1.8	
Flow travel time		min	3	*QUDM 2016, Figure 4.5*

Total Time of Concentration min **25**

Peak Flow Rate Calculation

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
"y' yr Coefficient of Discharge	C_y		0.50	As above	
Catchment Area	*A*	ha	19.97		
Average rainfall intensity for a design duration of '*t*' hours (calculated abvoe) and an ARI of 'y' years	$^{t}I_y$	mm/hr	77.1	2016 IFD	

Peak Flow Rate for an ARI of 'y' years Q_y m^3/sec **2.147**

Stormwater Design
Rational Method

Project No:	**R002-22-23 / 001**
Project Descrption:	**Self Storage Unit Facility - Kabra**
Design Details:	**39% AEP, Post-Development**

Coefficient of Discharge Section

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Fractions Impervious	f_i		0.100		***Building Roof + Carpark***
1 hour ARI 10 rainfall intensity	$^{1hr}i_{10}$	mm/hr	62.7	2016 IFD	
Frequency Factor	F_y		0.85	QUDM 2016, Table 4.5.2	***39% AEP***
10yr Coefficient of Discharge	C_{10}		0.59	QUDM 2016, Table 4.5.3	
"y' yr Coefficient of Discharge	C_y		0.50	QUDM 2016, Equ 4.3 $= F_y \times C_{10}$	

Adopted Coefficient of Discharge is:	C_y	**0.50**	***Where a coefficient of discharge calculated from Equation 4.3 for an urban catchment exceeds 1.00, it should be arbitrarily set to 1.0 in accordance with 'the recommendations of Australian Rainfall and Runoff (2016).***

Time of Concentration - Overland Sheet Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Flow path Length	L	m	200		

Breakdown of Horton's Surface Areas

	n	*m2*	*%*	
Grass	0.035	179730	90%	0.032
Road	0.014	19970	10%	0.001
Total		**199700**		**0.033**

Pre Development

Horton's surface roughness factor	n		0.033		***Refer above for breakdown of areas***
Slope of surface	S	%	1.0		
Overland sheet flow travel time	t	min	20.55	QUDM 2016, Equ 4.5 $= (107\ n\ L^{0.333}) / S^{0.2}$	*Friend's Equation (QUDM 2016, 4.5)*

Time of Concentration - Concentrated Channel Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*
Flow distance		m	180	
Fall of channel		m	1.8	
Flow travel time		min	3	*QUDM 2016, Figure 4.5*

Total Time of Concentration	min	**24**

Peak Flow Rate Calculation

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
"y' yr Coefficient of Discharge	C_y		0.50	As above	
Catchment Area	A	ha	19.97		
Average rainfall intensity for a design duration of 't' hours (calculated abvoe) and an ARI of 'y' years	$^{t}I_y$	mm/hr	78.9	2016 IFD	

Peak Flow Rate for an ARI of 'y' years	Q_y	m^3/sec	**2.197**

Stormwater Design
Rational Method

Project No:	**R002-22-23 / 001**
Project Descrption:	**Self Storage Unit Facility - Kabra**
Design Details:	**1% AEP, Pre-Development**

Coefficient of Discharge Section

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Fractions Impervious	f_i		0.000		***Vaccant Land***
1 hour ARI 10 rainfall intensity	$^{1hr}i_{10}$	mm/hr	62.7	2016 IFD	
Frequency Factor	F_y		1.20	QUDM 2016, Table 4.5.2	***1% AEP***
10yr Coefficient of Discharge	C_{10}		0.59	QUDM 2016, Table 4.5.3	
"y' yr Coefficient of Discharge	C_y		0.71	QUDM 2016, Equ 4.3 $= F_y \times C_{10}$	

Adopted Coefficient of Discharge is: C_y **0.71**

Where a coefficient of discharge calculated from Equation 4.3 for an urban catchment exceeds 1.00, it should be arbitrarily set to 1.0 in accordance with 'the recommendations of Australian Rainfall and Runoff (2016).

