TECHNICAL NOTE

EASTGARDENS DEVELOPMENT SOCIETAL RISK RESULTS SCENTRE CASE

SCENTRE LTD

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1. INTRODUCTION

1.1. Background

The most recent revision of the Botany Industrial Park (BIP) QRA report was completed in 2018, approved and then publicly released by DPIE in 2020 (Ref 1). The QRA presents the individual fatality risk and societal risk around the BIP as well as other forms of risk required by DPIE's Hazardous Industry Planning Advisory Paper (HIPAP) guidelines. The QRA is referred to as the 'BIP QRA 2018'.

The BIP QRA 2018 Riskcurves model is held by Sherpa Consulting Pty Ltd (Sherpa) on behalf of the BIP operators. The BIP QRA 2018 fatality risk results, i.e. individual fatality risk contours and societal risk in the form of FN curves, are reproduced in Figure 1.1.

The societal risk for the BIP QRA 2018 'Approved Development' case:

- is in the 'ALARP' region for N < 1000 but is approaching the intolerable region.

- exceeds the HIPAP upper 'N limit' of 1000 people (the maximum number of people 'N' affected is potentially greater than 1000). The results graph was extrapolated past the 'N limit' of 1000 to show this as per Figure 1.1.

Societal risk is a measure of the probability of incidents affecting an actual person/population. HIPAP 10 *Land Use Safety Planning* (Ref 2) specifies risk criteria for new development in the vicinity of potentially hazardous facilities (e.g. the BIP) and also provides guidance for application of the criteria.

In accordance with HIPAP 10, where a development proposal involves a significant intensification of population in the vicinity of a potentially hazardous facility, the change in societal risk needs to be accounted for, even if individual risk criteria are met.

DPIE are therefore concerned about developments that further intensify populations in the vicinity of the BIP and could further increase societal risk.

Scentre Ltd (Scentre) has proposed an expansion to the Westfield shopping centre at Eastgardens (as initially defined in *Westfield Eastgardens Revised Planning Justification Report* prepared by Urbis for Scentre Group December 2019) and are required by DPIE to assess the potential impacts of the associated increase in population on the societal risk.

1.2. History

Eastgardens is a major shopping centre located approximately 280m north of the BIP north site boundary and more than 400m from the nearest process areas or storages. Eastgardens is well outside the individual fatality risk contours hence complies with all individual risk criteria. However population changes in the Eastgardens area potentially affect the societal risk.

At the request of DPIE, Bayside Council initially retained Sherpa to assess the potential societal risk implications of the proposed Eastgardens Westfield expansion in the Urbis

planning report. Results were provided in June 2020 and showed a further increase in the maximum N (i.e. further beyond the BIP 2018 QRA results).

Scentre Ltd (Scentre) subsequently retained Sherpa (May - July 2021) to update the modelling with a reduced population based on population surveys compared to the basis (i.e. the Urbis planning report estimates) used for the Bayside Council update. Whilst the reduced population meant there was no change in the maximum N compared to the BIP QRA, the results still showed a small increase in the frequency of the curve in eth area N> 1000 (as reported in Sherpa report *Technical Note Eastgardens Development Societal Risk Results Scentre Case* doc no 21449-TN-003 Rev 0, 5 July 2021 and reproduced in Figure 3.1).

Scentre therefore retained Sherpa to undertake some additional sensitivity studies to determine if the development could be modified to avoid any material change in the societal risk curve.

1.3. Scope and objectives

This technical note provides:

- A summary of the approach taken to estimating a population that would not affect the societal risk compared to the BIP QRA 2018 'Approved Development' case.

- The societal risk results using revised population.

- Recommendation for maximum scale of proposed Eastgardens development to ensure that the cumulative societal risk in the region N > 1000 is not affected by the overall increase in population.

The BIP QRA 2018 'Approved Development' case was used as the baseline for assessing the societal risk implications of the proposed Eastgardens development.
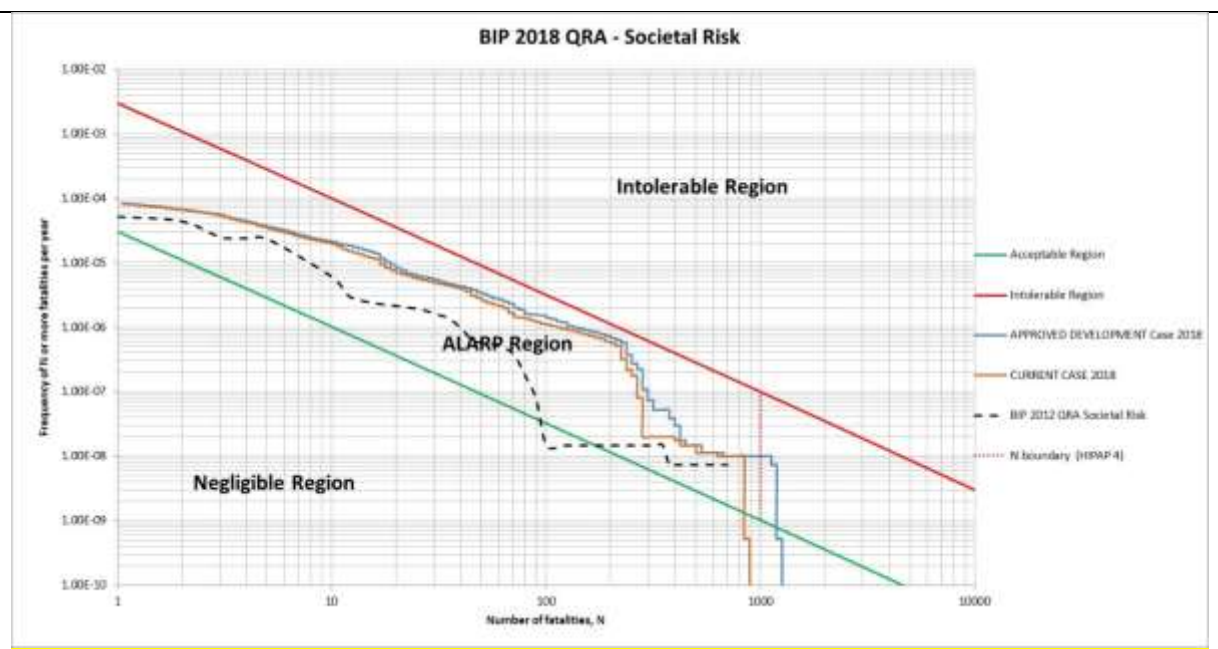
No changes to any modelling assumptions apart from the populations were made to the BIP QRA model.

Figure 1.1: BIP QRA 2018 risk results

Individual Fatality Risk Contours (HIPAP criteria)

Societal Risk

2. POPULATION BASIS

2.1. Location

Population is entered in the risk model either as a grid or by assigning a density or number of people to a polygon. For this study polygons were used with a total number of people assigned to the polygon. The software then distributes these over a grid. The smallest allowable grid size in the software was used (in this case 10 m by 10 m grid).

Broadly the Scentre proposal involves:

- modifications to increase the Gross Lettable Area (GLA) of the retail footprint

- additional commercial space in the form of three new towers in the south east area of the site.

The changes made to allow different population densities in different parts of the overall Westfield Eastgardens site to be entered into the risk model are shown in Figure 2.1.

In summary as per Figure 2.1 :

- The BIP QRA model had a single polygon representing Eastgardens.

