Metrics Realty Inc.

Proposed Residential Development

720 Granite Court
Pickering, Ontario

Derailment Protection Report

Metrolinx Kingston Subdivision
Mile 314.86

Prepared by:

Consulting Engineers and Landscape Architects
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Richmond Hill, Ontario, L4B 1G6

May 2nd, 2023
Project No. 22-14

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Summary of Issues/Revisions

No.	Date	Description
1	May 2nd, 2023	1st Submission to Metrolinx and City of Pickering

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF DRAWINGS

DWG. NO.	TITLE
DP-1	Derailment Protection Plan
DP-2	Derailment Protection Sections

LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This Report is based on site conditions known or inferred from information, reports and/or drawings provided by the Client and others as of the date of this report. Should changes occur which would potentially impact the conditions of the site, the recommendations made by JSW in this report may require revision. JSW should be made aware of any special concerns or considerations that may arise, so that JSW may arrange, as necessary, for additional studies to be undertaken that are beyond the scope of this Report.

RELIANCE ON INFORMATION PROVIDED

The design development, recommendations and conclusions contained in this Report are based on information, drawings and/or reports provided to JSW by the Client and others. This Report has been prepared to address conditions at this site only, for the objectives and purposes as communicated by the Client. JSW has relied in good faith upon such representations, information and instructions. JSW accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report resulting from misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. The applicability and reliability of the design development, recommendations and conclusions provided in the Report are only valid to the extent that there has been no material alteration to the information provided to JSW.

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REPORT FORMAT

1.0 INTRODUCTION

1.1 Objectives

This report has been prepared as supporting documentation for the redevelopment of the property at 720 Granite in the City of Pickering. The report will be supplemental to the Rezoning By-Law Amendment (ZBA), Site Plan Amendment (SPA) and Official Plan Amendment (OPA). In the post-development condition the site will consist of a residential condominium that comprises of a 12-storey residential tower.

1.2 Scope of Report

Since 1980, railway companies have established a set of criteria for new developments adjacent to their respective rail corridors. Based on the adjacent railway track's function and volume of traffic, each track is compartmentalized into different classifications. With each railway classification, a stringent set of guidelines and regulations are applied to the development to safeguard against train derailment.

As per the existing site conditions, proposed site features and railway elements, the proposed development will be analyzed in accordance with the guidelines of the Railway Association of Canada (RAC), the Federation of Canadian Municipalities (FCM) and AECOM's Submission Guidelines. Once the development has been analyzed, the necessary protection measures will be recommended accordingly.

1.3 Study Area

Presently, the site consists of a small plot of undeveloped land. The subject site is 1.1932 hectares (2.95 acres) in area and is in close proximity to the intersection of Whites Road and Granite Court located in Pickering, Ontario (see ***Figure 1*** for details).

Immediately west of the site is a principal mainline railway corridor that runs in parallel to the site in a north-south fashion. Abutting the site to the east and north

is Whites Road South. To the south, the site is directly adjacent Granite Court. Further south of Granite Court are residential developments that contain single family homes.

The proposed development (720 Granite Court, Pickering, ON) is located within 300 meters of the Metrolinx Kingston Subdivision (which carries Lakeshore East GO rail service). Within this corridor there are two (2) principal mainline tracks located at mile 314.86 of the Metrolinx Kingston Subdivision. The centerline of the closest track is offset 26.95m meters from the subject site's property line. Furthermore, there are no switches directly adjacent or in close proximity to the site, within the subject rail corridor. The current track design speeds on this Subdivision are 100 mph for passenger cars and 65 mph for freight cars. It is anticipated that GO rail service on this Subdivision will be comprised of diesel and electric trains. The GO rail fleet combination on this Subdivision will consist of up to 2 locomotives and 12 passenger cars. The planned trip break down is listed below in ***Table 1***:

Table 1 – GO Rail Service Trip Breakdown

Lakeshore East GO Rail Service	1 Diesel Locomotive	2 Diesel Locomotives	1 Electric Locomotive	2 Electric Locomotives
Day (0700-2300)	35	35	88	42
Night (2300-0700)	8	2	18	8

Figure 1 - Key Plan

1.4 Development Concept

Metrics Realty Inc. is proposing to redevelop the subject site for residential development. The development will consist of one (1) residential tower with 12 storeys (with a mechanical penthouse), where the building will be constructed with podium levels. The height of each podium will be at the fourth storey, sixth storey, and eighth storey. The development in its entirety will be a condominium in the post development condition. Lastly, there will be two (2) proposed below grade levels to service the parking requirements of the development. This underground parking configuration is situated beneath the proposed building.