Time of Concentration - Overland Sheet Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Flow path Length	L	m	200		

Breakdown of Horton's Surface Areas

	n	*m2*	*%*	
Grass	0.035	199000	100%	0.035
Road	0.016	0	0%	0.000
Roof	0.012	0	0%	0.000
Total		**199000**		**0.035**

Pre Development

Horton's surface roughness factor	n		0.035		***Refer above for breakdown of areas***
Slope of surface	S	%	1.0		
Overland sheet flow travel time	t	min	21.86	QUDM 2016, Equ 4.5 $= (107\, n\, L^{0.333}) / S^{0.2}$	*Friend's Equation (QUDM 2016, 4.5)*

Time of Concentration - Concentrated Channel Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*
Flow distance		m	180	
Fall of channel		m	1.8	
Flow travel time		min	3	*QUDM 2016, Figure 4.5*

Total Time of Concentration min **25**

Peak Flow Rate Calculation

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
"y' yr Coefficient of Discharge	C_y		0.71	As above	
Catchment Area	A	ha	19.97		
Average rainfall intensity for a design duration of 't' hours (calculated abvoe) and an ARI of 'y' years	$^{t}I_y$	mm/hr	159	2016 IFD	

Peak Flow Rate for an ARI of 'y' years Q_y m^3/sec **6.250**

Stormwater Design
Rational Method

Project No:	**R002-22-23 / 001**
Project Descrption:	**Self Storage Unit Facility - Kabra**
Design Details:	**1% AEP, Post-Development**

Coefficient of Discharge Section

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Fractions Impervious	f_i		0.000		***Building Roof + Carpark***
1 hour ARI 10 rainfall intensity	$^{1hr}I_{10}$	mm/hr	62.7	2016 IFD	
Frequency Factor	F_y		1.20	QUDM 2016, Table 4.5.2	***1% AEP***
10yr Coefficient of Discharge	C_{10}		0.59	QUDM 2016, Table 4.5.3	
"y' yr Coefficient of Discharge	C_y		0.71	QUDM 2016, Equ 4.3 $= F_y \times C_{10}$	

Adopted Coefficient of Discharge is: C_y **0.71**

Where a coefficient of discharge calculated from Equation 4.3 for an urban catchment exceeds 1.00, it should be arbitrarily set to 1.0 in accordance with 'the recommendations of Australian Rainfall and Runoff (2016).

Time of Concentration - Overland Sheet Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
Flow path Length	*L*	m	200		

Breakdown of Horton's Surface Areas

	n	*m2*	*%*	
Grass	0.035	179730	90%	0.032
Road	0.014	19970	10%	0.001
Total		**199700**		**0.033**

Pre Development

Horton's surface roughness factor	*n*		0.033		***Refer above for breakdown of areas***
Slope of surface	*S*	%	1.0		
Overland sheet flow travel time	*t*	min	20.55	QUDM 2016, Equ 4.5 $= (107\ n\ L^{0.333}) / S^{0.2}$	*Friend's Equation (QUDM 2016, 4.5)*

Time of Concentration - Concentrated Channel Flow

Description	*Symbol*	*Unit*	*Value*	*Reference*
Flow distance		m	180	
Fall of channel		m	1.8	
Flow travel time		min	3	*QUDM 2016, Figure 4.5*

Total Time of Concentration min **24**

Peak Flow Rate Calculation

Description	*Symbol*	*Unit*	*Value*	*Reference*	*Comments*
"y' yr Coefficient of Discharge	C_y		0.71	As above	
Catchment Area	*A*	ha	19.97		
Average rainfall intensity for a design duration of '*t*' hours (calculated abvoe) and an ARI of 'y' years	^tI_y	mm/hr	163	2016 IFD	

Peak Flow Rate for an ARI of 'y' years Q_y m^3/sec **6.407**