

## TECHNICAL MEMORANDUM

**DATE** April 15, 2019

**Project No.** 18108181

**TO** Mr. Hitesh Gajiwala  
TMD – Atria Corp.

**CC** Rafael Abdulla, PEng

**FROM** David Hinton, PEng  
Gerard Van Arkel, PEng

**EMAIL:** [David\\_Hinton@Golder.com](mailto:David_Hinton@Golder.com)

### **WATER BALANCE ASSESSMENT FOR PROPOSED DEVELOPMENT AT 290, 294, 298, 302 GEORGIAN DRIVE, BARRIE, ONTARIO**

#### **1.0 INTRODUCTION**

TMD – Atria Corp. retained Golder Associates Ltd. (Golder) to provide a conceptual water balance for the proposed development at 290, 294, 298, 302 Georgian Drive, Barrie, Ontario (the Site).

As shown in the attached site plan, the Site has an area of 17,280 m<sup>2</sup> and is proposed to be developed with a 19-storey apartment building and below ground parking garage. The Site is bordered by Georgian Drive to the south, low density residential properties to the west, Highway 400 to the north, and three-storey townhouses to the east.

A water balance analysis was carried out for both existing and proposed conditions. The existing and proposed conditions were based on the proposed Site Plan provided by TMD – Atria Corp. (Attachment 1), including the existing features. The purpose of the water balance assessment was to:

- Compare average monthly and average annual surplus (runoff + infiltration), under existing and proposed conditions, to estimate the difference in surplus;
- Evaluate proposed Low Impact Development (LID) features which could assist in maintaining existing infiltration conditions under post-development conditions, based on the water balance analysis and data review; and,
- Complete a mitigated water balance analysis including the proposed LID features to estimate the surplus with mitigation options, which is compared to the existing conditions and the target annual infiltration.

## 2.0 METHODOLOGY

The water balance assessment was based on meteorological data, land use data and soil types observed during recent geotechnical investigations. Meteorological data was obtained from Environment and Climate Change Canada (ECCC) Shanty Bay Station, which is approximately 6 km east of the Site (Climate ID 6117684). The data for this composite was collected for the time period between for 1973 to 2015.

Water balance calculations were based on the following equation:

$$P = S + ET + R + I$$

Where: P = precipitation;  
S = change in soil water storage;  
ET = evapotranspiration;  
R = surface runoff; and  
I = infiltration (groundwater recharge).

Precipitation data obtained from ECCC for the Shanty Bay station indicates a mean annual precipitation (P) of 974 mm/yr.

Short-term or seasonal changes in soil water storage (S) occur as demonstrated by the dry conditions in the summer months and the wet or flooded conditions in the winter and spring. Long-term changes (e.g., year to year) in soil water storage are considered to be negligible.

Evapotranspiration (ET) refers to water lost to the atmosphere from vegetated surfaces. The term combines evaporation (i.e., water lost from soil or water surfaces) and transpiration (i.e., water lost from plants and trees) because of the difficulties in measuring these two processes separately. Potential ET refers to the calculated maximum potential loss of water from a vegetated surface to the atmosphere under conditions of an unlimited water supply. In this analysis, that potential ET is calculated following the Thornthwaite methodology using daily temperatures. The actual ET is a measure of ET that actually occurs, and is typically less than the potential ET rate as dry conditions (e.g., during the summer months when there is a moisture deficit) means that the potential ET for some months sometimes exceeds the amount of water available in the soil to evaporate. The mean annual potential ET for Shanty Bay is 607 mm/yr based on data provided by ECCC.

Annual water surplus is the difference between P and the actual ET. The water surplus represents the total amount of water available for either surface runoff (R) or groundwater infiltration (I) on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snow melt, and maximum soil or snow pack storage is exceeded. Maximum soil storage is quantified using a water holding capacity (WHC) specific to the soil type and land use.

Infiltration rates and WHC were estimated using the MOE Stormwater Management Planning and Design (SWM) Manual (2003). There are three main factors that determine the percent infiltration of the total surplus: topography, soil type and ground cover. The sum of the fractions representing the three characteristics establishes the approximate annual percentage of surplus which can be infiltrated in an area with a sufficient downward groundwater gradient.

## 2.1 Site Water Balance Areas

Land use within the Site under existing conditions was identified using the provided Site Plan (Attachment 1) and Google Earth images. Existing land use includes three detached dwellings, asphalt driveways, and open spaces with urban lawns. The northern portion of the property is a wooded area.

Land use within the study area under post-development conditions was identified from the Site Plan (Attachment 1). The Site Plan provides the extents of the proposed apartment building, as well as the total area of the proposed parking, pathway, and open space/urban lawn area. The northern portion of the property was assumed to remain wooded north of the tree protection line, with the exception of a proposed infiltration basin near the north property line.

## 3.0 WATER BALANCE PARAMETERS

Golder's Geotechnical and Hydrogeological Investigations identified surficial layers of fine sandy loam across the majority of the Site. Hydrologic Cycle Component Values from Table 3.1 of the MOE SWM Manual (MOE 2003) were used to determine the WHC and infiltration factors assuming a fine sandy loam soil type over the described land uses. For impervious areas, it was assumed that 90% of the sum of rainfall plus snowmelt resulted in runoff after evaporation was removed as per the Hydrogeological Assessment Submissions Conservation Authority Guidelines to Support Development Applications (Conservation Ontario 2013).

Infiltration factors were calculated using a sum of site-specific topography, surficial soil type, and vegetative cover factors for each land use, as shown in Table 3.1 of the MOE SWM manual (MOE 2003). Runoff was calculated as the difference between surplus and infiltration. Annual evapotranspiration values were based on the water holding capacity of each land use area. Surplus values were calculated as the annual precipitation minus annual actual evapotranspiration.

### 3.1 Water Holding Capacities, Infiltration Factors, and evapotranspiration rates

The following pre- and post-development water holding capacities and infiltration factors were assigned to the Site.

#### Pre-development Water Holding Capacity and Infiltration Factors

- For existing grassed and open areas, a WHC of 75 mm was used, representing urban lawns in fine sandy loam soils. An infiltration factor of 0.6 was used, representing hilly land with an average slope of between 28 m/km and 47 m/km (factor of 0.1), open sandy loam (factor of 0.4), and urban lawns (factor of 0.1).
- For existing wooded areas, a WHC of 300 mm was used, representing mature forests in fine sandy loam soils. An infiltration factor of 0.7 was used, representing hilly land with an average slope of between 28 m/km and 47 m/km (factor of 0.1), open sandy loam (factor of 0.4), and woodland (factor of 0.2).
- For existing houses and paved areas, an infiltration factor of zero was applied, indicating no infiltration occurring on these surfaces. The surplus value for these impervious areas was calculated as the annual precipitation minus annual potential evapotranspiration. As stated above, it was assumed that 90% of rainfall plus snowmelt resulted in runoff after evaporation was removed.

## Post-Development Water Holding Capacity and Infiltration Factors

- For post-development grassed and open areas, a WHC of 75 mm was used, representing urban lawns in fine sandy loam soils. An infiltration factor of 0.6 was used, representing hilly land with an average slope of between 28 m/km and 47 m/km (factor of 0.1), open sandy loam (factor of 0.4), and urban lawns (factor of 0.1).
- For post-development wooded areas, a WHC of 300 mm was used, representing mature forests in fine sandy loam soils. An infiltration factor of 0.7 was used, representing hilly land with an average slope of between 28 m/km and 47 m/km (factor of 0.1), open sandy loam (factor of 0.4), and woodland (factor of 0.2).
- For the post-development impervious areas, including walkways, pavement surfaces and the building roof, an infiltration factor of zero was applied, indicating no infiltration occurring on these surfaces. The surplus value for these impervious areas was calculated as the annual precipitation minus annual potential evapotranspiration. As stated above, it was assumed that 90% of rainfall plus snowmelt resulted in runoff after evaporation was removed (10% evapotranspiration).

## 4.0 PRELIMINARY WATER BALANCE RESULTS

Water balance results for the 17,280 m<sup>2</sup> Site catchment area are summarized herein.

### 4.1 Pre-Development Condition

Table 1 presents the results of the water balance for the Site area under existing conditions on an average annual basis. Under existing conditions, the estimated average annual runoff from the Site is approximately 2,750 m<sup>3</sup>, and the estimated average annual infiltration from the Site is approximately 4,280 m<sup>3</sup>.

### 4.2 Unmitigated Post-Development Condition

Detailed land use areas associated with the proposed development were assumed as described above. Approximately 28% of the post-development site is proposed to be impervious, including the building area, parking area, and walkways.

Table 1 presents the results of the water balance within the study area under post-development conditions on an average annual basis with no mitigation (i.e., no LID) measures applied. The estimated average annual runoff from the un-mitigated Site is approximately 5,720 m<sup>3</sup> and the estimated average annual infiltration is approximately 3,210 m<sup>3</sup>. Runoff contributions from the un-mitigated Site are estimated to increase by approximately 2,970 m<sup>3</sup>/yr or 108%, while the infiltration is estimated to decrease by approximately 1,070 m<sup>3</sup>/yr or 25%, relative to the pre-development conditions.

**Table 1: Pre-Development and Unmitigated Post-Development Annual Water Balance Results**

Parameter	Existing Conditions		Unmitigated Post-Development Conditions	
	mm/yr	m <sup>3</sup> /yr	mm/yr	m <sup>3</sup> /yr
Precipitation	974	16,830	974	16,830
Evapotranspiration	567	9,800	457	7,900
Surplus	407	7,030	517	8,930
Infiltration	248	4,280	186	3,210
Runoff	159	2,750	331	5,720

### 4.3 Mitigated Post-Development Condition

The attached site plan identified a 269 m<sup>2</sup> section of land to the north of the building to be used as an infiltration planting area. It is expected that the infiltration planting will act as bioretention to store, treat, and infiltrate runoff during smaller events and will not require an underdrain, due to the fine sandy loam soil observed on-site. Since groundwater levels observed at the Site generally ranged between 8 mbgs and 14 mbgs, it is expected that the infiltration planting could be designed to maintain at least 1 m vertical separation from the seasonally high groundwater level. Although the design is preliminary, it is assumed that the infiltration planting would reduce runoff from its footprint area by approximately 85% through increased infiltration (TRCA and CVC 2010). This is a typical estimate for the purpose of initial screening of LID practices and should be confirmed during detailed design.

The attached site plan identified a 533 m<sup>2</sup> section of the fourth floor terrace to be used as a green roof. Although the design is preliminary, it is assumed that the green roof would reduce runoff from that area of the roof by approximately 45% through increased evapotranspiration (TRCA and CVC 2010). This is a typical estimate for the purpose of initial screening of LID practices and should be confirmed during detailed design.

All runoff from the roof will be directed to a quantity control basin at the top of the slope to the north of the building and will be directed down the slope to an infiltration basin (based on personal communication with Pearson Engineering Ltd.). Inflow to the infiltration basin will also include overland runoff from approximately 3,206 m<sup>2</sup> of forested area and 997 m<sup>2</sup> of grassed area based on available topographic mapping. Although design details were not available for the infiltration basin, it is anticipated that the basin will be designed to manage infrequent flow events while allowing sufficient surface storage volume to infiltrate the runoff volume control target for smaller flow events. Assuming an infiltration rate of approximately 12 mm/hr (estimated from the hydraulic conductivity measurement at BH-18-2), it is anticipated that the infiltration basin could be designed to infiltrate approximately 0.56 m in 48 hours for a runoff control volume target of approximately 20 mm for the contributing drainage area.

Infiltration from the proposed infiltration basin was estimated on an annual basis by analyzing the daily precipitation record at Shanty Bay (1974 to 2017). The infiltration basin was assumed to infiltrate all rainfall depth that was equal to or less than 20 mm in a 48 hour period. This resulted in an infiltration factor of 0.59 (59%) for the

entire roof area, an increased infiltration factor of 0.84 (84%) for the grassed portion and an increased infiltration factor of 0.88 (88%) for the wooded portion of the catchment area.

Table 2 presents the results of the post-development site-wide water balance, including the infiltration planting, green roof, and infiltration basin mitigations for average annual conditions. The total estimated average annual runoff from the Site is approximately 3,390 m<sup>3</sup>/yr and the estimated average annual infiltration is approximately 5,360 m<sup>3</sup>/yr for the mitigated post-development condition. Compared to the existing condition, the Site-wide infiltration is expected to increase by approximately 1,080 m<sup>3</sup>/yr or 25%, and the total runoff from the Site is estimated to increase by 640 m<sup>3</sup>/yr or 23%.

**Table 2: Mitigated Post-Development Annual Water Balance Results**

Parameter	Existing Conditions		Mitigated Post-Development Conditions	
	mm/yr	m <sup>3</sup> /yr	mm/yr	m <sup>3</sup> /yr
Precipitation	974	16,830	974	16,830
Evapotranspiration	567	9,800	468	8,080
Surplus	407	7,030	506	8,750
Infiltration	248	4,280	310	5,360
Runoff	159	2,750	196	3,390

## 5.0 DISCUSSION & CONCLUSION

Based on the results of the preliminary water balance assessment, the average annual runoff from the Site is expected to increase by approximately 23% and the average annual infiltration is expected to increase by approximately 25% under mitigated post-development conditions, compared to pre-development conditions. This assessment included the proposed infiltration planting, green roof, and infiltration basin LID measures. The design of the LID measures will need to be confirmed during detailed design. However, this assessment indicates that, with the proper use of the proposed LID measures, the mitigated average annual post-development infiltration rate is considered to exceed pre-development conditions.

## 6.0 REFERENCES

Conservation Ontario, "Conservation Authority Guidelines for Hydrogeological Assessment Submissions", June, 2013.

Environment and Climate Change Canada. Historical Weather Data. Shanty Bay, Ontario, Climate ID 6117684  
[http://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](http://climate.weather.gc.ca/historical_data/search_historic_data_e.html)

Ontario Ministry of the Environment, "Stormwater Management Planning and Design Manual", 2003.

Toronto and Region Conservation Authority and Credit Valley Conservation Authority (TRCA and CVC), "Low Impact Development Stormwater Management Planning and Design Guide", 2010.