- For the previous Bayside Council and Scentre sensitivity studies additional polygons were added to represent the three new towers with the retail are left as a single polygon.

To narrow the scope for the additional sensitivity studies, a series of tests using the risk model with different populations were run. It was found that the population within the 1×10^{-9} per year fatality contour had the most significant effect on the fN curve so the Eastgardens polygon was further sub-divided into two areas, inside and outside this contour, as shown in Figure 2.2.

2.2. Populations

As the results were found to be most sensitive to the population with the 1×10^{-9} per year area, the approach taken was to iterate this parameter only until there was minimal change in the fN curve.

As a starting point to the sensitivity study, the number of people within the 1×10^{-9} per year contour allowed for in the BIP QRA 2018 was calculated. This estimate is shown in Table 2.1. This area will also contain some population from the proposed office towers so an allowance for this was deducted, giving a starting population of 2529 people within the risk affected area.

To equate this number of people to a building parameter, Scentre undertook a layout and GLA analysis as shown in APPENDIX A. This showed that the proposal would equate to approximately 1 person per 16m² of GLA and 14,152 m² GLA in the area within the 1×10^{-9} per year contour (excluding the office towers).

The population input data for each polygon and comparison to the BIP QRA 2018 is summarised in Table 2.3 for the whole series of updates for this proposal i.e. data covers the initial Bayside Council update (June 2020), previous Scentre update (July 2021 from survey (Ref 3) and the present case (December 2021).

Table 2.1: BIP QRA Eastgardens population within 1x10^{-9} per year contour

Split polygon along 1e-9 per year contour		Population distribution	
		BIP QRA 2018	**Scentre July 2021**
inside 1e-9	47,156	2965	3250
outside 1e-9	46,772	2941	3224
TOTAL	**93,928**	**5,906**	**6,474**
Results insensitive to population outside 1e-9 contour			
Target - keep population within 1e-9 same as BIP QRA 201		2529	BIP QRA 2018 minus CST06A (436 people)

2.3. Sensitivity study on population

To limit the number of iterations of the risk model the following approach was taken:

- The estimated populations in the proposed towers was kept the same as previous models (i.e. 1000 people split as per Table 2.3).

- The population in the Eastgardens area outside the 1 x10^{-9} per year contour was kept the same as the previous Scentre July 2021 case.

- The number of people in the area within the 1x0-9 per year contour polygon was incrementally reduced until there was no visible change in the fN curve in the area N> 1000.

As per Table 2.2 the population where the change in the fN curve in the area N> 1000 became undetectable was at N = 2444. Refer to Section 3 for the fN curves and development implications. Table 2.1

Table 2.2: Maximum Eastgardens population within 1x10^{-9} per year contour

	Previous reports	Sensitivities	
	Scentre July 2021	Run 5C (BIP QRA estimate)	Run 5N
TOTAL pop	6474	6406	6321
outside 1e-9	3877	3877	3877
inside 1e-9	**2597**	**2529**	**2444**
Results	Still affects fN curve	Still affects fN curve	OK - no visible change at N> 1000

Note: all intermediate model runs are not reported in above table.