In regard to site access, the development will be serviced through a main driveway off of Granite Court. Additionally, the site's fire route is fronting the development, along White's Road. The fire route traverses in a north-south fashion along the aforementioned road.

2.0 DERAILMENT PROTECTION AND SETBACK

2.1 Derailment Protection Criteria

The Federation of Canadian Municipalities (FCM) criteria for derailment protection is based on the classification on the track to which the development is adjacent. The track classification indicates the specific design requirements of the derailment protection measure and the required setback distance of the development.

If the development is to be used in conjunction with a standard earth berm, the minimum setbacks are dependent on the classification of the track. The proposed development is adjacent to a principle main line which typically requires a 2.5-meter-high berm with a 30-meter setback. Exceptions to the aforementioned setback requirements can be permitted by the railway company with a maximum reduction up to 5.0 meters to the setback distance (i.e., 25 meters). However, the height of the berm must be increased to accommodate the reduction in setback distance. Berm height is taken relative to the grade along the property line of the railway corridor.

Although an earth berm would provide adequate derailment protection, the use of a crash wall would be an approved equivalent. However, standard crash wall heights and thicknesses cannot be recommended due to varying site conditions, setback distances and crash wall designs. In order to design the crash wall, the criteria set out in the FCM/RAC Guidelines and AECOM's memorandum are to be referenced. Based on this criterion, one of two methods may be used to engineer the crash wall. These methods are as follows:

- *Method 1 (Minimum Point Load)*
  - The wall may be designed for a minimum point load of 600 kip (2700 kN) applied horizontally and normal to the face at any point along the wall.
    - The point load shall be applied at a height of 6 feet (1.8 meters) above the top of rail for walls up to 25 feet (7.6 meters) from the centerline of track, or a height of 6 feet (1.8 meters) above the groundline for walls farther than 25 feet (7.6 meters) from the centerline of the track.
    - This method may be applied where track speeds do not exceed 50 mph (80 km/hr) for freight or 70 mph (112 km/hr) for passenger trains; where speeds exceed these limits, Method 2 shall be used.

- *Method 2 (Energy balance approach)*
  - An energy balance approach considering collision by glancing blow and single car rotation my be used to determine the design load. The following four (4) cases must be considered:
    - *Freight Train Load Case 1* – Glancing Blow: nine cars weighing 143 tons (129,700 kg) each, impacting the wall at an angle Θ_G. The angle of impact will be a function of track curvature, and for tangent track may be taken as 3.5 degrees.

- *Freight Train Load Case 2* – Single Car Impact: single weighing 143 tons (129,700 kg) impacting the wall as it undergoes rotation about its center. The angle of rotation at impact is:

  $$\Theta_f = \text{asin}\left(\frac{d_{CL}}{8.5}\right) \qquad \text{[Equation 1]}$$

  Where;

  D_{CL} is the distance from the cash wall to the centerline of track in meters. The closest existing or future track is to be used. Where d_{CL} is greater than 8.5 meters, this load case need not be considered.

- *Passenger Train Load Case 3* – Glancing Blow eight (8) cars weighing 74 tons (67,120 kg) each impacting the wall at an angle, Θ_G. The angle of impact will be function of track curvature, and for tangent track may be taken as 3.5 degrees.

- *Passenger Train Load Case 4* – Single Car Impact: single car weighing 74 tons (67,120 kg) impacting the wall as it undergoes rotation about its center. The angle of rotation at impact is:

  $$\Theta_f = \text{asin}\left(\frac{d_{CL}}{13}\right) \qquad \text{[Equation 2]}$$

  Where D_{CL} is greater than 13 meters, this load case need not be considered.

- In all of the above cases, the following parameters are to be taken into account:
  - Speed of derailed units impacting the wall must be equivalent to the track speed.
  - Height of the application of impact force must be applied at 3 feet above the ground.