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Attachments: Attachment 1: Site Plan

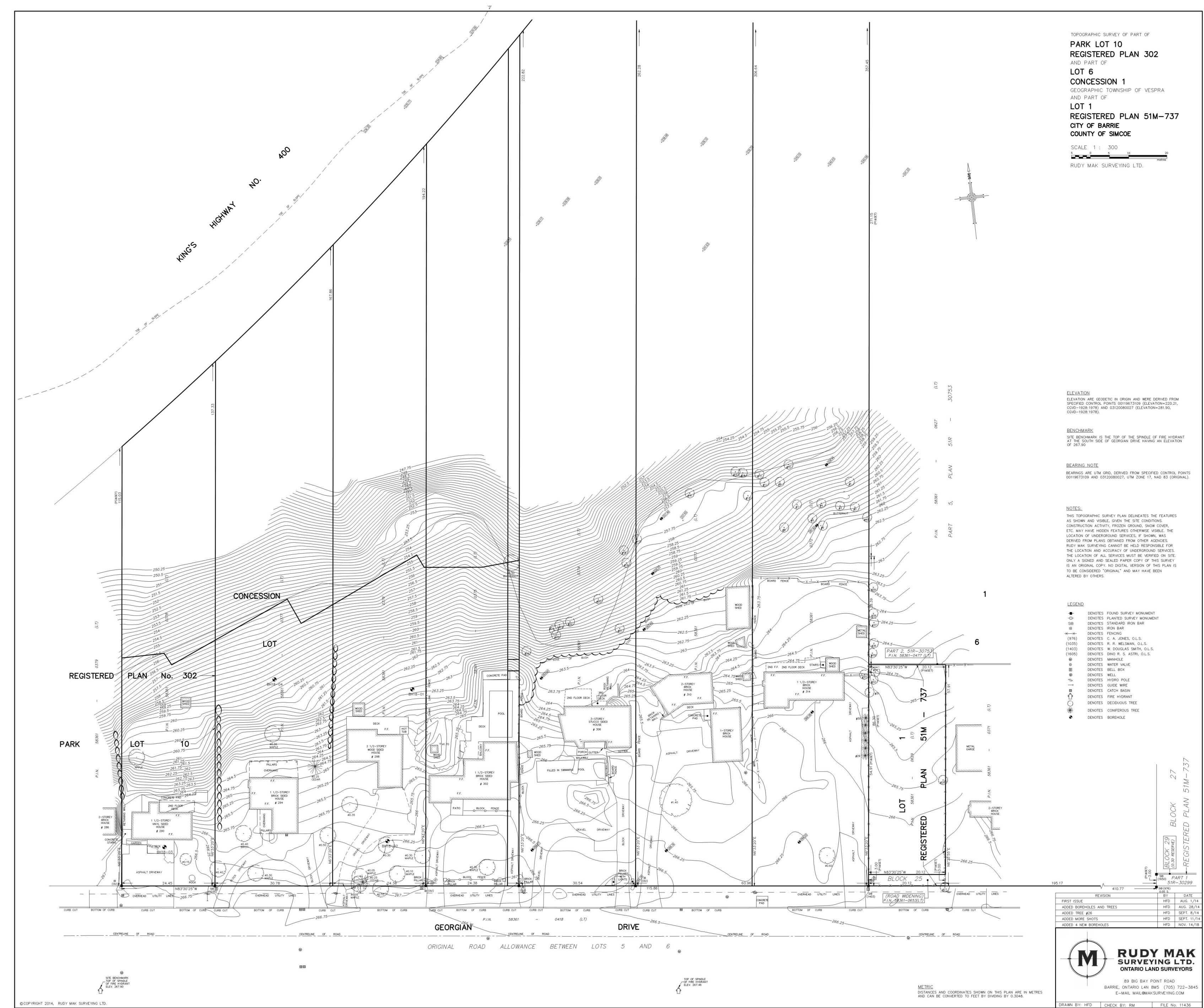
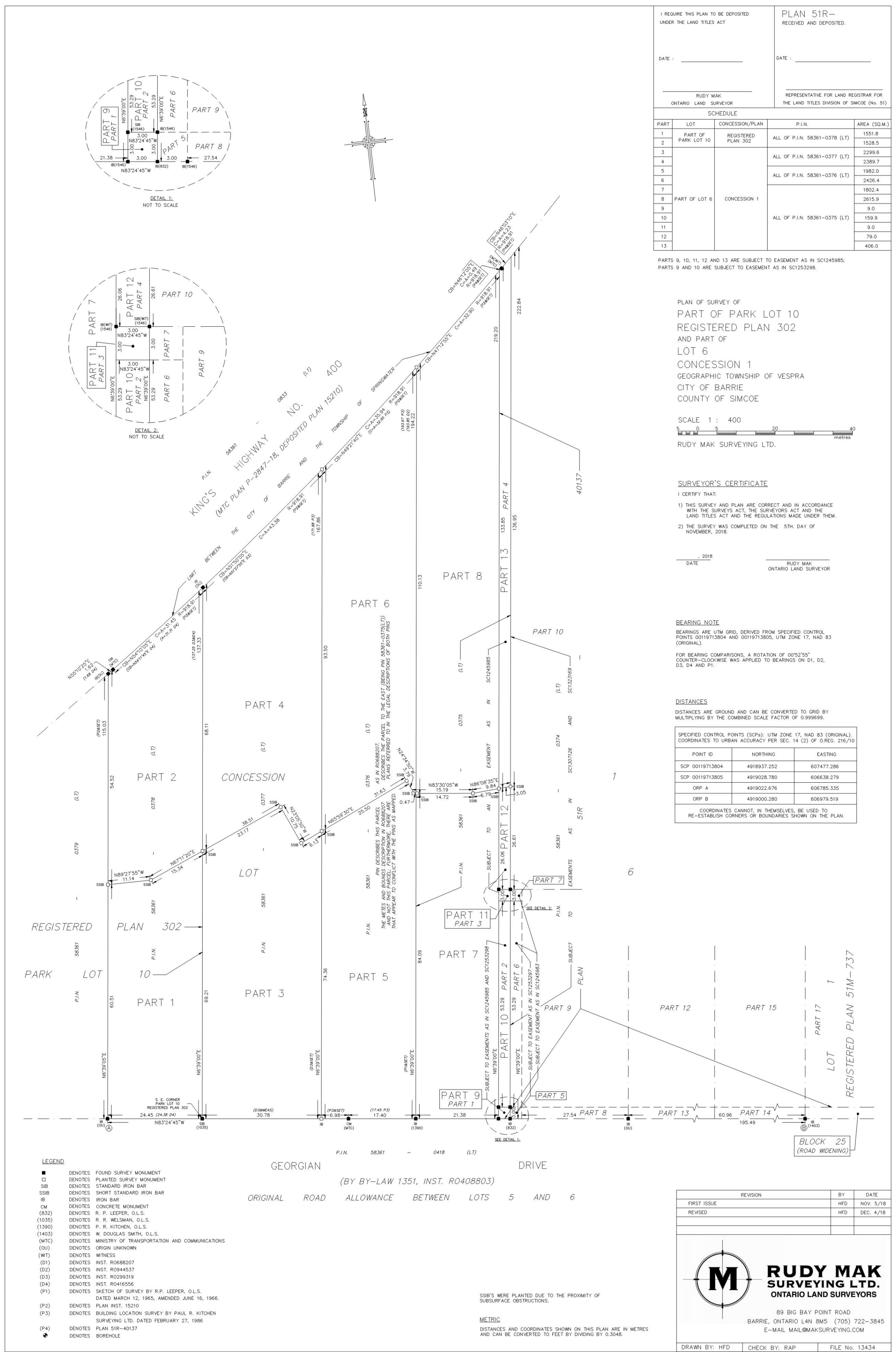
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**ATTACHMENT 1**

# Site Plan







2	2018/05/04	ISSUED FOR REZONING, OPA AND SPA
1	2018/01/16	ISSUED FOR PRE-CONSULTATION MEETING

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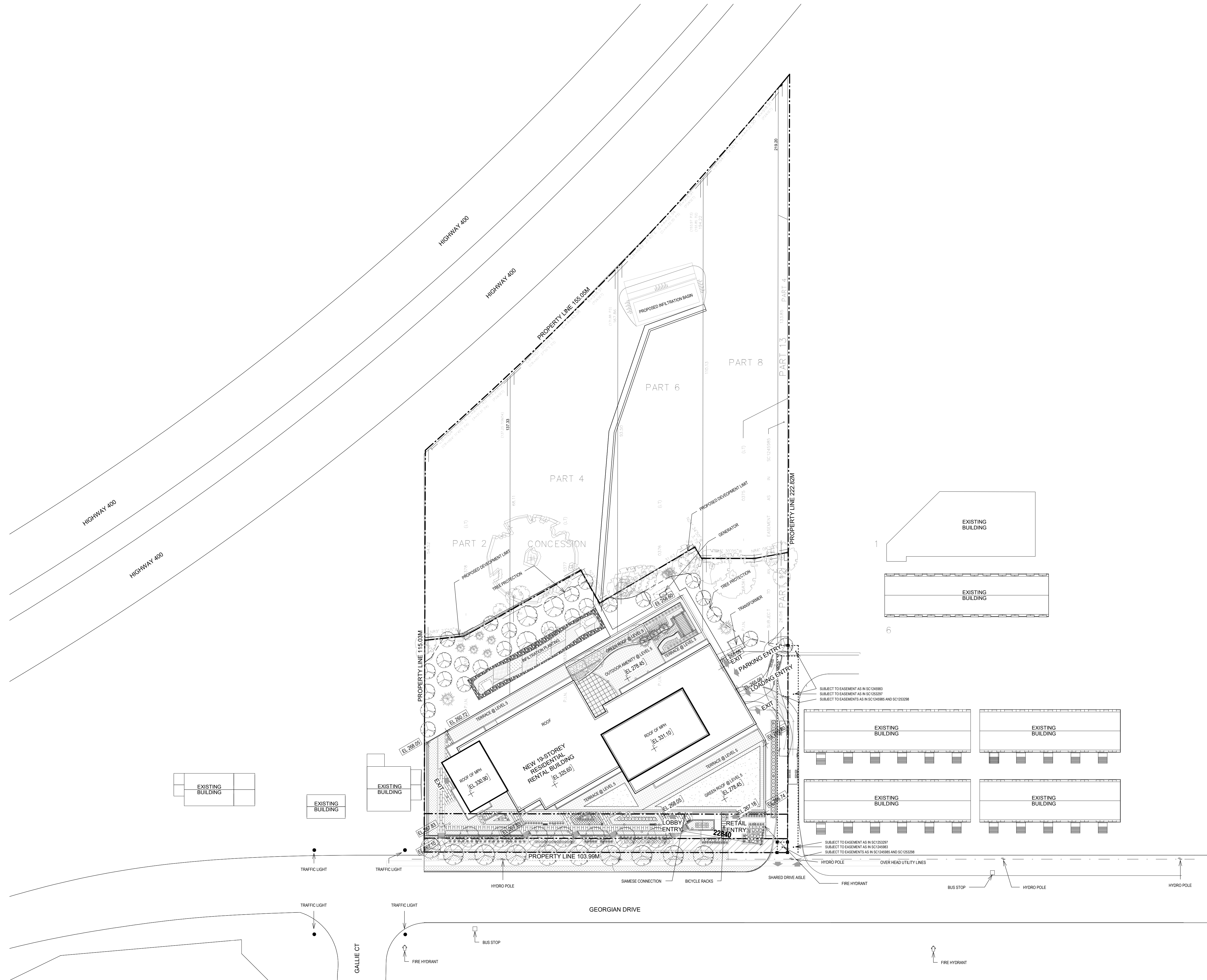
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290-302 GEORGIAN DRIVE, BARRIE

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SHEET NAME	SURVEY
PROJECT NO.	SHEET NO.
18-107	A002

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- DEVELOPMENT LIMIT
- - - FENCE
- - - LANDSCAPE PROTECTION AREA
- - - OVER HEAD UTILITY LINES
- ~ HYDRO POLE
- ⊕ FIRE HYDRANT
- ⊕ SIAMISE CONNECTION
- TRAFFIC LIGHT
- BUS STOP
- ▨ ROAD WIDENING

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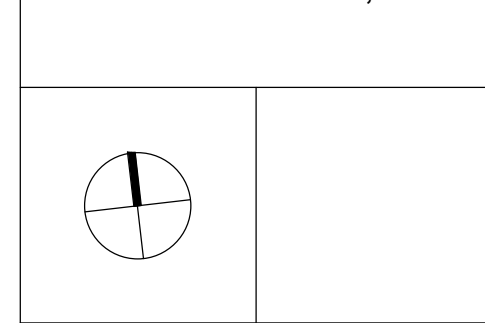
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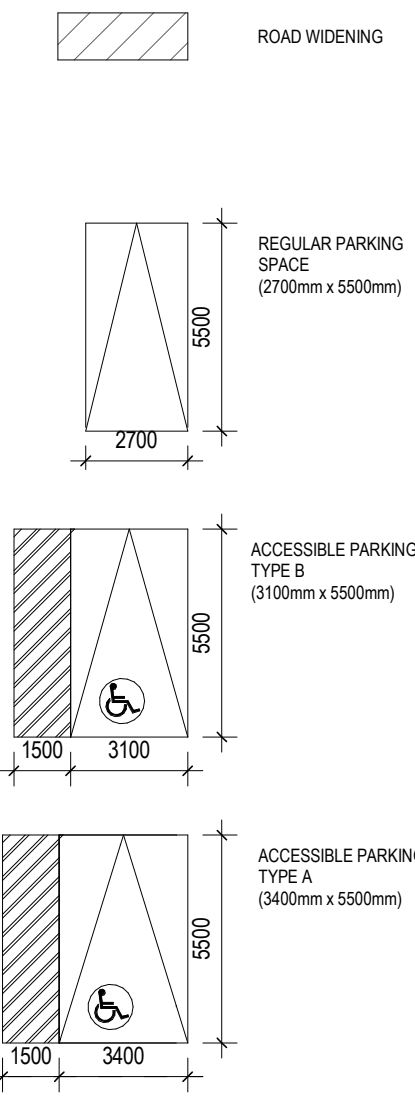
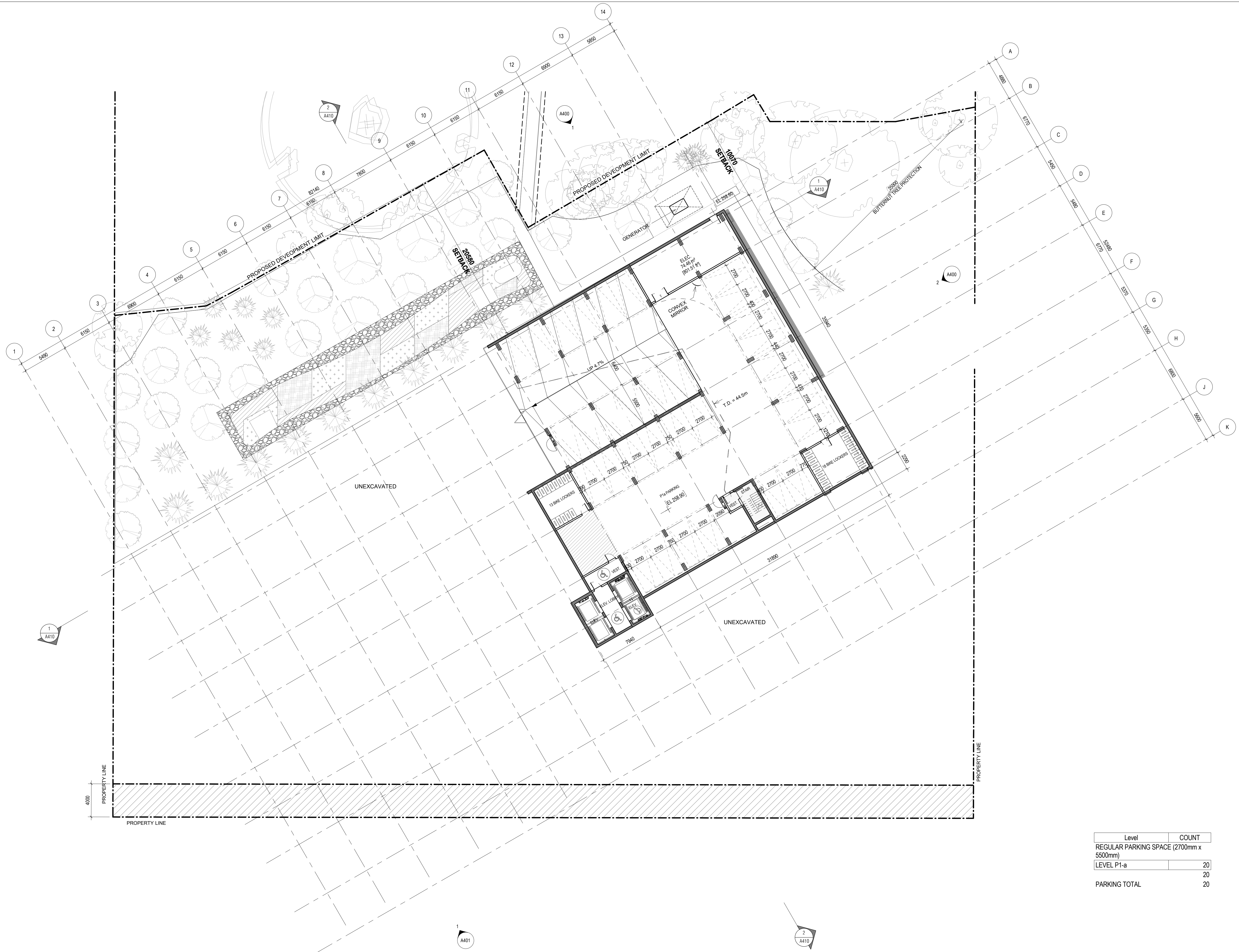