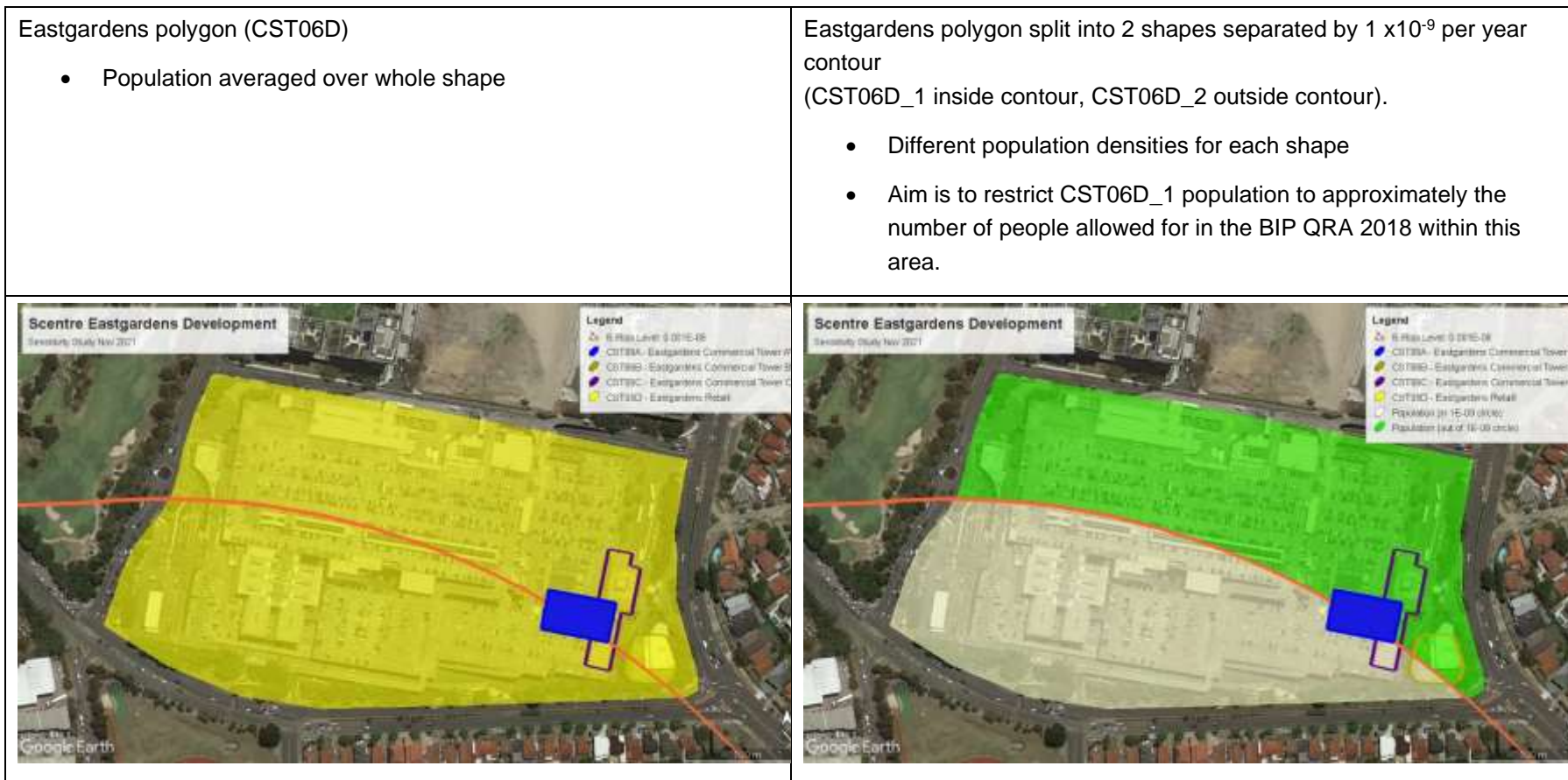**Figure 2.1: Population polygons**

BIP QRA 2018 (Approved Development case)	Changes for Westfield Eastgardens proposal July 2021
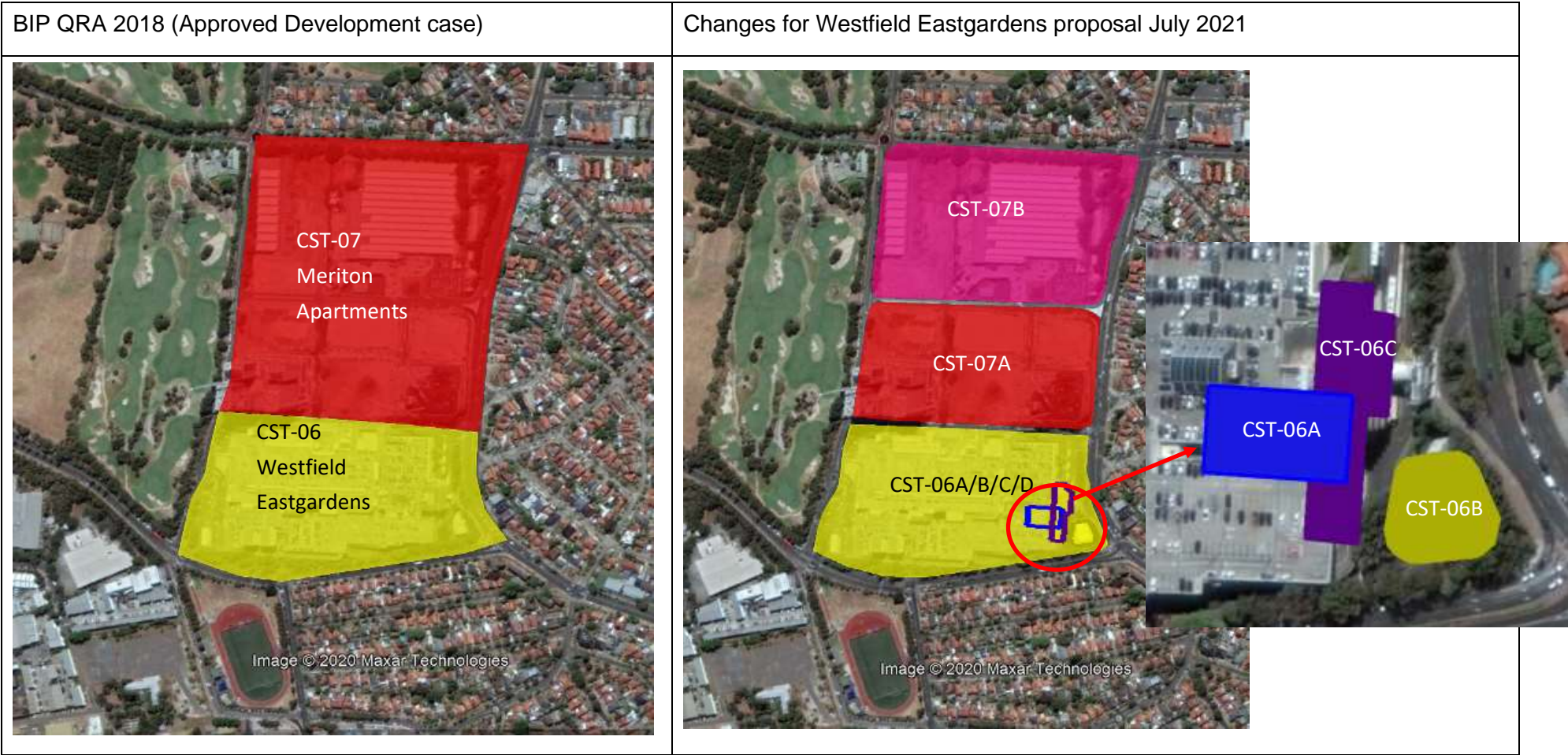
Figure 2.2: Eastgardens population polygon split by 1 x10^{-9} per year individual fatality risk contour

Eastgardens polygon (CST06D)	Eastgardens polygon split into 2 shapes separated by 1 x10^{-9} per year contour
• Population averaged over whole shape	(CST06D_1 inside contour, CST06D_2 outside contour). • Different population densities for each shape • Aim is to restrict CST06D_1 population to approximately the number of people allowed for in the BIP QRA 2018 within this area.

Table 2.3: Population input summary (June 2020 to Dec 2021 cases)

TZ 423	BIP QRA 2018	Bayside council update 2020 (as per report)	Proposed by Scentre (July 2021 update)	Scentre GLA analysis (Dec 2021) – sensitivity starting point	Impact
Residential	Meriton - estimated densities	Meriton – revised estimated densities as per Urbis report	No change cf 2020 update	No change cf 2020 update	None– Meriton too far away from BIP
Commercial - employees (all TZ retail and other EXISTING)	2817 2016 less 661 BAT workers version from 2017 version data) – BIP QRA report notes have a typo – says 616 BAT	2032 (lower than predicted in BIP QRA 2018) 2016 (projected 2021 from 2019 version of data)	1134 (confirmed Scentre 2/6/2021 email Nik Wheeler) One off survey by Scentre (covers existing office tower)	Total number of people including shoppers 6406 total - 3877 outside 1 x10-9 per year contour - 2529 inside 1 x10-9 per year contour	Most effect within 1x10-9 per year contour
Development proposal – commercial - retail	-	1139 (Urbis report 2019)	1000 (confirmed Scentre 2/6/2021 email Nik Wheeler)		Most effect within 1x10-9 per year contour
Development proposal - commercial – other - total new towers	-	1525 - apportioned by floor area: CST06 A - 739 CST06 B - 606 CST06 C - 180 (Urbis report 2019)	1000 (confirmed Scentre 2/6/2021 email Nik Wheeler) CST06 A - 485 CST06 B - 397 CST06 C – 118	1000 (confirmed Scentre 2/6/2021 email Nik Wheeler) CST06 A - 485 CST06 B - 397 CST06 C – 118	Some impact as concentrated in one place only a small portion within 1 x10-9 per year contour.
Shoppers	3089 (JRPP report 2015)	3340 (JRPP adjusted for parking changes)	3340 Assume same as 2020 (sufficiently conservative)	Included as part of GLA estimate 1/ 16m2 GLA includes shoppers and employees	Most effect within 1x10-9 per year contour
TOTAL Eastgardens (all retail)	-	Existing + new = 2032+1139 = 3171	Existing + new = 1134 + 1000 = 2134		
TOTAL Eastgardens (all commercial including retail)	2817	4696	3134	3066 (assuming 3340 shoppers)	
TOTAL Eastgardens (all)	5906	8036 (~36% increase cf BIP QRA 2018)	6474 (~10% increase cf BIP QRA 2018)	6406 (~8 % increase cf BIP QRA 2018)	

Note: Red text highlights areas where key changes are.

3.   SOCIETAL RISK

3.1.   Results

The cumulative societal risk results are presented as follows:

- Figure 3.1: Cumulative societal risk results, comparison of population BIP QRA 2018 and Eastgardens Scentre (July 2021).
- Figure 3.2: Cumulative societal risk results, comparison of population BIP QRA 2018 and Eastgardens Scentre (run 5N Dec 2021)
- Figure 3.3: Cumulative societal risk results comparison zoom in (for both cases)

Note that the incremental societal risk from the proposed development (i.e. the proposed development population only) is already in the negligible region as per previous results which are reproduced in Figure 3.4. (These have not been updated for the smaller population).

3.2.   Conclusion

Based on the sensitivity study, to achieve no detectable change in the societal risk curve compared to the BIP QRA 2018 "Approved Development 'case in the area N> 1000, the population in the area of Eastgardens within the $1x10^{-9}$ per year contour should not exceed 2444 people.