- For energy dissipation assume:
  - Plastic deformation of individual cars, due to direct impact, are applied at a maximum of 1 foot.

- Compression of linkages of three (3) locomotives and six (6) cars consist of a maximum of 5 feet.
- Deflection of the wall is to be determined by the designer. The design must incorporate horizontal and vertical continuity to distribute the impact loads from the derailed train.

AECOM's memorandum dated March 25, 2013 and AECOM's Crash Wall Guidelines Revision 2, dated July 29, 2014 (see copy of both in Appendix 'B') also defines structural assessment criteria presented above.

2.2 Proposed Setback

In order to provide an additional level of protection, building setbacks are used in conjunction with protection features to further safeguard against the possibility of train derailment. For the subject site, the building setbacks are measured from the proposed building façade to the railway corridor property line. These setbacks are intended to provide a dissipation buffer for several different factors such as rail-oriented emissions, noise, vibrations and ultimately energy attenuation in the event of a train derailment. Although an extensively long buffer would be preferred, it is not always feasible or practical to implement due to site conditions and constraints. Therefore, each site must undergo an assessment to evaluate a suitable protection feature(s) and setback distance to safeguard the development.

Since the closest railway track is classified as a principal mainline, the required building setback from the property line is to be 30 meters (as per the FCM/RAC Guidelines). Therefore, to adhere to the criteria set forth in the FCM/RAC guidelines, all of the 'high occupancy' regions of the development have been setback from the adjacent rail corridor by an offset of greater than 30 meters.

In accordance with the aforementioned guidelines, it is permissible to develop within the setback limits, so long as the area is developed as a 'low occupancy' area and there are no principal congregation locations. In the post-development condition, the area within the 30-meter setback will be utilized as parking space, a vehicular roadway, and a designated location for an outdoor amenity feature; this

ultimately deems the development within the setback area as a 'low-occupancy' region.

In order to further understand the setback limits throughout the subject site, ***Table 2*** has been prepared to provide additional clarity. The *Protection Feature Setback*[1] defines the offset distance from the easternmost existing track to the property line and the *Minimum Horizontal Setback*[2] defines the horizontal distance from the property line to the building façade (referencing the closest point of the building to the property line). The *Vertical Setback*[3] defines the difference in elevation between the closest track and the property line. Lastly, *Minimum Total Setback*[4] is defined by the combination of the *Minimum Horizontal Setback*[2] and the *Vertical Setback*[3].

Table 2 – Setback Summary

Development Level	Protection Feature Setback[1] (m)	Minimum Horizontal Setback[2] (m)	Vertical Setback[3] (m)	Minimum Total Setback[4] (m)
Ground Floor and Above	26.91	36.72	6.45	**43.17**

As illustrated in ***Table 2*** above, the subject site's *Minimum Horizontal Setback*[2] is 36.72m, which satisfies the requirement of a total setback of 30m. In addition to the 36.72m *Minimum Horizontal Setback*[2] distance, the development will be protected by the existing site conditions relative to the rail corridor. The existing railway is in a cut condition based on the natural topography of the area (see drawing **DP-2** and **Section 2.3** for additional details). Based on the topographic conditions of the site, the top of rail elevation is between 6.66 meters at the south end of the site and 6.45 meters at the north end of the site below existing grade of the subject site's property line. Given the cut condition, the vertical distance between the top of rail elevation and the elevation along the subject site's property line is to be considered as the *Vertical Setback*[3]. Furthermore, this may be combined with the *Minimum Horizontal Setback*[2] distance to provide the total setback for the site. Therefore, the *Minimum Total Setback*[4] for this site is a minimum of 43.17m. Design considerations for additional potential tracks being installed east of the existing tracks will not be considered due to the constraints of

the rail corridor from the surrounding area. These constraints consist of excessive sloped topography, as well as the existing Whites Road bridge and the existing Granite Court bridge abutments (and their subsequent overpass) located in the direct path of any potential expansion track(s). Therefore, it is highly unlikely rail authorities will elect to expand those tracks within this corridor due to these site-specific constraints.