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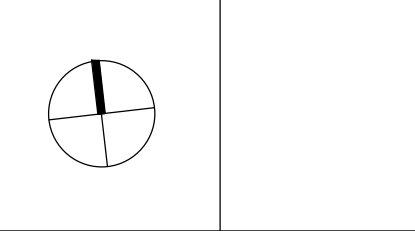
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Level	COUNT
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<b>PARKING TOTAL</b>	<b>20</b>

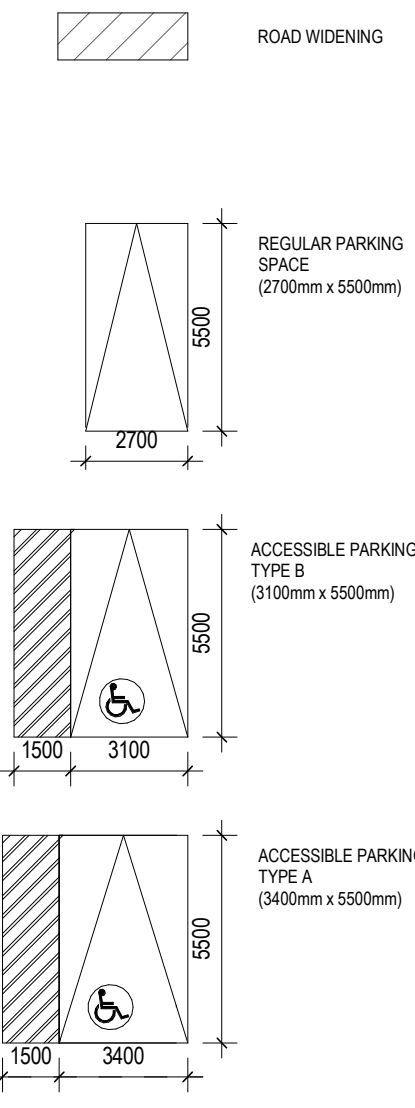
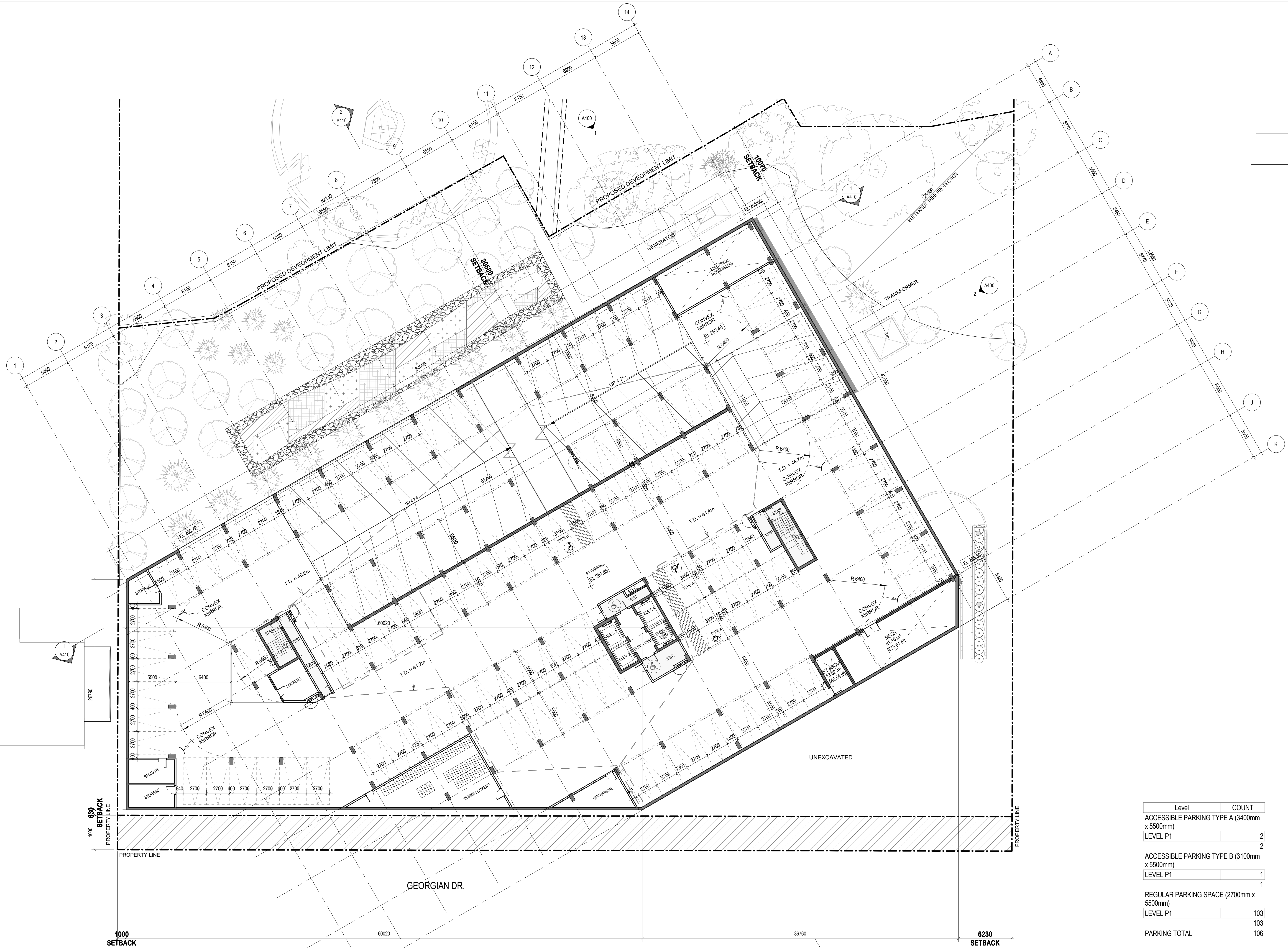


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PROJECT NO. 18-107 SHEET NO. A150

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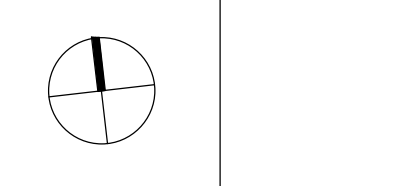
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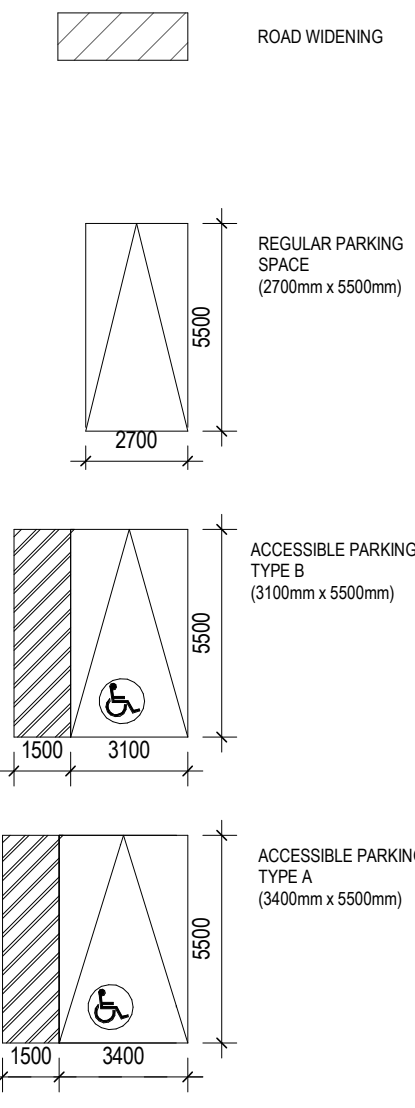
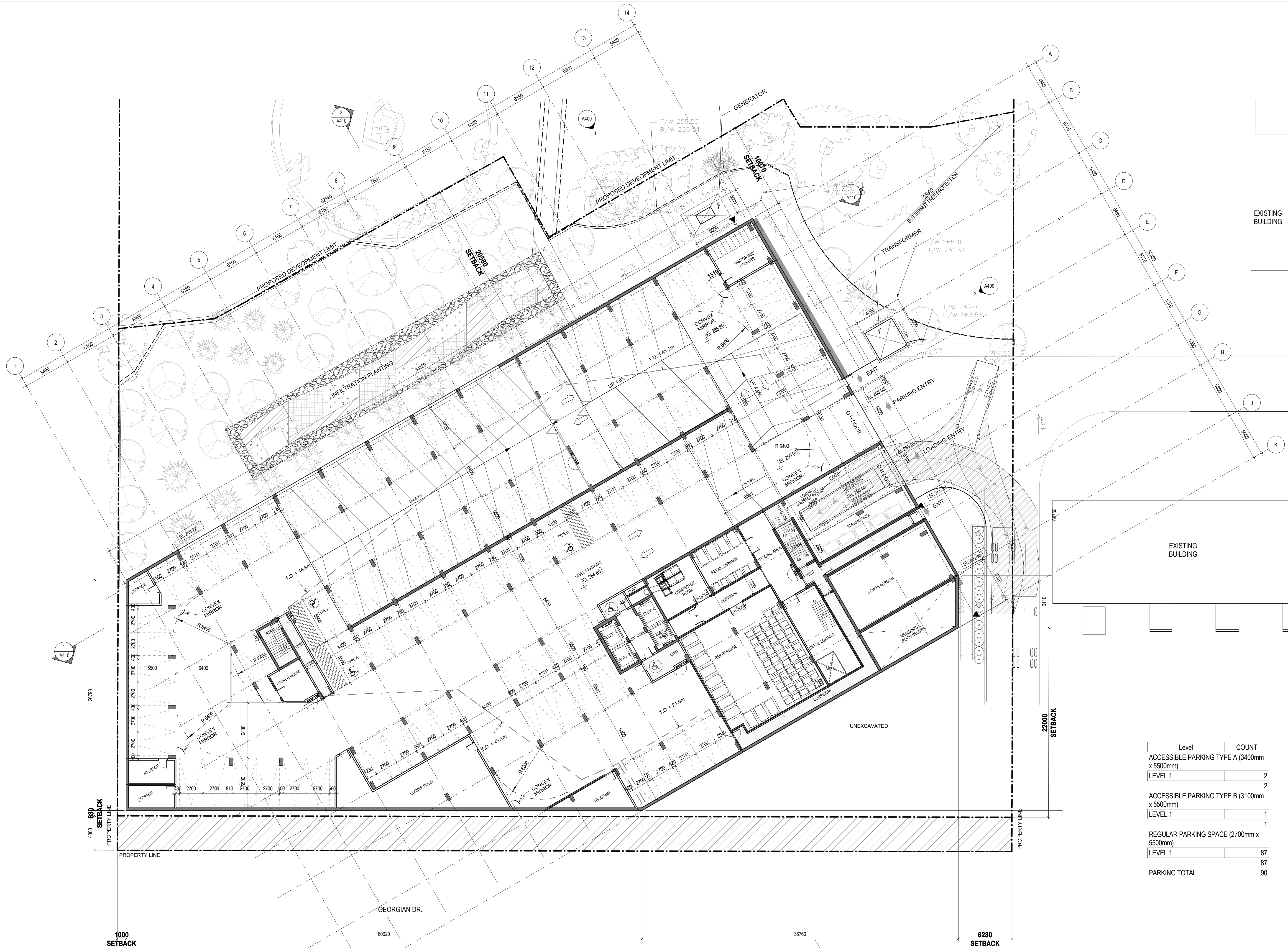
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PROJECT NO. 18-107 SHEET NO. A151

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LEVEL P1	2
	2
ACCESSIBLE PARKING TYPE B (3100mm x 5500mm)	
LEVEL P1	1
	1
REGULAR PARKING SPACE (2700mm x 5500mm)	
LEVEL P1	103
	103
<b>PARKING TOTAL</b>	<b>106</b>