Assuming an average density of 1 person per 16 m^2 GLA, the corresponding reduction in GLA within the $1 x10^{-9}$ per year contour (compared to the design in APPENDIX A) is $2,441m^2$ (i.e. to 11,711 m^2 or 83% of the design GLA in APPENDIX A).

This result is summarised in Table 3.1.

3.3.   Further work

In Sherpa's view the modelling carried out with respect to this proposal is at the limit of accuracy of the software inputs and assumptions for the number and location of people, and any further iterations will provide no further information to assist a decision.
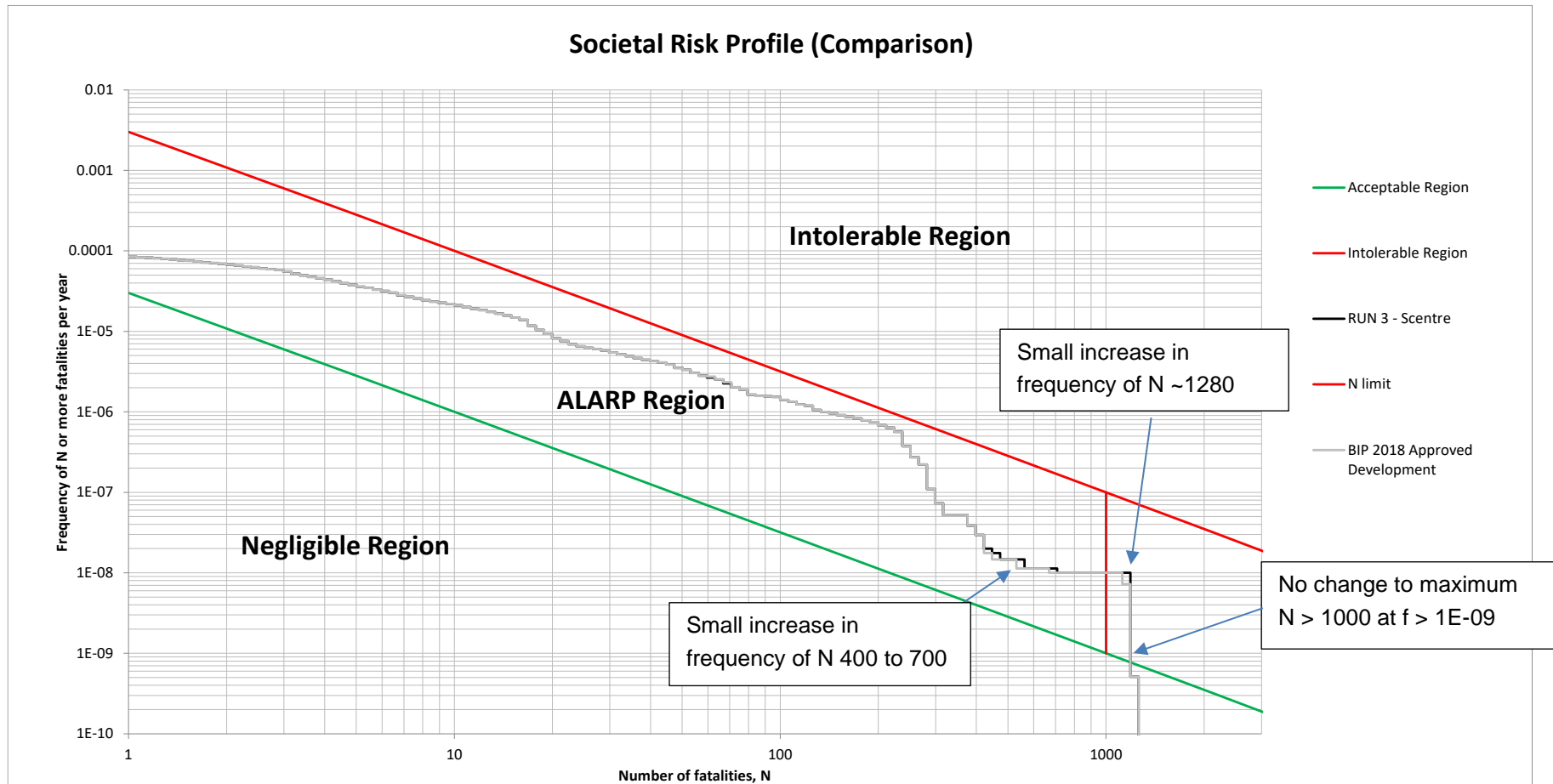
It is also noted that changes in population outside the $1x10^{-9}$ per year contour have a very small (although not zero) effect on the fN curve. The scale of Eastgardens development would need to be very different (eg higher density commercial or high density housing) to that proposed to have any material effect.

In Sherpa's view, this work supports a position that the practical limit of consideration of population for societal risk in the vicinity of the BIP is bounded by the $1 x10^{-9}$ per year contour or some logical planning representation of this contour (for example lot boundaries, survey points or physical structure in the built environment). Developments in areas outside this contour (or approximate representation) including within the northern area of Eastgardens will not be assisted by further formal societal risk assessment.

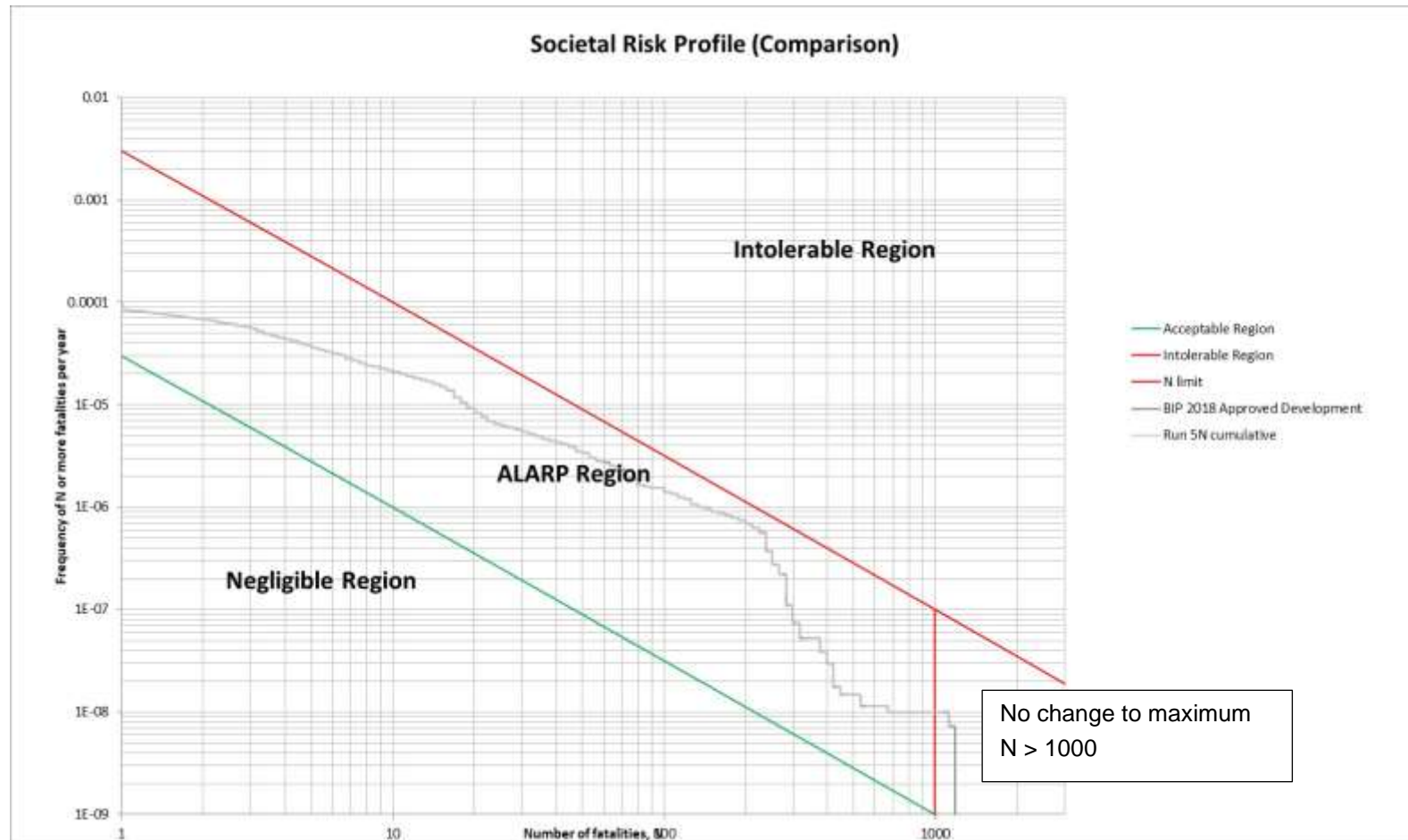**Table 3.1: Maximum GLA with 1 x10^{-9} per year contour**