2.3 Proposed Derailment Protection Feature

According to the FCM/RAC guidelines in Section 3.6, Page 36, an earthen berm is intended to absorb the energy of derailed cars, slowing them down and limiting the distance they travel outside of the railway right-of-way. This is achieved by intercepting the movement of the derailed car, pulling it down by gravity and causing the derailed car to begin to dig into the intervening earthen mass. Meaning the standard method of derailment mitigation in general is a berm.

The standard earth berm requirements on a principal mainline is 2.5 meters high from the property grade line, with 3:1 slope on the development side and 2.5:1 on the rail side, with 1 meter rounding on top. However, in lieu of a standard earth berm, there are exceptions in terms of alternative mitigative measures. Some examples of these alternative measures are crash walls and crash berms as stated in the FCM/RAC guidelines in Section 3.6.1.3, Page 40, Paragraph 1 and Section 3.6.1.1, Page 38, Point 6, respectively. A crash wall is a concrete structure designed to provide equivalent resistance in the case of a train derailment through an engineered structure. The key difference in proposing a crash wall as opposed to an earthen berm is that a crash wall is intended to absorb the energy of a derailed car and deflect its momentum away from the proposed development, whereas an earthen berm is designed to slow a derailed train.

As stated in the FCM/RAC Guidelines in Section 3.6.1, Page 38, Point 3, “where the railway line is in a cut of equivalent or exceeded depth, no berm is required”. For the subject site, the minimum difference of grade between the top of rail elevation of the closest track and the property line is 6.45 meters. Therefore, the cut condition criteria is met and this difference in elevation will act as an enhanced

berm without any additional protection features. This existing enhanced berm is owned by Metrolinx and traverses along the western property line of the subject site, ultimately this means that entirety of the site is protected by the enhanced berm. This enhanced berm is intended to absorb the energy of derailed cars, slowing them down and limiting the distance they travel outside of the railway corridor. The berm works by dissipating the energy of a derailed car by propagating the impact forces throughout the earthen berm. As it relates to this scenario, the derailed car will travel into the natural topography adjacent to the development in which the impact forces would be dissipated prior to engaging with the sensitive use buildings within the site.

In terms, of derailment protection from the site's flanks from any potentially derailed train, typically a return protection feature is required. Return protection features are designed based on the potential stopping distance of a train, the posted track design speed, the angle of car rotation and the mass of the train. For the subject site, a return protection feature is not required since the enhanced berm traverses along the property line and extends far enough north and south of the subject site's boundaries to act as a return protection feature. Therefore, the existing enhanced berm provides additional protection to the development from the flank.

Lastly, the possibility of expansion of the rail corridor was investigated where a track would be installed closer to the property line, at a higher elevation than the closest existing tracks to the subject site. However, track expansion closer to the development is very unlikely because there are overpasses on Whites Road South and on Granite court. Based on the existing abutment configuration, future tracks are unlikely to be installed.

2.4 Rail Corridor Security

To safeguard against trespassing, the rail corridor will be cordoned off with a chain link security fence along the property line. This chain link fence will be 2.43m in height and will possess non-cut and non-climb chain link fabric; this fence will be installed along the western limits of the property line (see ***Appendix 'D'*** for details).

2.5 Risk Assessment

As outlined in the 2013 CFM Guidelines, the individual risks for the proposed development must be identified and evaluated. Each risk shall outline mitigation measures which are proposed or planned to address these risks. Such risks may include injury, loss of life and/or damage to public or private infrastructure.

Table 3 (See Appendix 'C' for details) summarizes potential risk generated from developing 720 Granite Court adjacent to a rail corridor.

3.0 CONCLUSION AND SUMMARY

a) The subject site will be developed into one (1) residential tower to be 12 storeys in height with a mechanical penthouse; the development in its entirety will be a residential condominium.

b) The site presently, and will be, protected by a principal protection feature in the form of a natural earth berm. The earth berm is situated within the subject rail corridor and is 6.45 metres in height from the closest existing track to the grade at the property line.

c) The railway corridor is in a cut condition of depth 6.45 meters from the property line to the top of the closest track. Therefore, the natural earth berm provides adequate protection, and no further derailment protection measures are required.

d) A 2.43m high non-cut, non-climb chain link fence will be situated along the western property line of the subject site.

e) The subject site adheres to the FCM/RAC Guidelines total setback criteria of 30-meters by providing a minimum total setback of 43.17 meters to the nearest 'high occupancy' region of the development.

f) A 'low-occupancy' area has been integrated within the 30-meter setback region, which only consists of parking, roadways, and an outdoor amenity feature.