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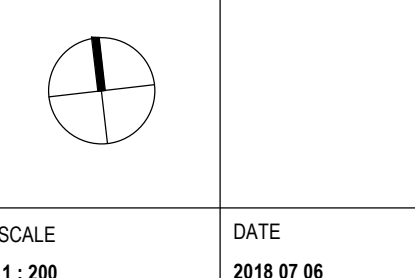
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Level	COUNT
ACCESSIBLE PARKING TYPE A (3400mm x 5500mm)	
LEVEL 1	2
ACCESSIBLE PARKING TYPE B (3100mm x 5500mm)	
LEVEL 1	1
REGULAR PARKING SPACE (2700mm x 5500mm)	
LEVEL 1	87
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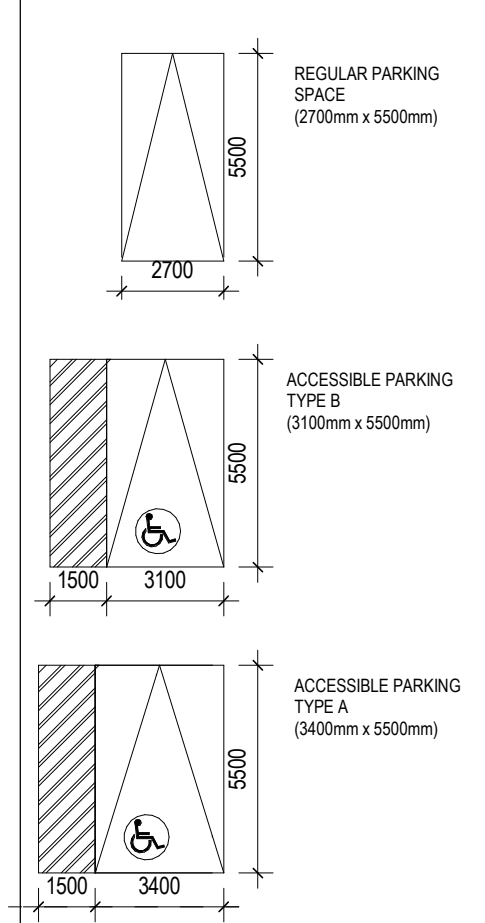


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PROJECT NO. 18-107 SHEET NO. A201

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- LANDSCAPE PROTECTION AREA
- OVER HEAD UTILITY LINES
- ~ HYDRO POLE
- ~ FIRE HYDRANT
- ~ SIAMISE CONNECTION
- TRAFFIC LIGHT
- BUS STOP
- ▨ ROAD WIDENING



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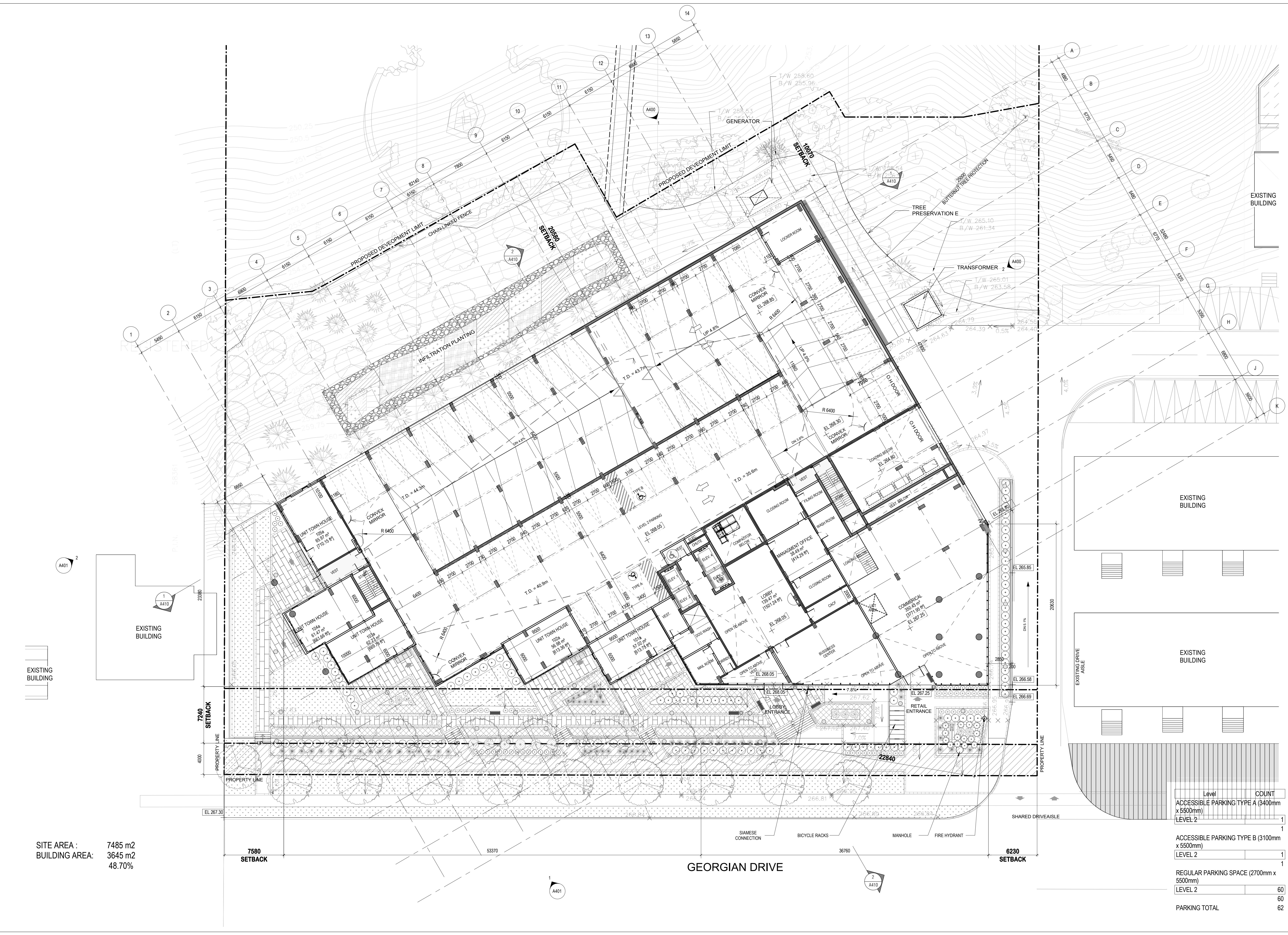
290-302 GEORGIAN DRIVE, BARRIE

Level	COUNT
ACCESSIBLE PARKING TYPE A (3400mm x 5500mm)	1
ACCESSIBLE PARKING TYPE B (3100mm x 5500mm)	1
REGULAR PARKING SPACE (2700mm x 5500mm)	60
<b>PARKING TOTAL</b>	<b>62</b>

SCALE 1:200 DATE 2018.07.06

SHEET NAME  
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PROJECT NO. 18-107 SHEET NO. A202

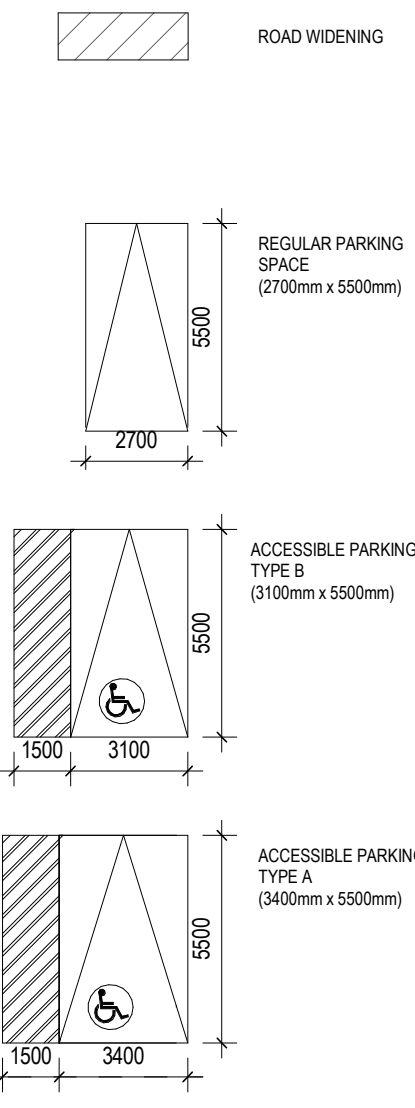
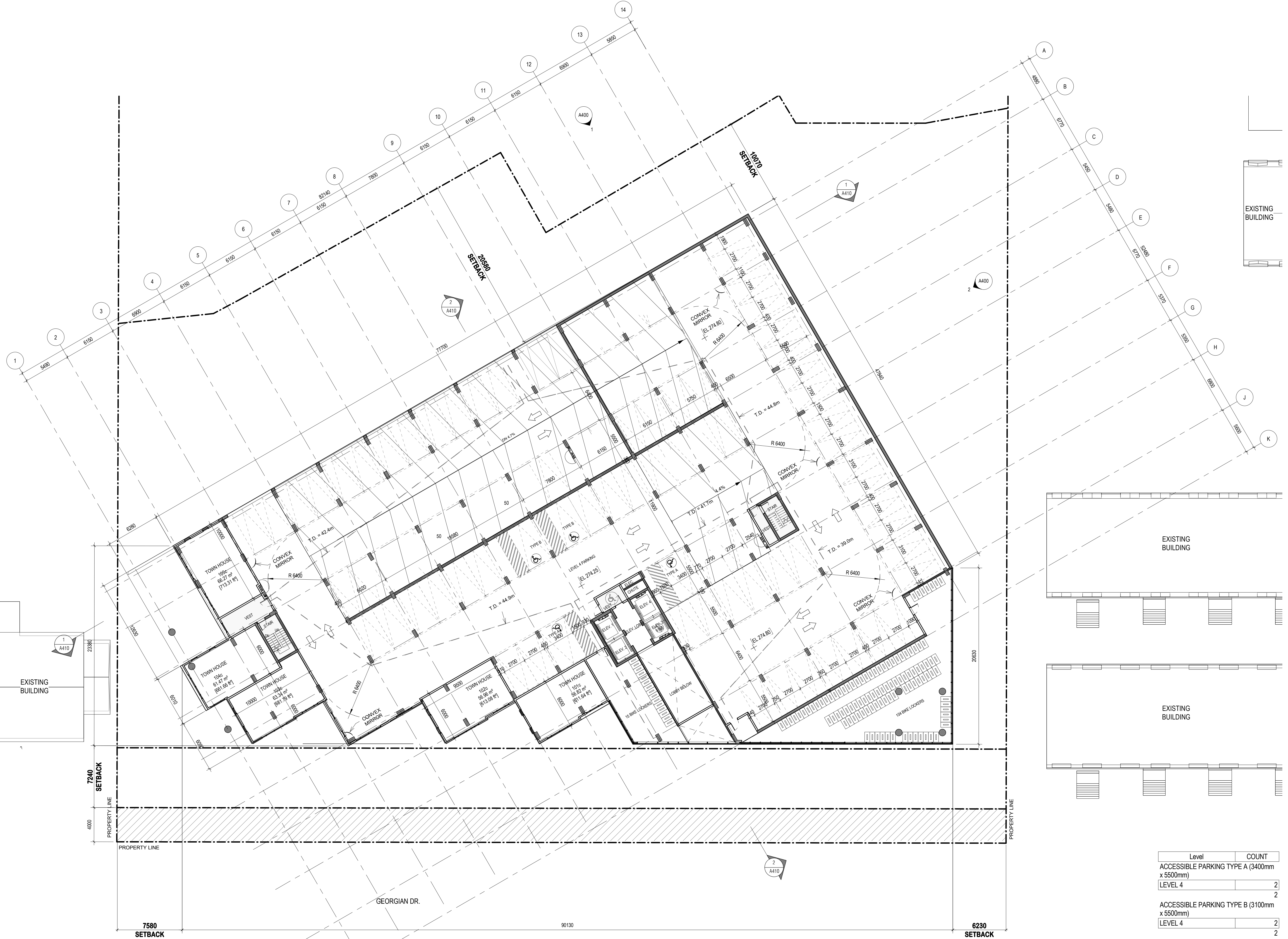


SITE AREA : 7485 m2  
 BUILDING AREA: 3645 m2  
 48.70%

Level	COUNT
ACCESSIBLE PARKING TYPE A (3400mm x 5500mm)	1
ACCESSIBLE PARKING TYPE B (3100mm x 5500mm)	1
REGULAR PARKING SPACE (2700mm x 5500mm)	60
<b>PARKING TOTAL</b>	<b>62</b>

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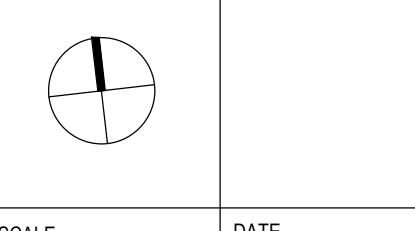
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**THE GEORGIAN**

290-302 GEORGIAN DRIVE, BARRIE



SCALE 1:200 DATE 2018/07/06

SHEET NAME **LEVEL 4 PLAN**

PROJECT NO. 18-107 SHEET NO. A204

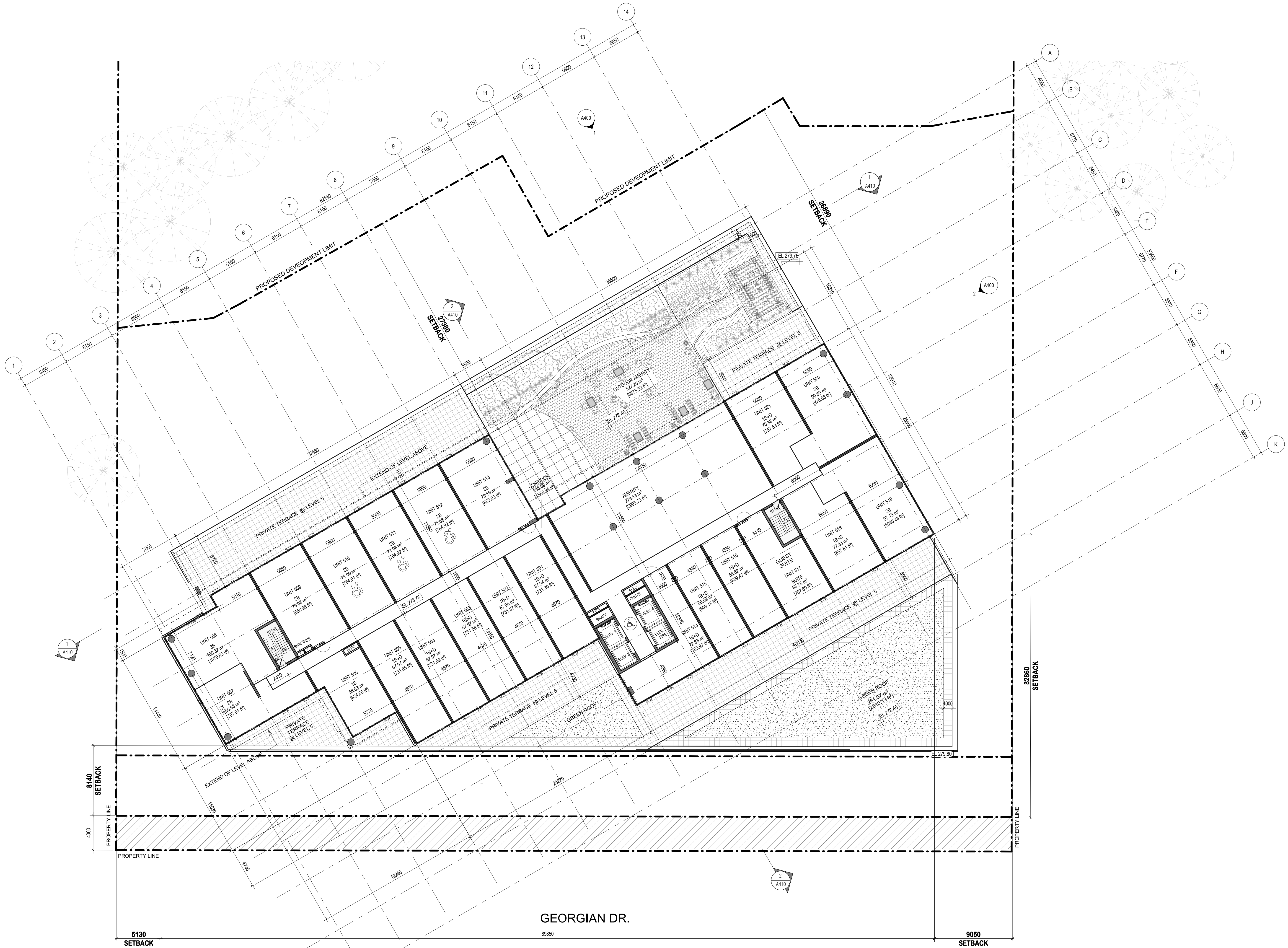
Level	COUNT
ACCESSIBLE PARKING TYPE A (3400mm x 5500mm)	
LEVEL 4	2
ACCESSIBLE PARKING TYPE B (3100mm x 5500mm)	
LEVEL 4	2
REGULAR PARKING SPACE (2700mm x 5500mm)	
LEVEL 4	79
PARKING TOTAL	83