	Previous reports	Sensitivities	
	Scentre July 2021	Run 5C (BIP QRA estimate)	Run 5N
TOTAL pop	6474	6406	6321
outside 1e-9 and including towers	3877	3877	3877
inside 1e-9 (excluding towers)	**2597**	**2529**	**2444**
Results	Still affects fN curve	Still affects fN curve	OK - no visible change at N> 1000
GLA m2 per person		16	m2/ person
Required reduction in population		153	(2597-2444)
Required reduction in GLA within 1 e-9 per year contour		**2441**	**m2**
Maximum GLA within 1 e-9 per year contour		**11,711**	**m2**
Original GLA within 1 e-9 per year contour		14,152	m2
% of original		83%	

Figure 3.1: Cumulative societal risk results, comparison of population BIP QRA 2018 and Eastgardens Scentre (July 2021)

Figure 3.2: Cumulative societal risk results, comparison of population BIP QRA 2018 and Eastgardens Scentre (run 5N Dec 2021)
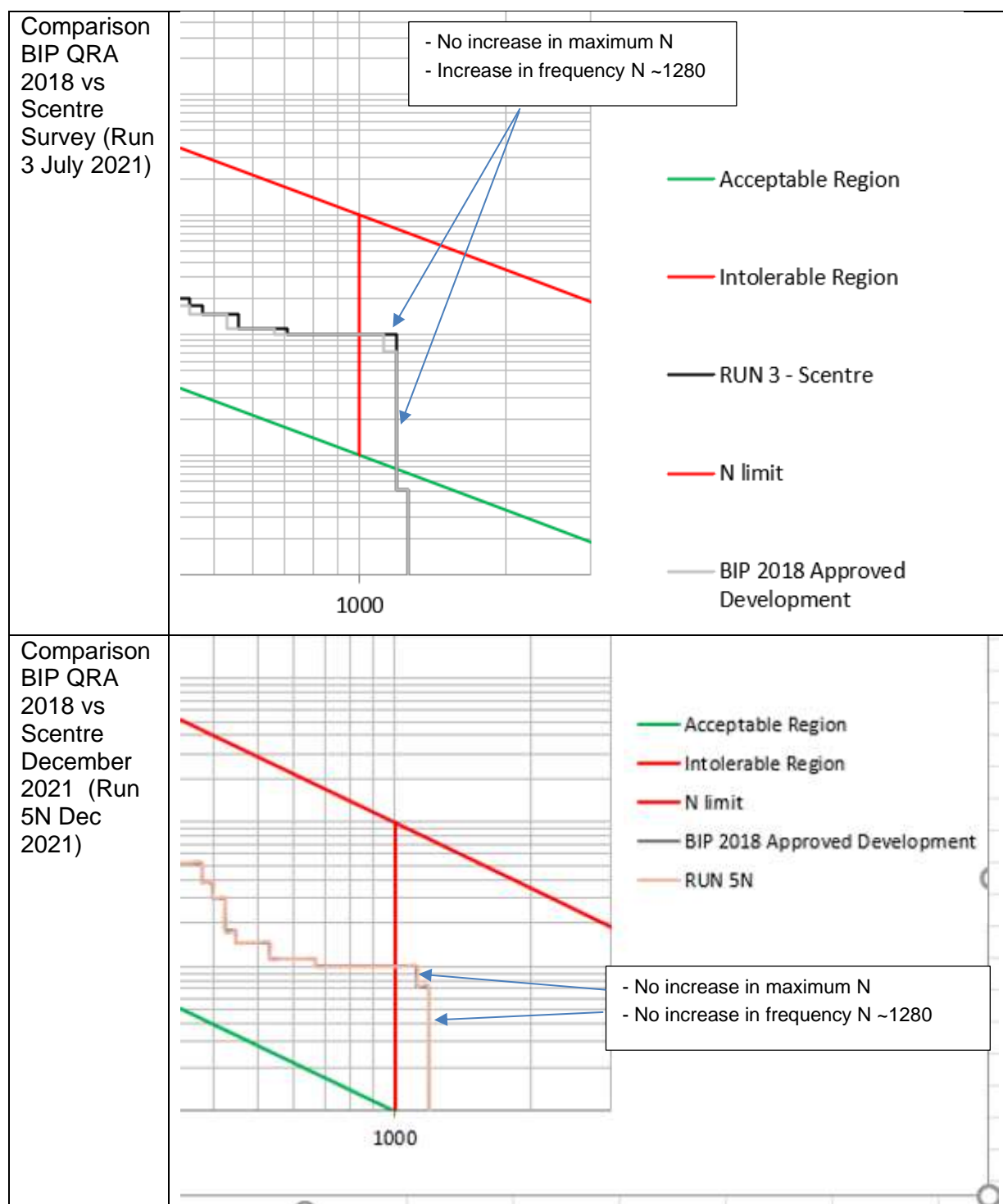

Societal Risk Profile (Comparison)

No change to maximum N > 1000

Figure 3.3: Cumulative societal risk results comparison zoom in

Comparison BIP QRA 2018 vs Scentre Survey (Run 3 July 2021)	
Comparison BIP QRA 2018 vs Scentre December 2021 (Run 5N Dec 2021)	

Figure 3.4: Incremental societal risk results

Incremental FN (Comparison)

Legend:
- Acceptable Region
- Intolerable Region
- RUN 1 (Bayside 2020)
- RUN 3 Scentre Survey (June 2021)
- N limit

Intolerable Region

ALARP Region

Negligible Region

Y-axis: Frequency of N or more fatalities per year

X-axis: Number of fatalities, N
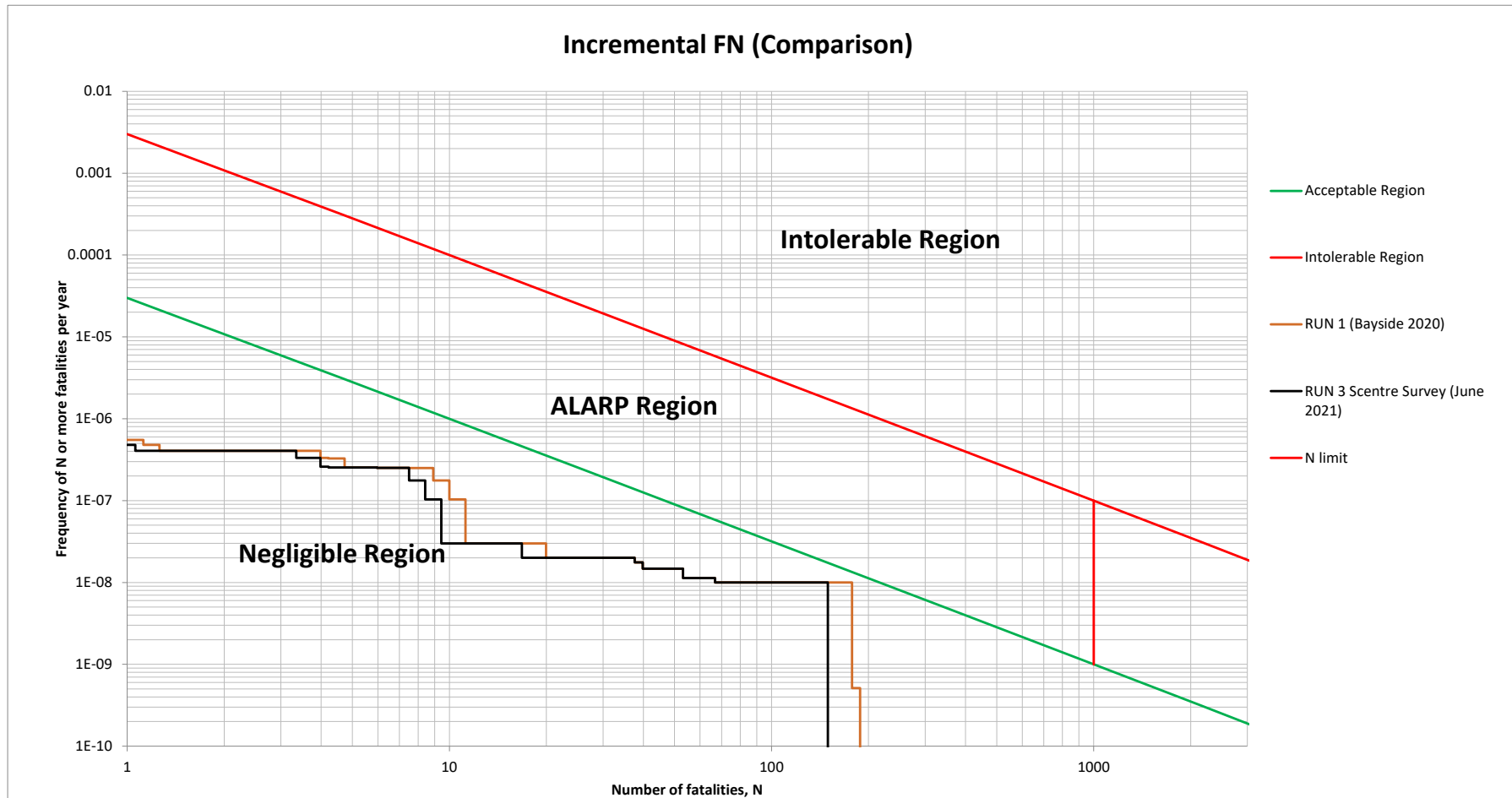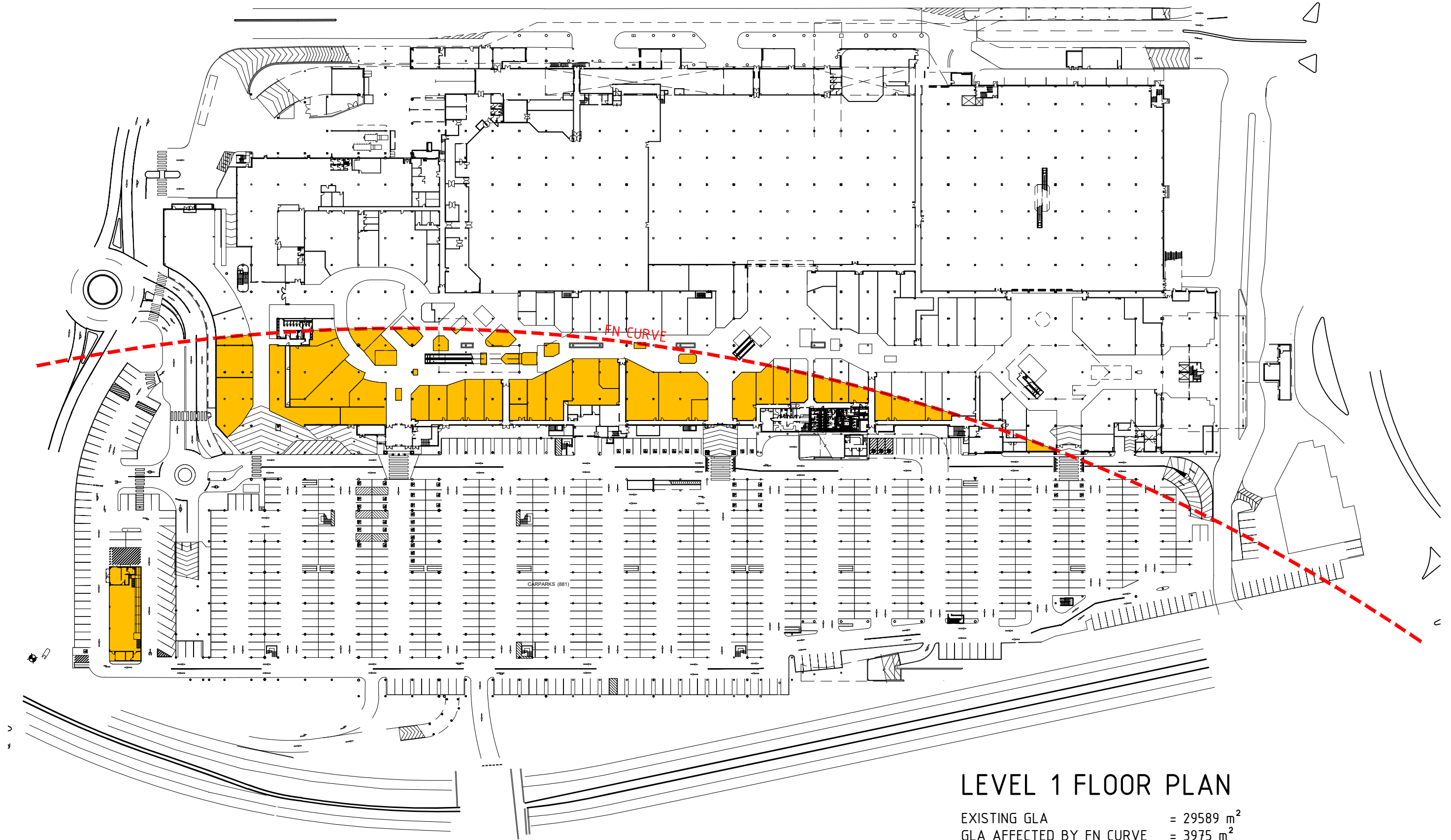
APPENDIX A.   PROPOSED LAYOUT - SCENTRE GLA ANALYSIS