DATE PRODUCED: 2018/07/06 10:48 AM

C:\REVIT\_LOCAL\_FILES\17\_Georgian Drive\_Corridor\09\_NEW\_mirrors\A204.rvt



ROAD WIDENING



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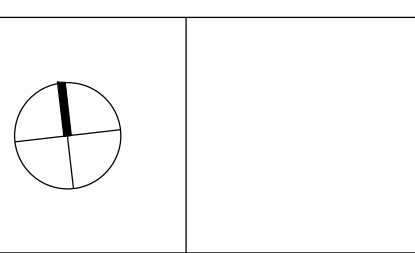
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SCALE 1:200 DATE 2018.07.06

SHEET NAME LEVEL 5 PLAN

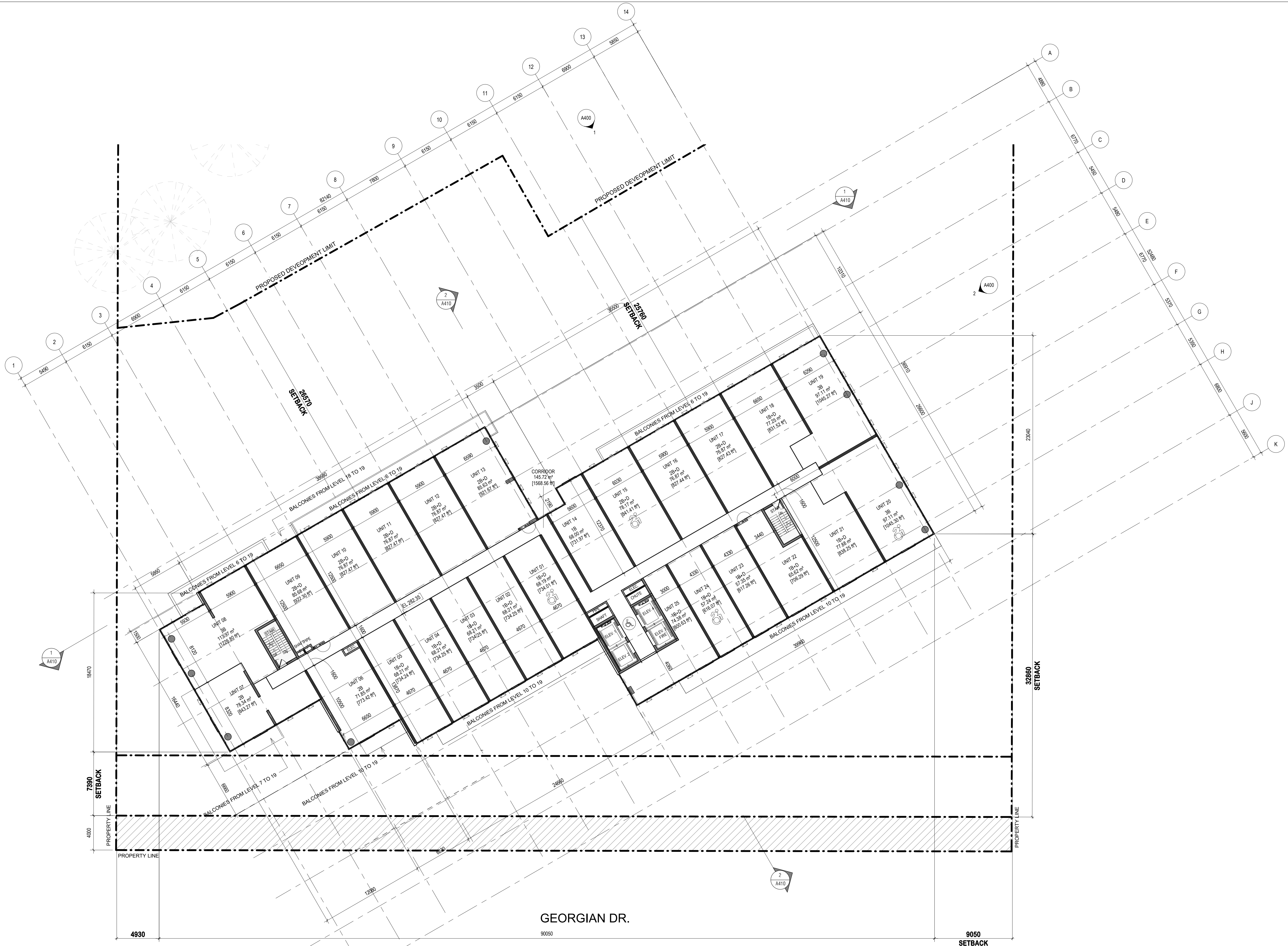
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DATE PRODUCED: 4/20/19 10:58:55 PM

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ROAD WIDENING



GEORGIAN DR.

290 GEORGIAN DRIVE STATISTICS\_TYPICAL 6 TO 19

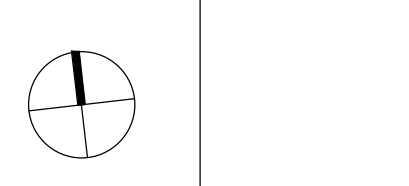
LEVEL	NUMBER OF REPEATED FLOOR	RESIDENTIAL GFA		RENTABLE FLOOR		RESIDENTIAL UNIT COUNT					TOTAL UNITS	AVERAGE UNIT SIZE (SF)	AVERAGE UNIT SIZE (SF)		
		GFA/FLOOR	TOTAL GFA	RENTABLE/FLOOR	TOTAL RENTABLE	UNIT/FLOOR	STUDIO	1B	1B+DEN	2B				2B+DEN	3B
Level 6-19	14	2060 m <sup>2</sup>	28847 m <sup>2</sup>	1911 m <sup>2</sup>	26754 m <sup>2</sup>	25	0	14	154	28	112	42	350	76.4 m <sup>2</sup>	823 SF

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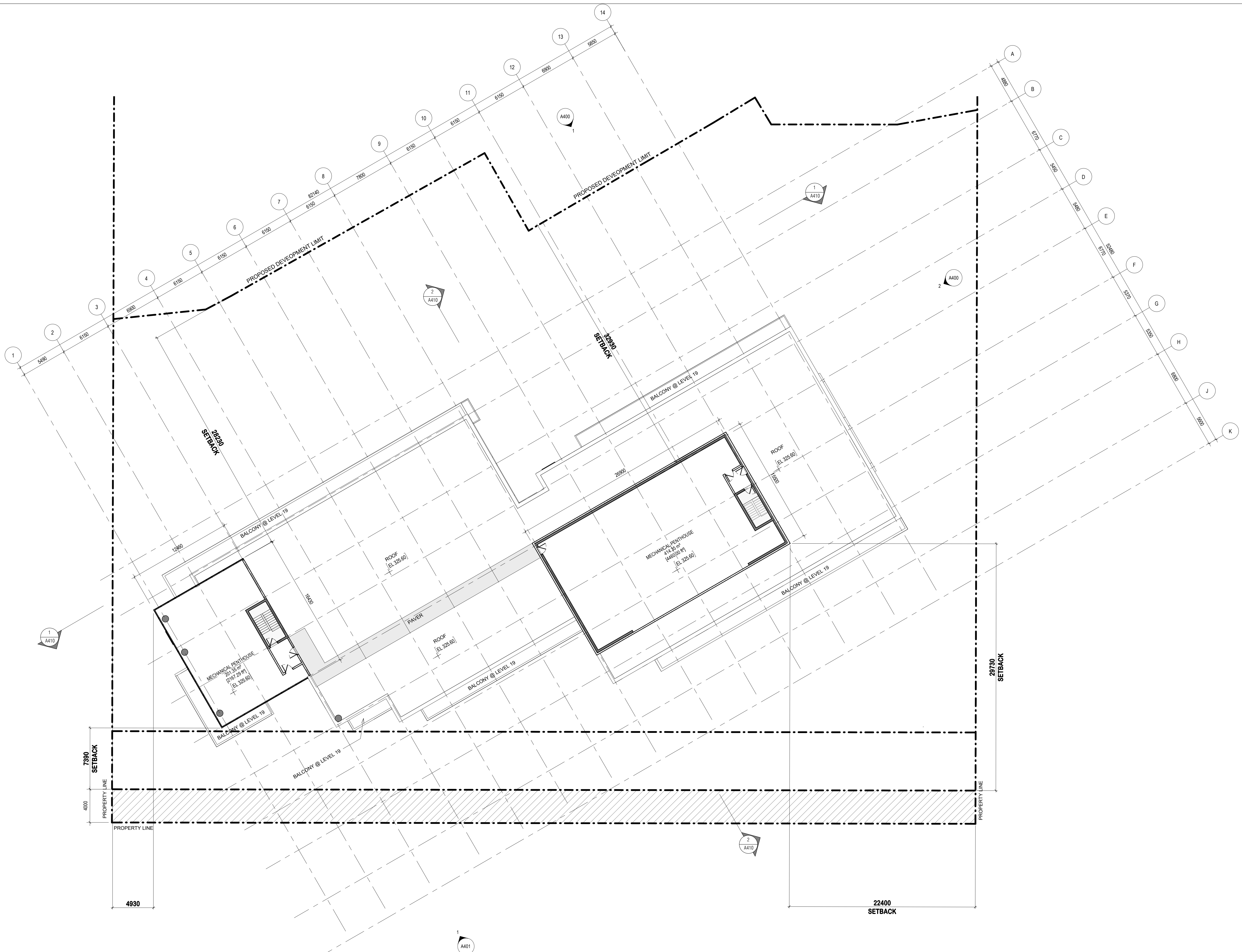


SCALE 1:200 DATE 2018.07.06

SHEET NAME LEVEL 6 TO 19 PLAN

PROJECT NO. 18-107 SHEET NO. A206

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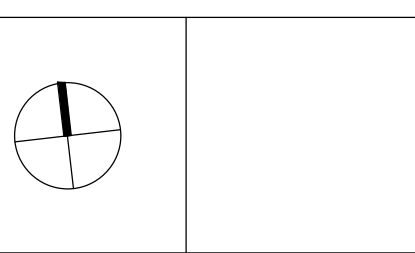
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SCALE  
1 : 200