A1. GLA within 1x10-9 per year contour - summarised from plan (all levels)

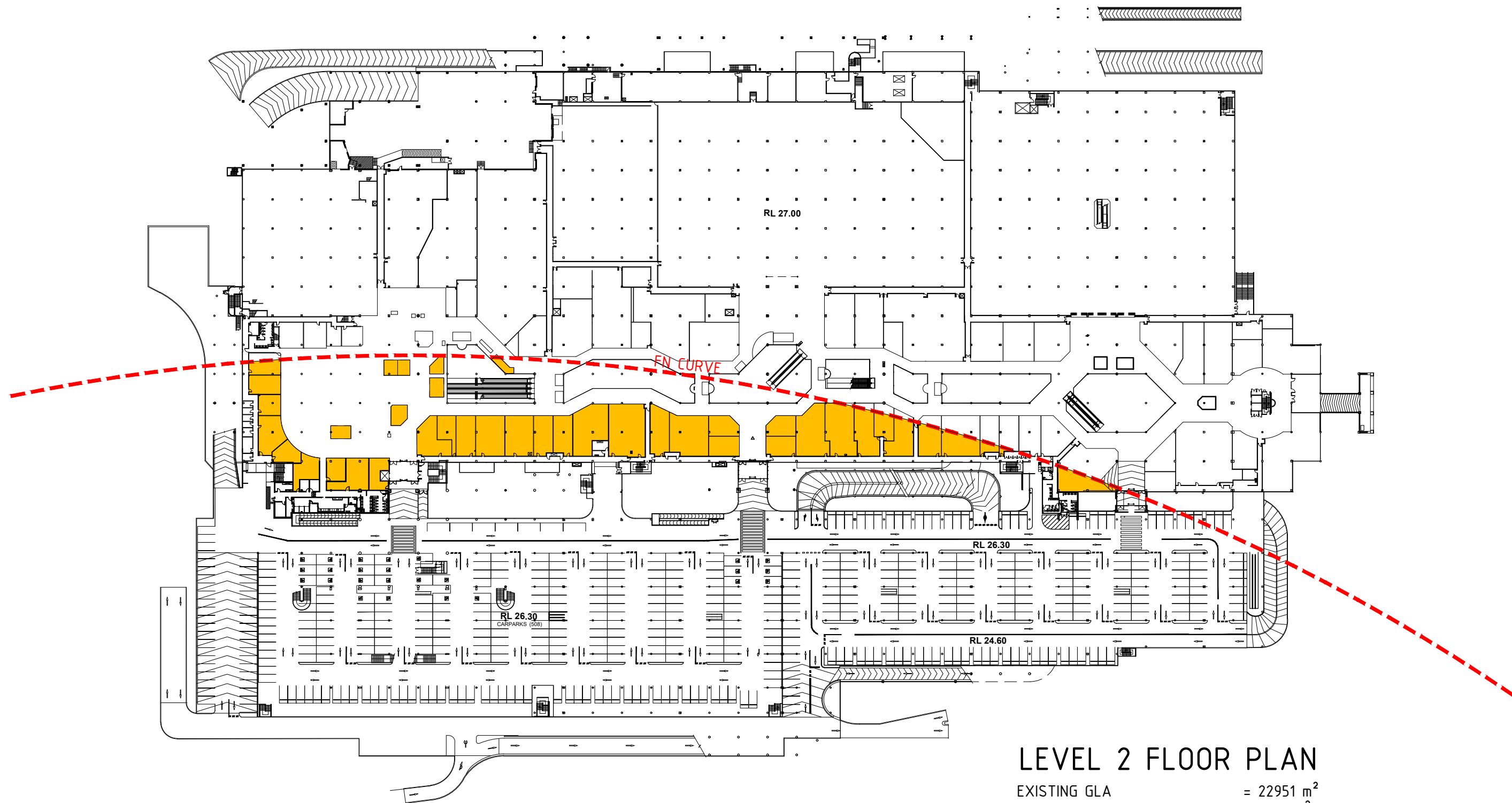| East Garden Area / Risk Analysis				2021.10.11	
	EXT GFA	EXT GLA	Existing GLA affected by FN	Existing GLA unaffected by FN (Yellow area)	
LEVEL 1	39,328	29,589	3,975	25,614	
LEVEL 1M	0	0		0	
LEVEL 2	36,589	22,951	2,818	20,133	
LEVEL 3	31,474	23,805	7,359	16,446	
LEVEL 4	1,090	877			
LEVEL 5	1,090	894			
LEVEL 6	1,090	894			
	110,661	79,010	14,152		
Total Area Excluding Offices	**107,391**	**76,345**	**14,152**	**62,193**	
DA approved GLA		27,500			
DA approved Overall GLA		**103,845**			
Total number of People in East Gardens			6,474		
Area per capita of overall approved GLA	103845 / 6474		16.04		
Population in unaffected area	62193 / 16.04		3,877		
Population in affected area (white area)	**6474 - 3877**		**2,597**		