DATE  
2018 07 06

SHEET NAME  
**LEVEL MPH PLAN**

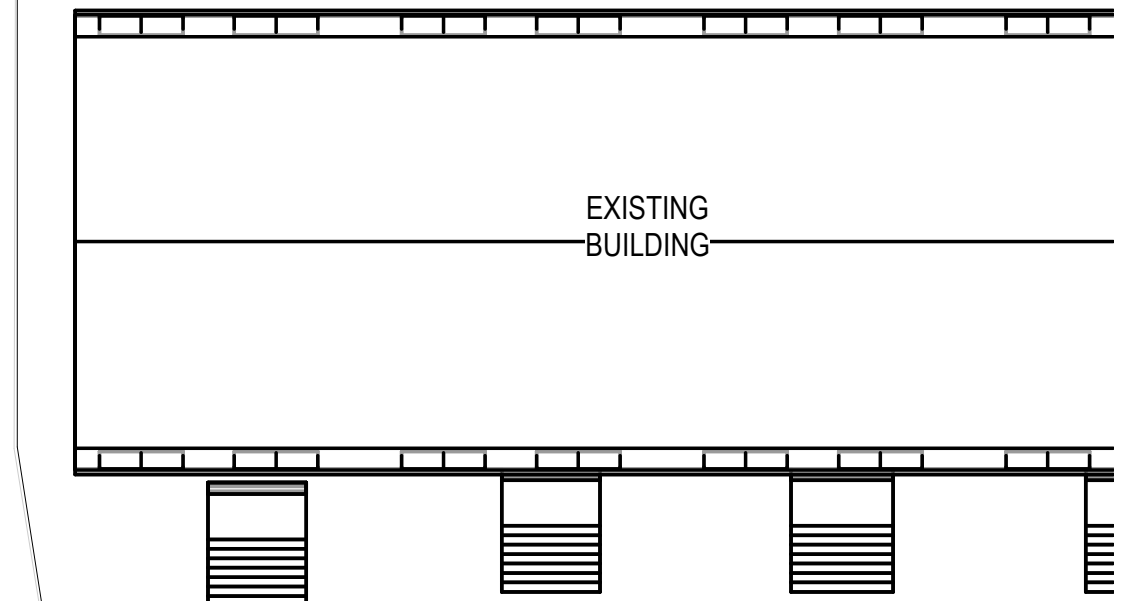
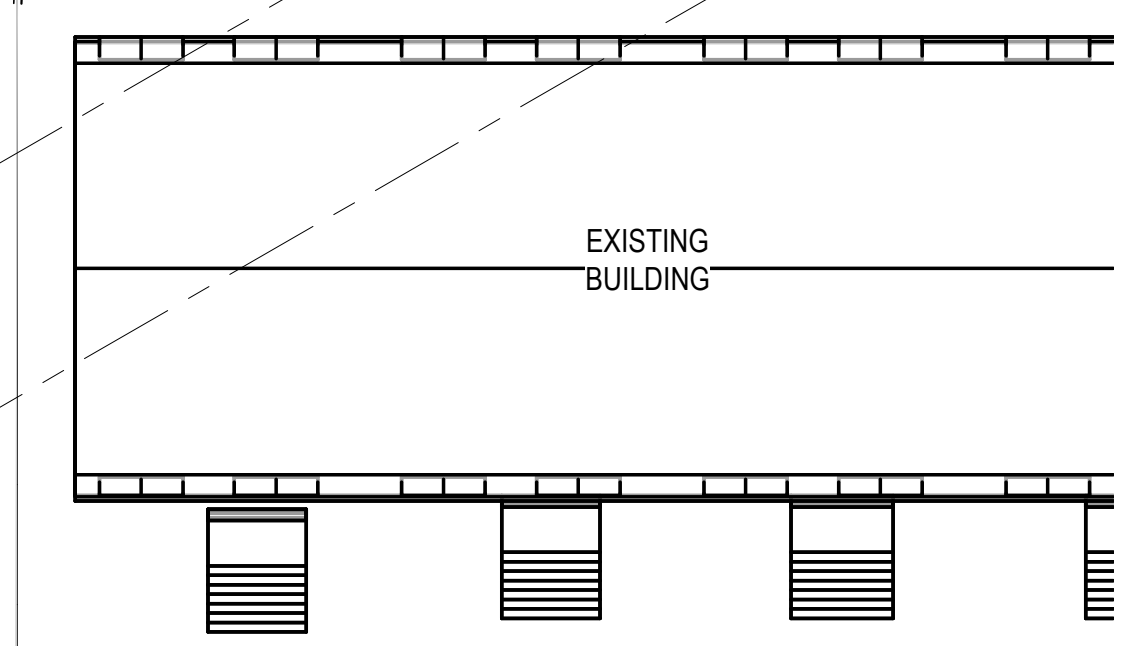
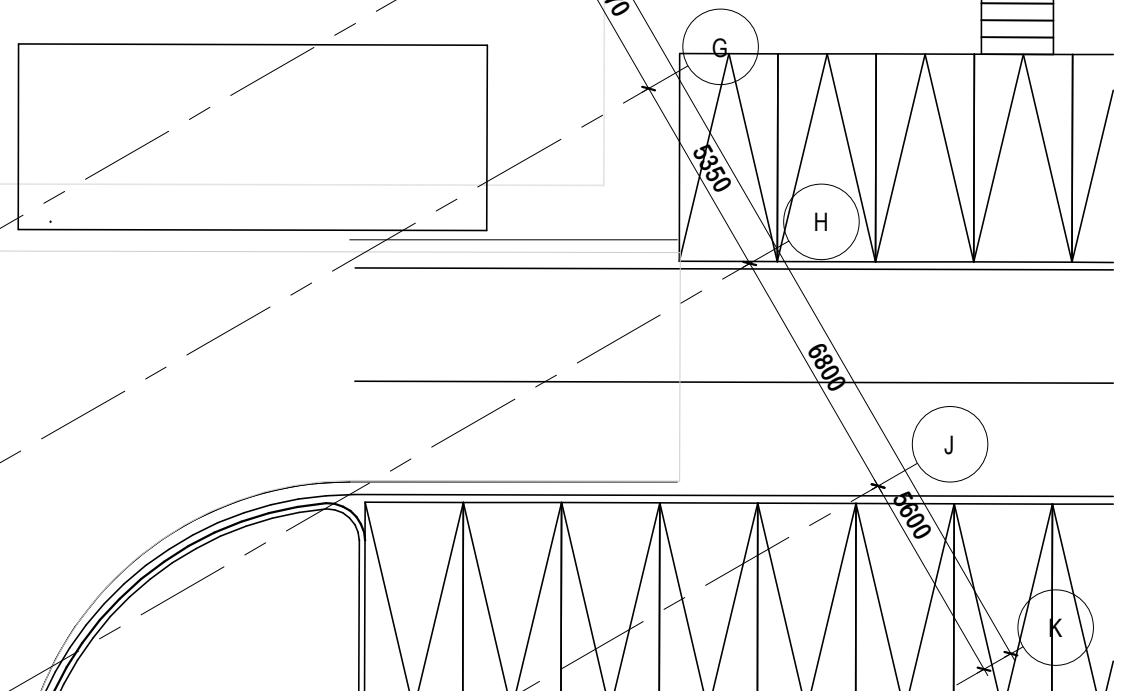
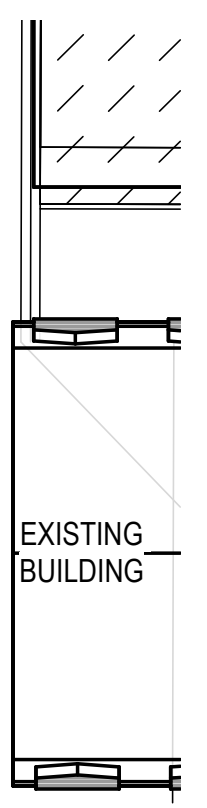
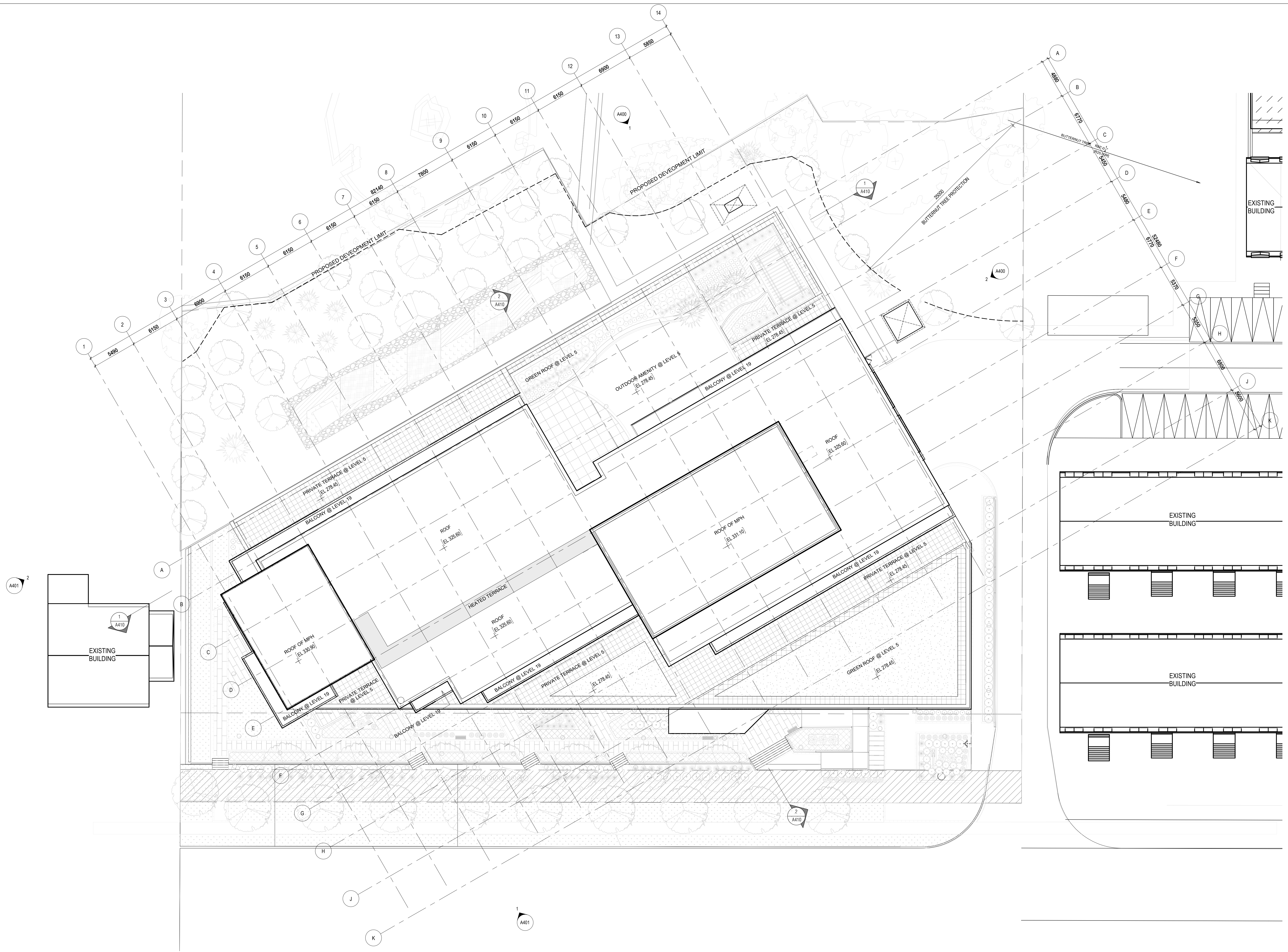
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**18-107**

SHEET NO.  
**A207**

DATE PRODUCED: 4/20/19 5:09:26 PM

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ROAD WIDENING



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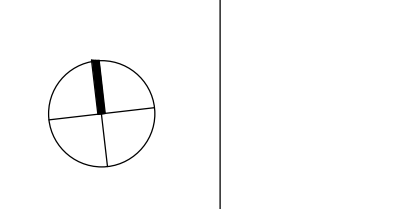
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






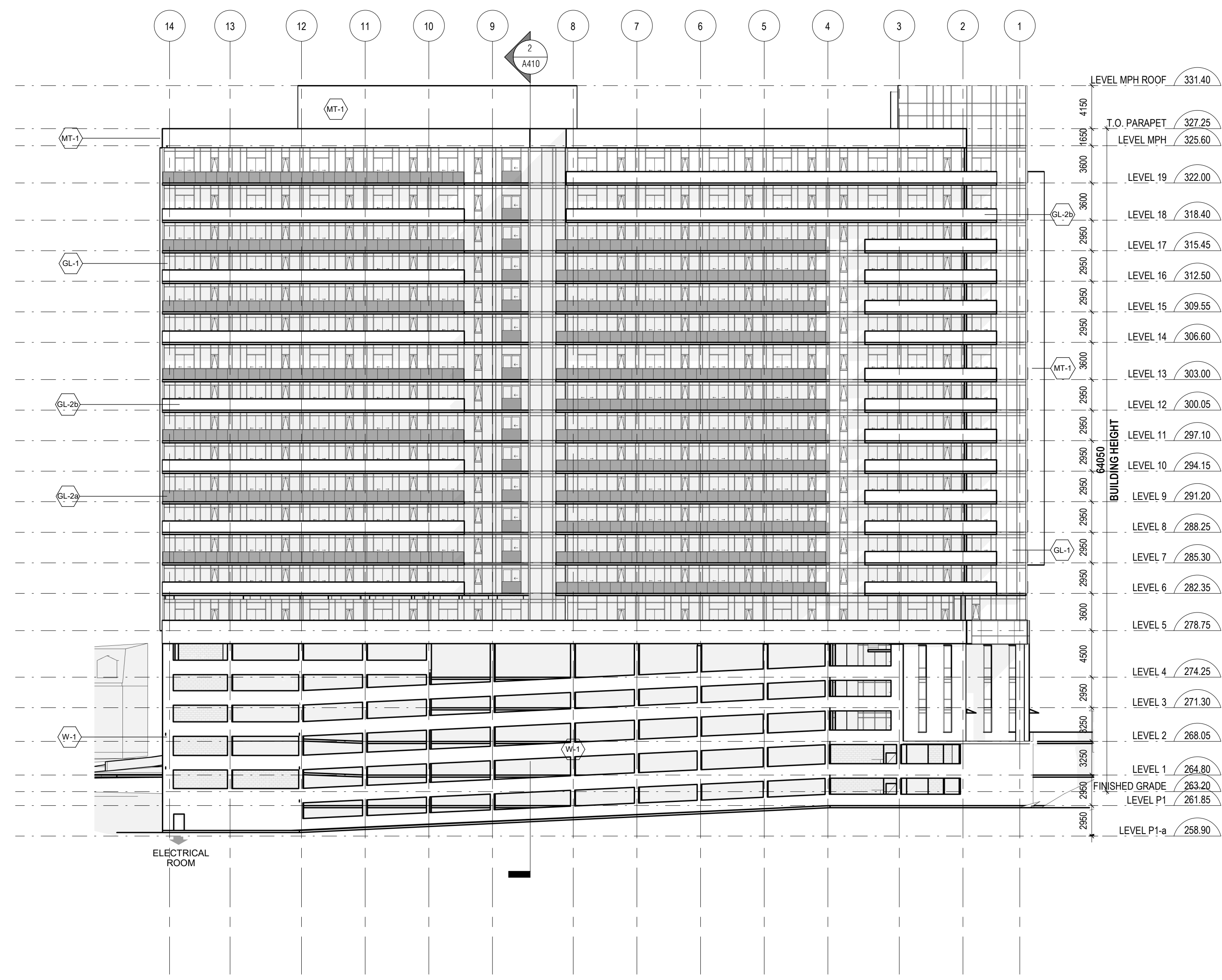
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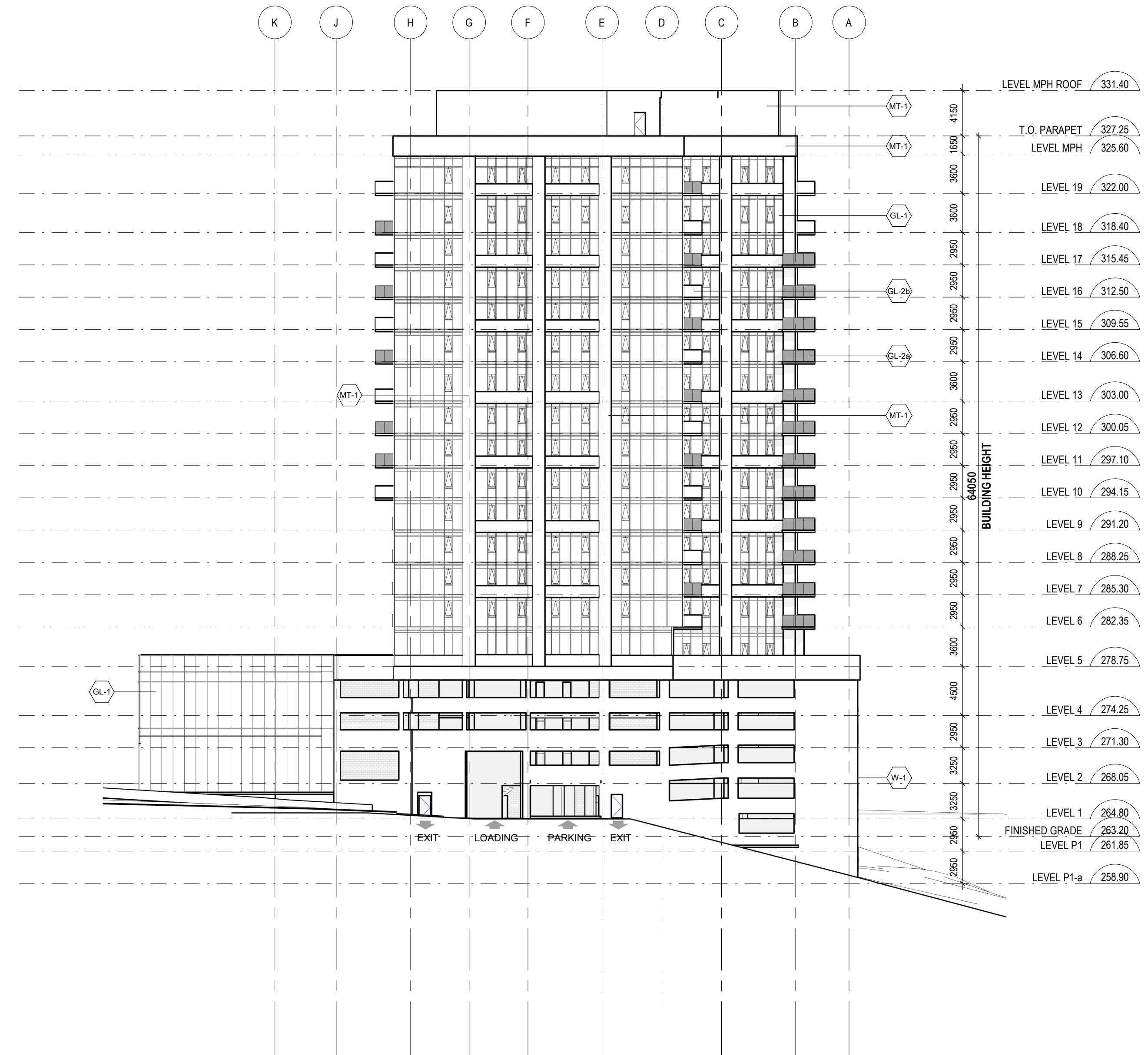
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-  METAL PANEL
-  GLAZING
-  CLEAR GLASS RAILING
-  WHITE FROSTED GLASS RAILING
-  PRECAST CONCRETE



1 NORTH ELEVATION  
A400 1:300



2 EAST ELEVATION  
A400 1:300

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




290-302 GEORGIAN DRIVE, BARRIE

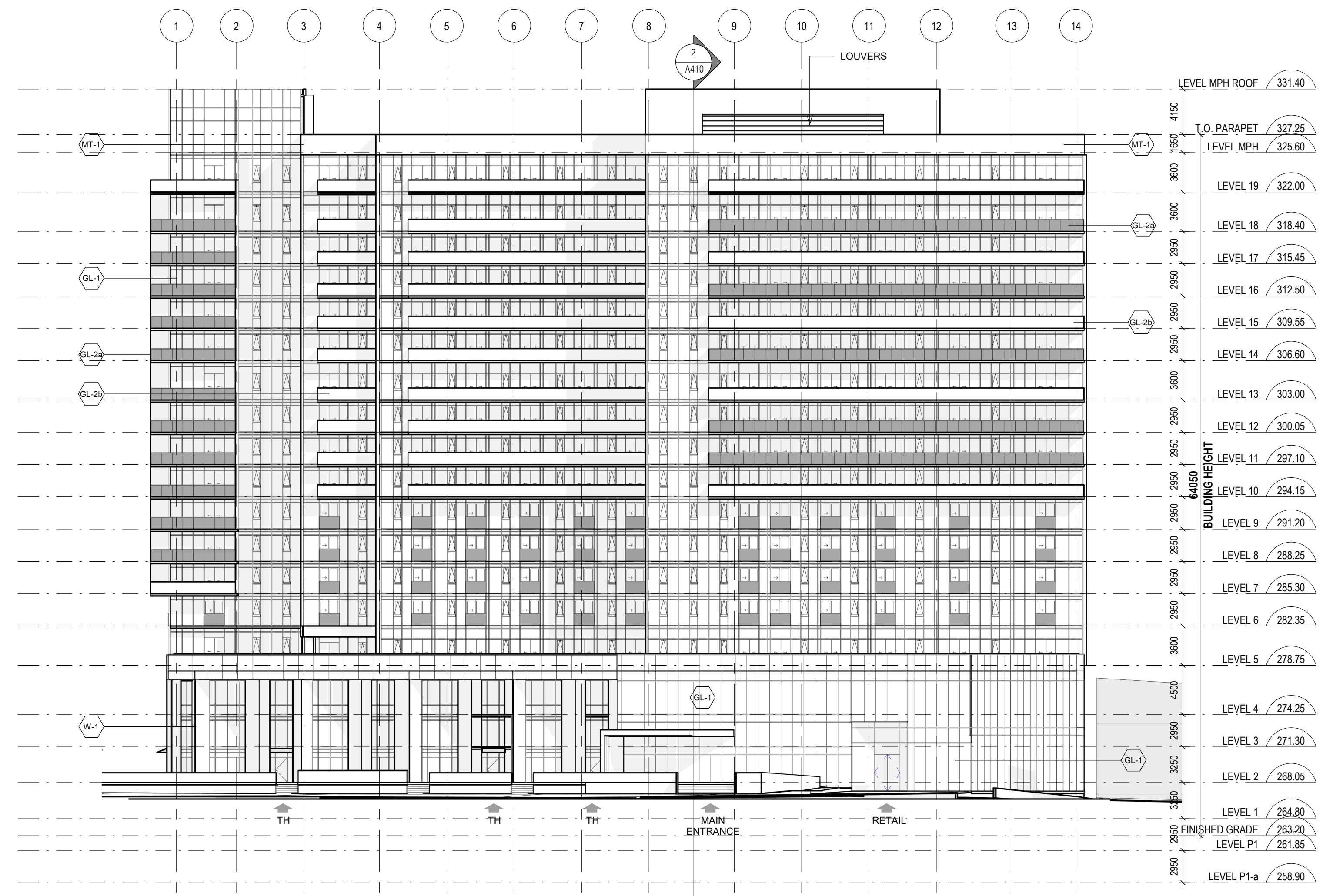
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SHEET NAME NORTH & EAST ELEVATIONS

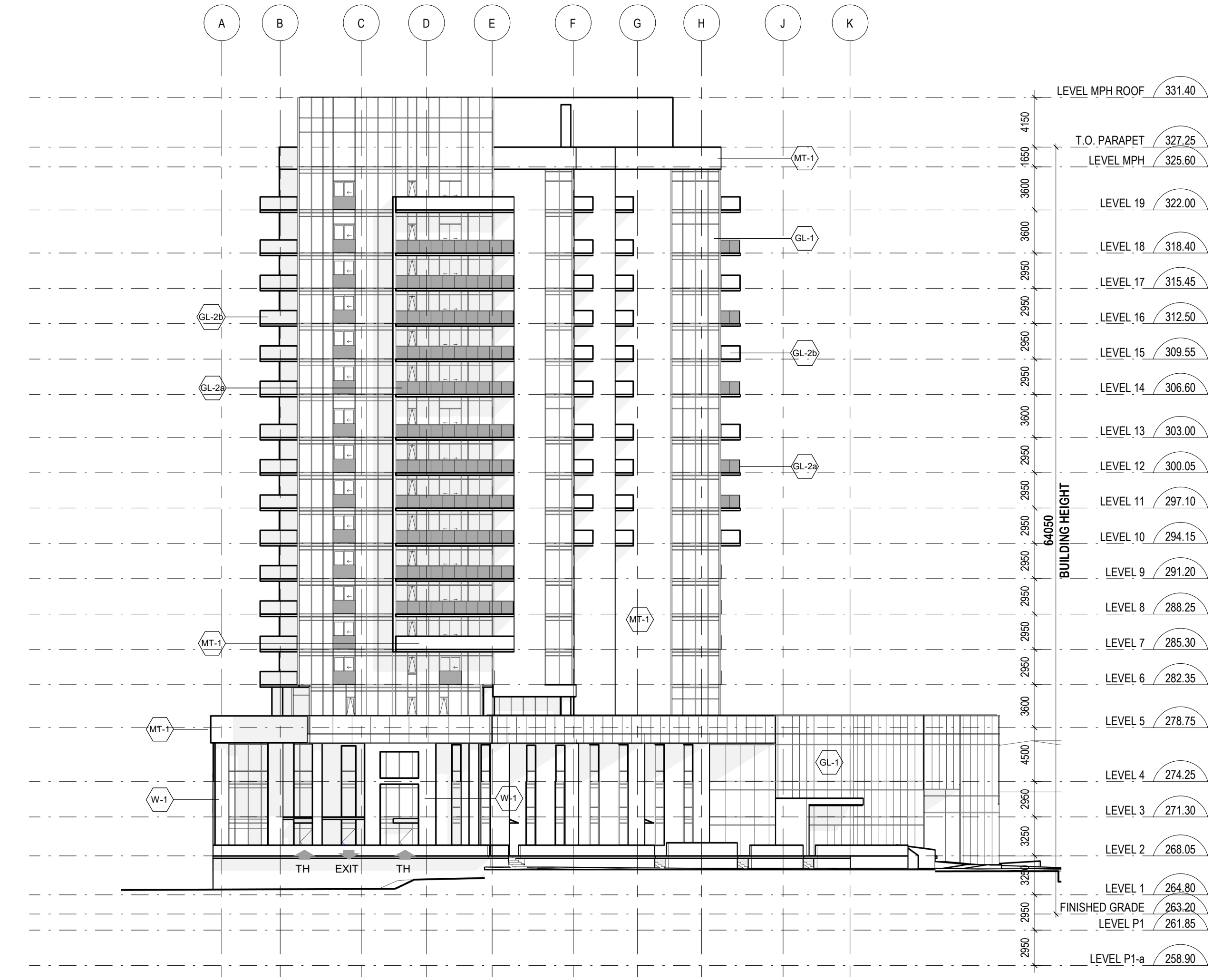
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-  METAL PANEL
-  GLAZING
-  CLEAR GLASS RAILING
-  WHITE FROSTED GLASS RAILING
-  PRECAST CONCRETE



1 SOUTH ELEVATION  
A401 1:300



2 WEST ELEVATION  
A401 1:300

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SCALE 1:200 DATE 2018 07 06

SHEET NAME SOUTH & WEST ELEVATIONS

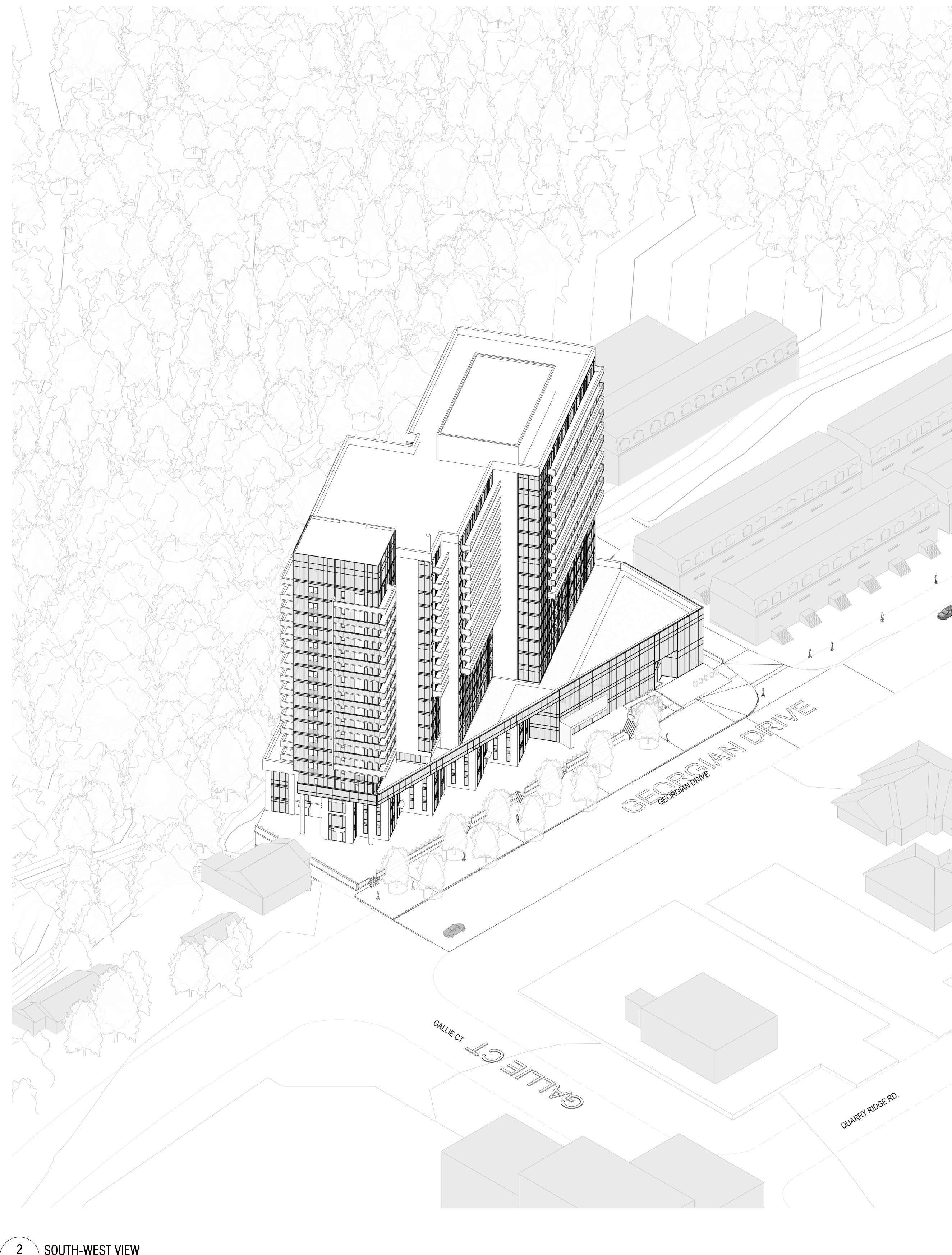
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DATE PRODUCED: 4/20/19 7:48:25 PM C:\REVIT\_LOCAL\_FILES\18-107\_Georgian Drive\Drawings\18-107\_NEW\main\A401.rvt

FOR LOCATION OF BALCONIES,  
REFER TO PLAN DRAWINGS.