A2. Area within 1 x10^{-9} per year contour - all levels

The following layouts show the 1 x10^{-9} per year contour overlaid onto the proposed development. The GLA within the risk contour has been estimated.
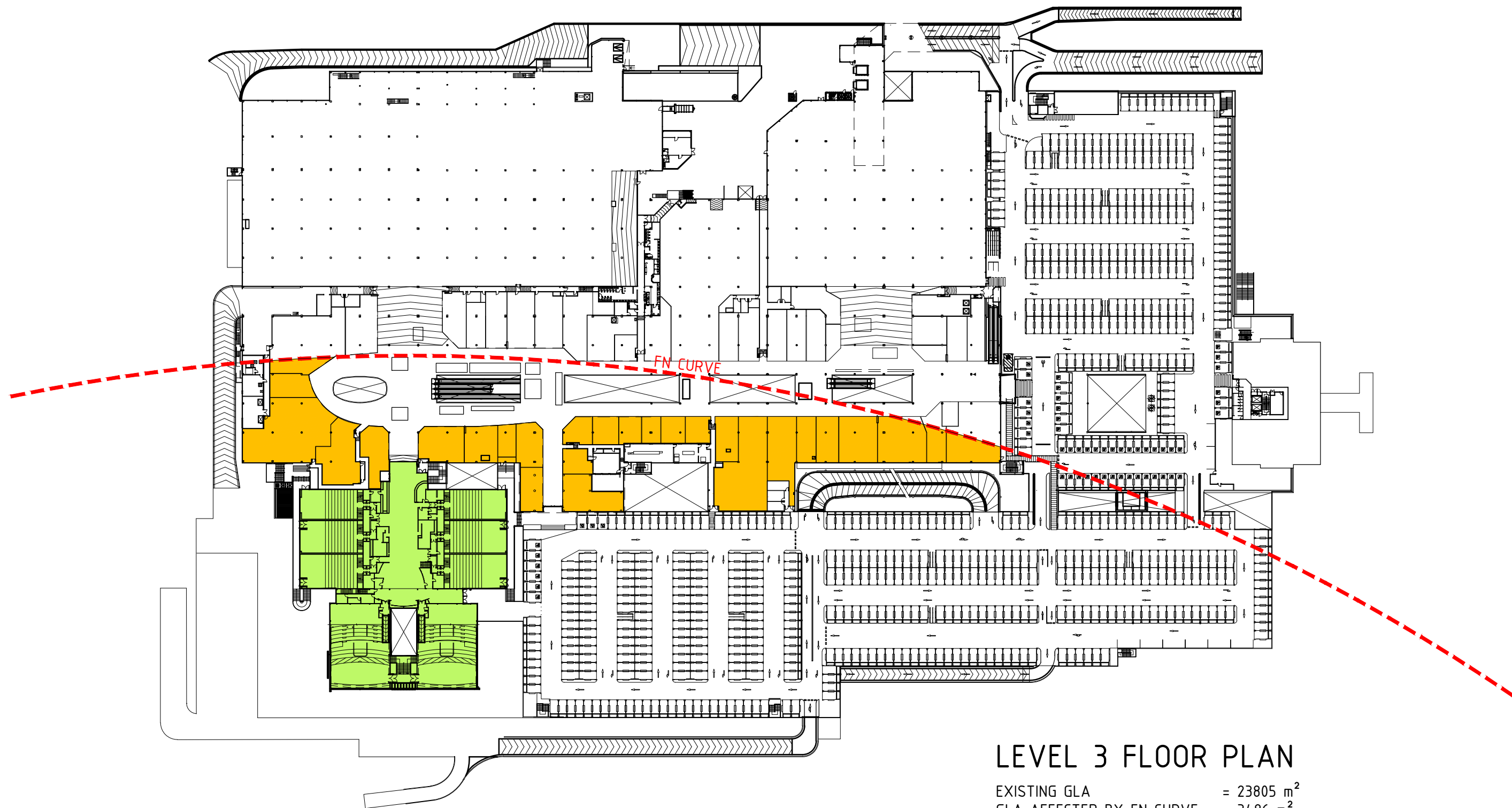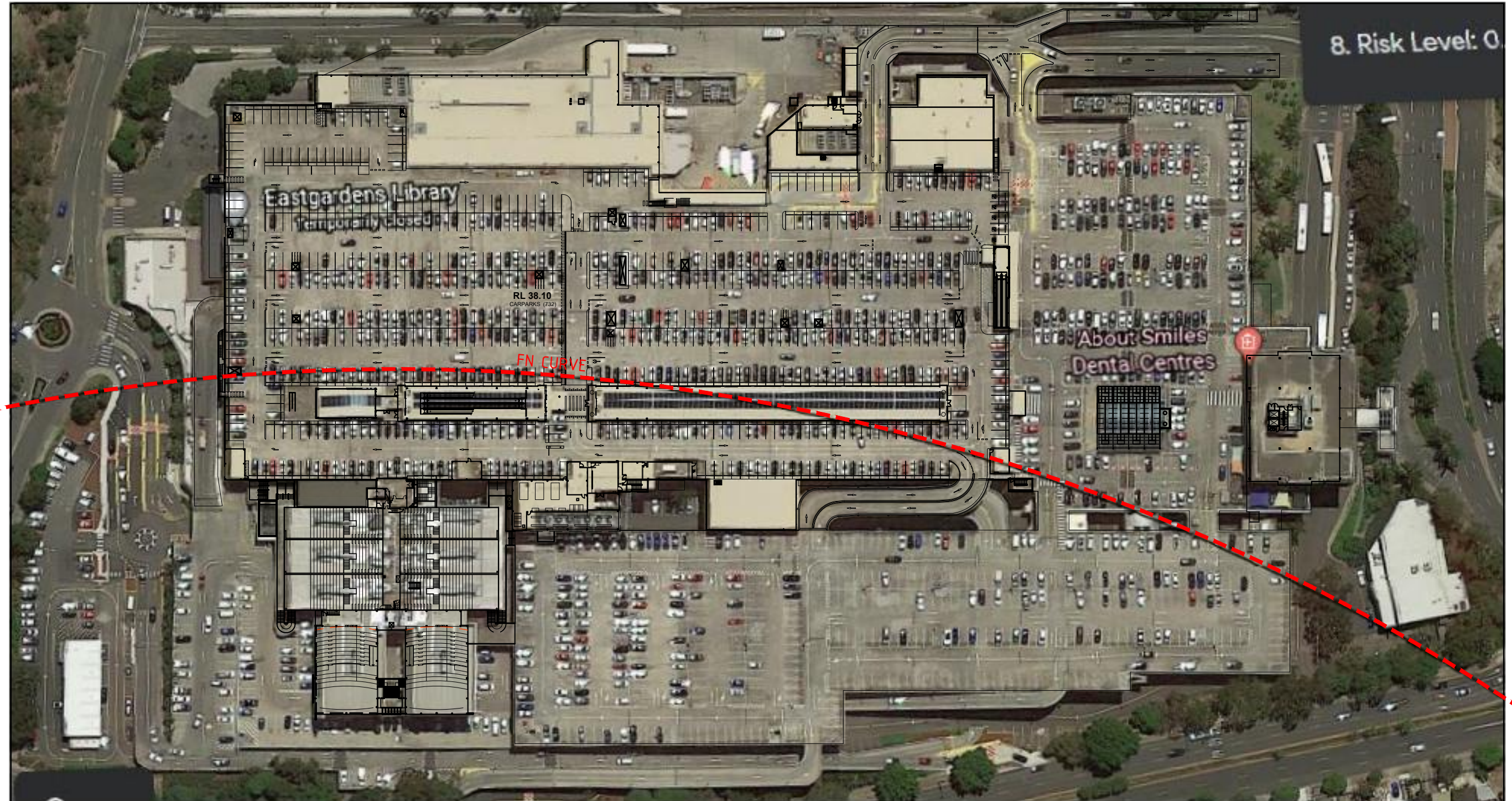
FN CURVE

LEVEL 1 FLOOR PLAN

EXISTING GLA   = 29589 m²
GLA AFFECTED BY FN CURVE = 3975 m²

RL 27.00

FN CURVE

RL 26.30

RL 26.30
CARPARKS (508)

RL 24.60

LEVEL 2 FLOOR PLAN

EXISTING GLA   = 22951 m^2
GLA AFFECTED BY FN CURVE   = 2818 m^2

FN CURVE

LEVEL 3 FLOOR PLAN

EXISTING GLA   = 23805 m²
GLA AFFECTED BY FN CURVE = 3486 m²
CINEMA AFFECTED BY FN CURVE = 3873 m²

Eastgardens Library
Temporarily closed

RL 38.10
CARPARKS (732)

FN CURVE

About Smiles
Dental Centres

LEVEL 4 FLOOR PLAN

APPENDIX B.   REFERENCES

1   Sherpa Consulting Pty Ltd (2018): Botany Industrial Park Quantitative Risk Assessment (QRA) Report, Document Number: 21158-RP-001, Rev 1.

   Webpage   https://www.planning.nsw.gov.au/-/media/Files/DPE/Reports/quantitative-risk-assessment-2018-botany-industrial-park-report-2020-01-24.pdf?la=en

2   NSW Department of Planning and Environment (2011): Hazardous Industry Planning Advisory Paper No 10 – Land Use Safety Planning.

3   Email Nik Wheeler, Urbis to Jenny Polich Sherpa cced to Doris Yau, DPIE, 2 June 2021, and Email Nik Wheeler, Urbis to Jenny Polich Sherpa, 16 June 2021