1 SOUTH-EAST VIEW  
A402



2 SOUTH-WEST VIEW  
A402

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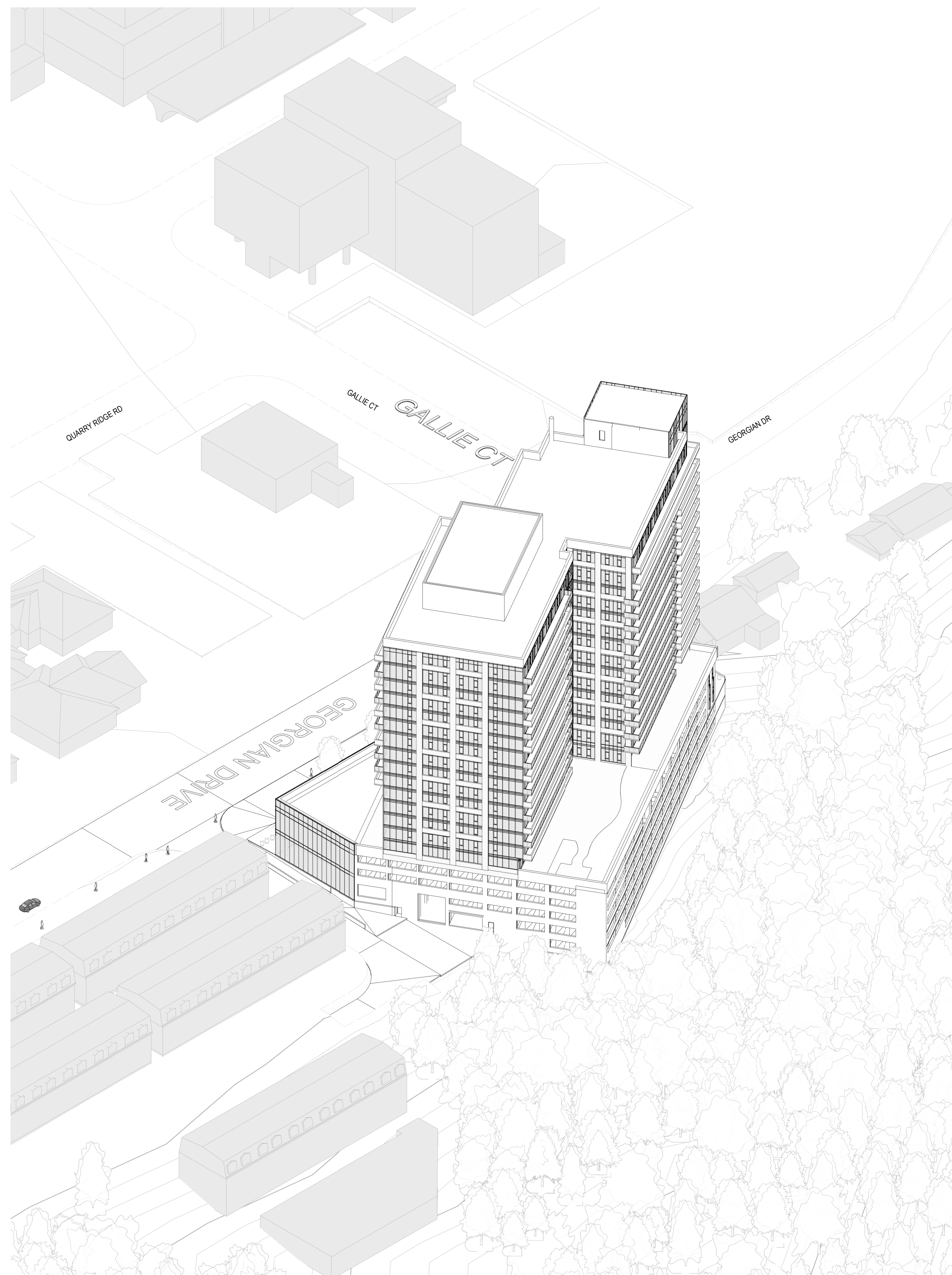
290-302 GEORGIAN DRIVE, BARRIE

SCALE DATE  
2018 07 06

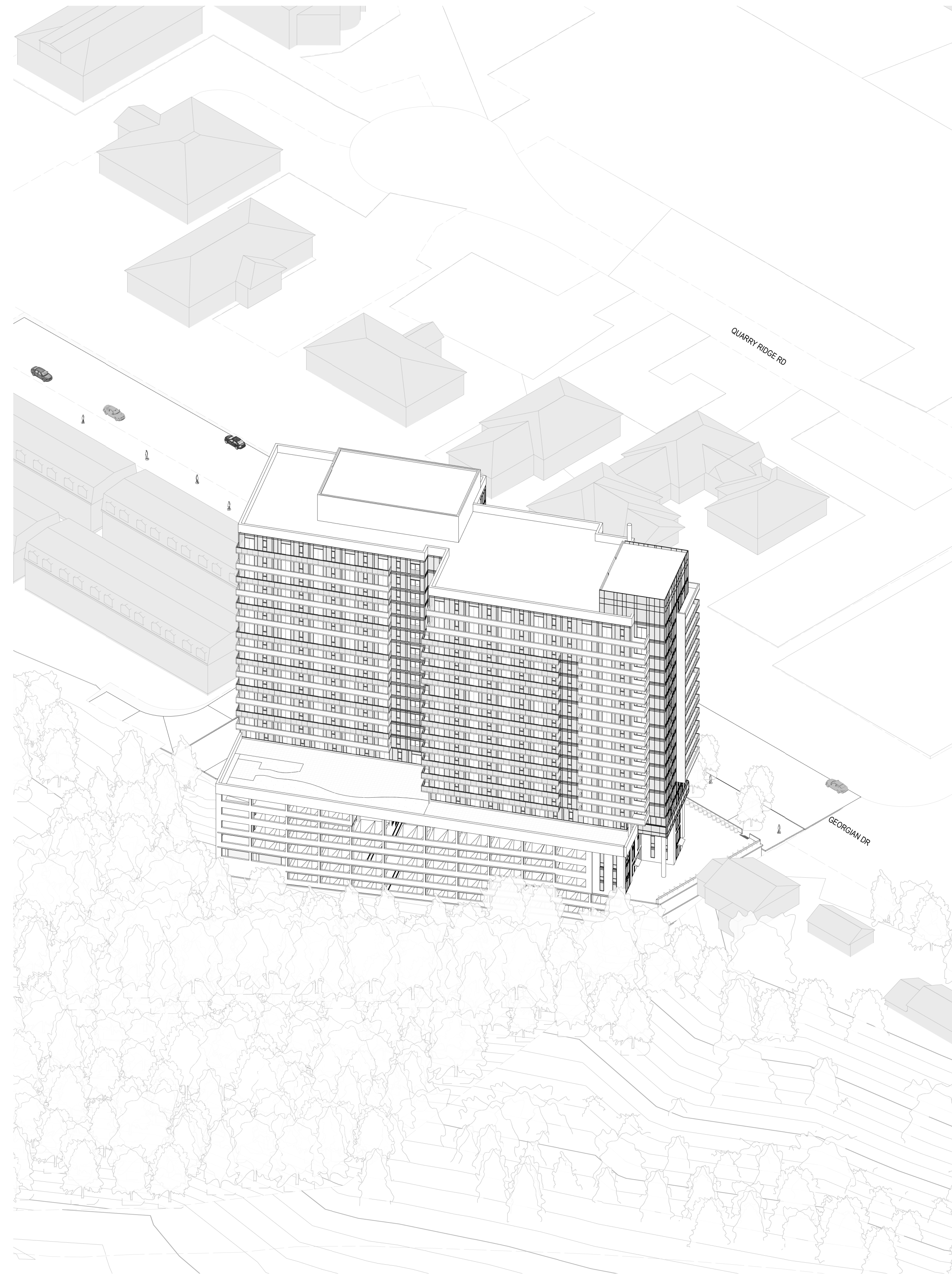
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VIEWS

PROJECT NO. SHEET NO.  
18-107 A402

DATE PRODUCED: 2019 07 02 07 PM C:\RENT\_LOCAL\_FILES\18-107\_Georgian Drive\_Corridor\03\_NEW\main\A402.rvt



1 NORTH-EAST VIEW  
A403



2 NORTH-WEST VIEW  
A403

FOR LOCATION OF BALCONIES,  
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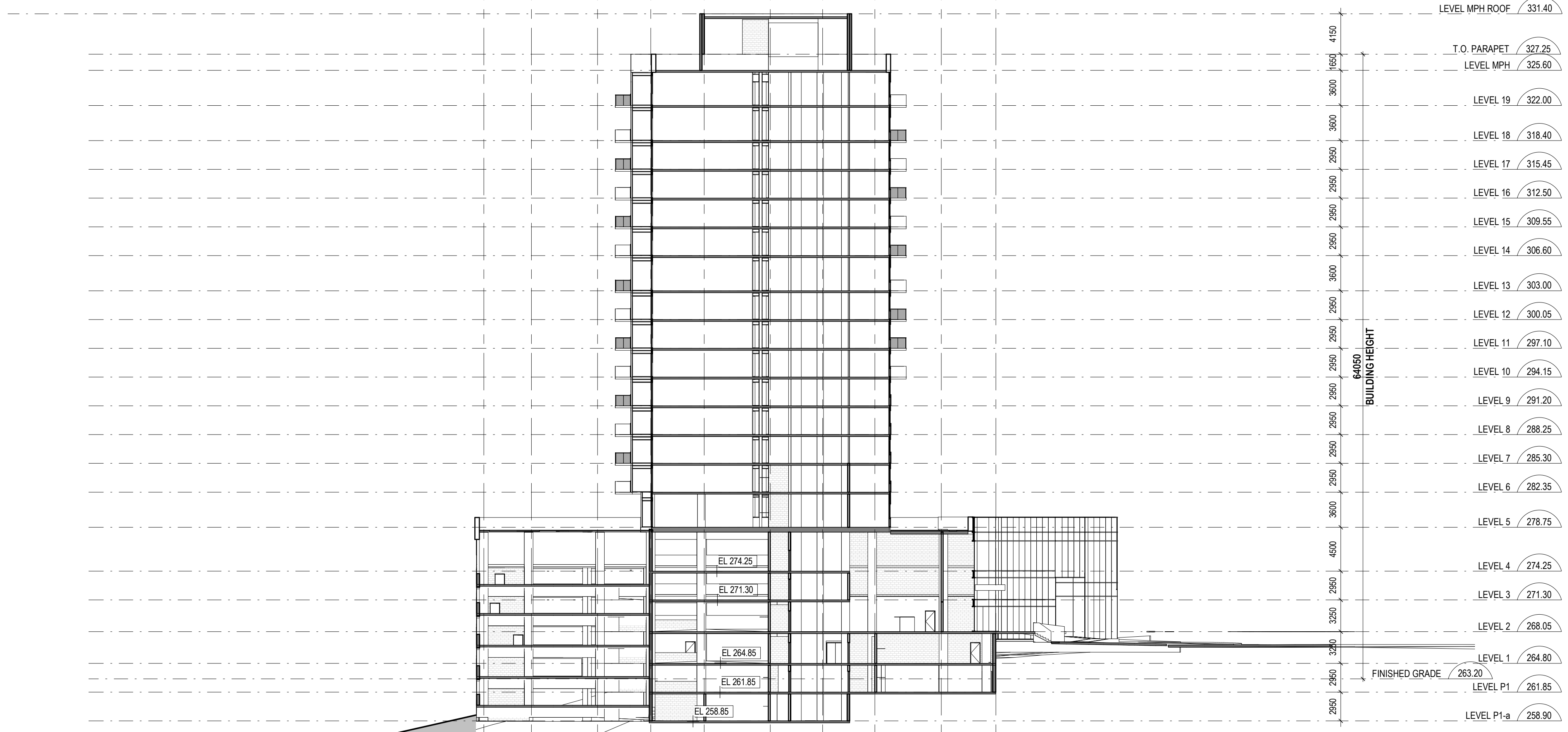
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290-302 GEORGIAN DRIVE, BARRIE

SCALE	DATE
	2018.07.06
SHEET NAME	
VIEWS	
PROJECT NO.	SHEET NO.
18-107	A403

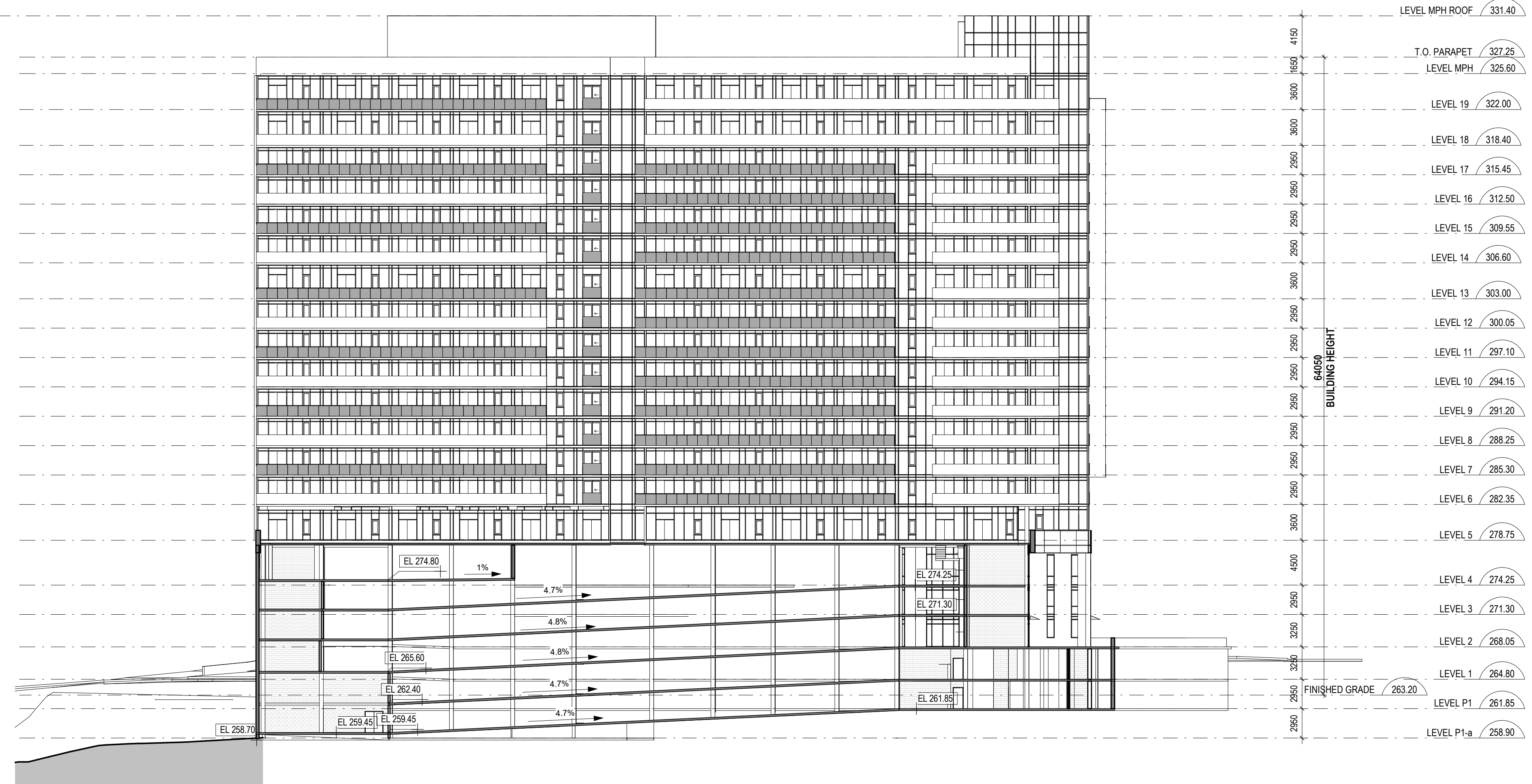
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A B C D E F G H J K



2 BUILDING SECTION NORTH-SOUTH  
A410 1 : 300



1 BUILDING SECTION-EAST WEST  
A410 1 : 300

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SHEET NAME SECTION EAST-WEST & NORTH-SOUTH

PROJECT NO. 18-107 SHEET NO. A410

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