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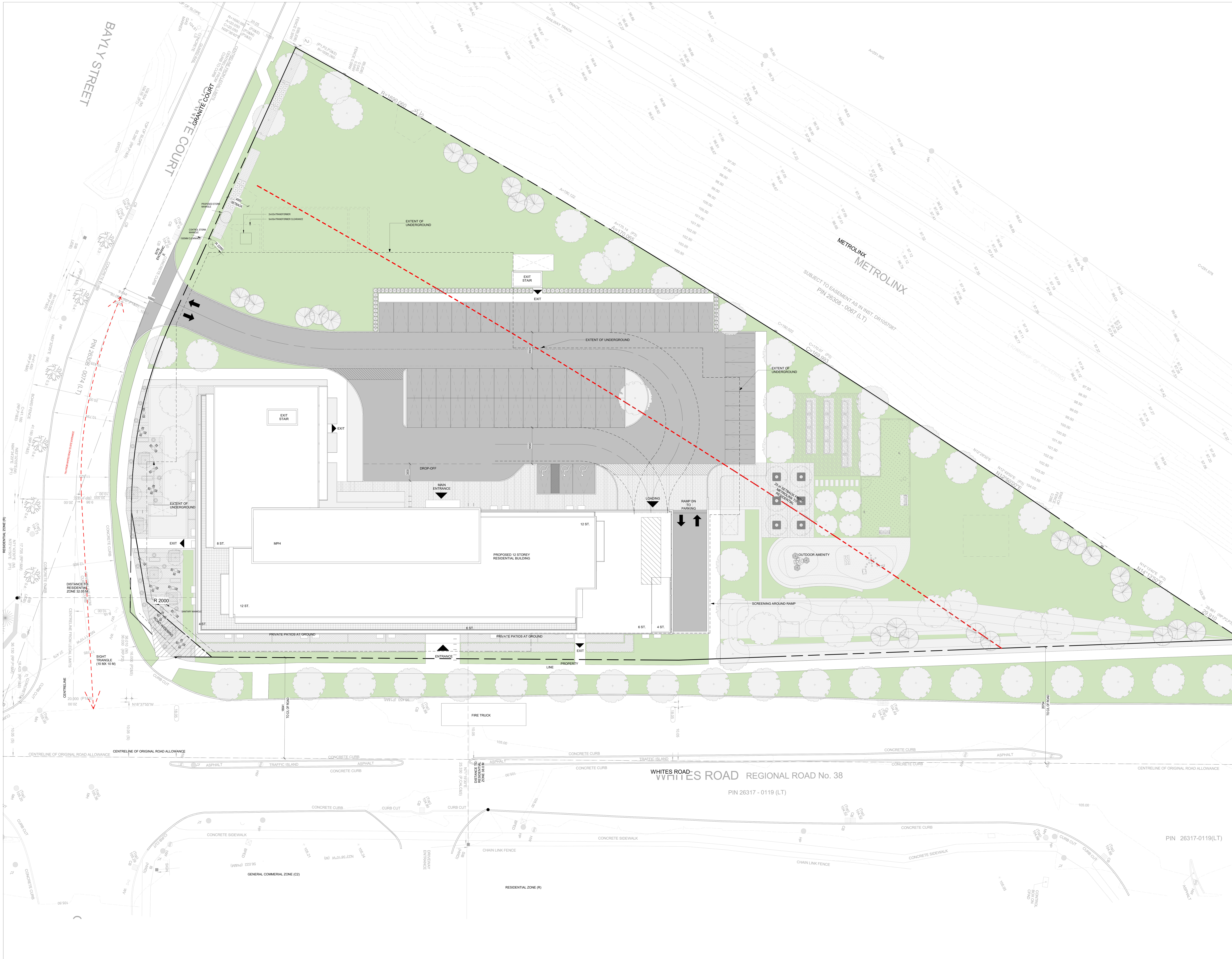
Checked By:

Michael Mikhail, P.Eng.

APPENDIX ‘A’

Architectural Drawing Set



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ADDRESS
720 Granite Court
Street
City, State Zip

DRAWING
Site Plan

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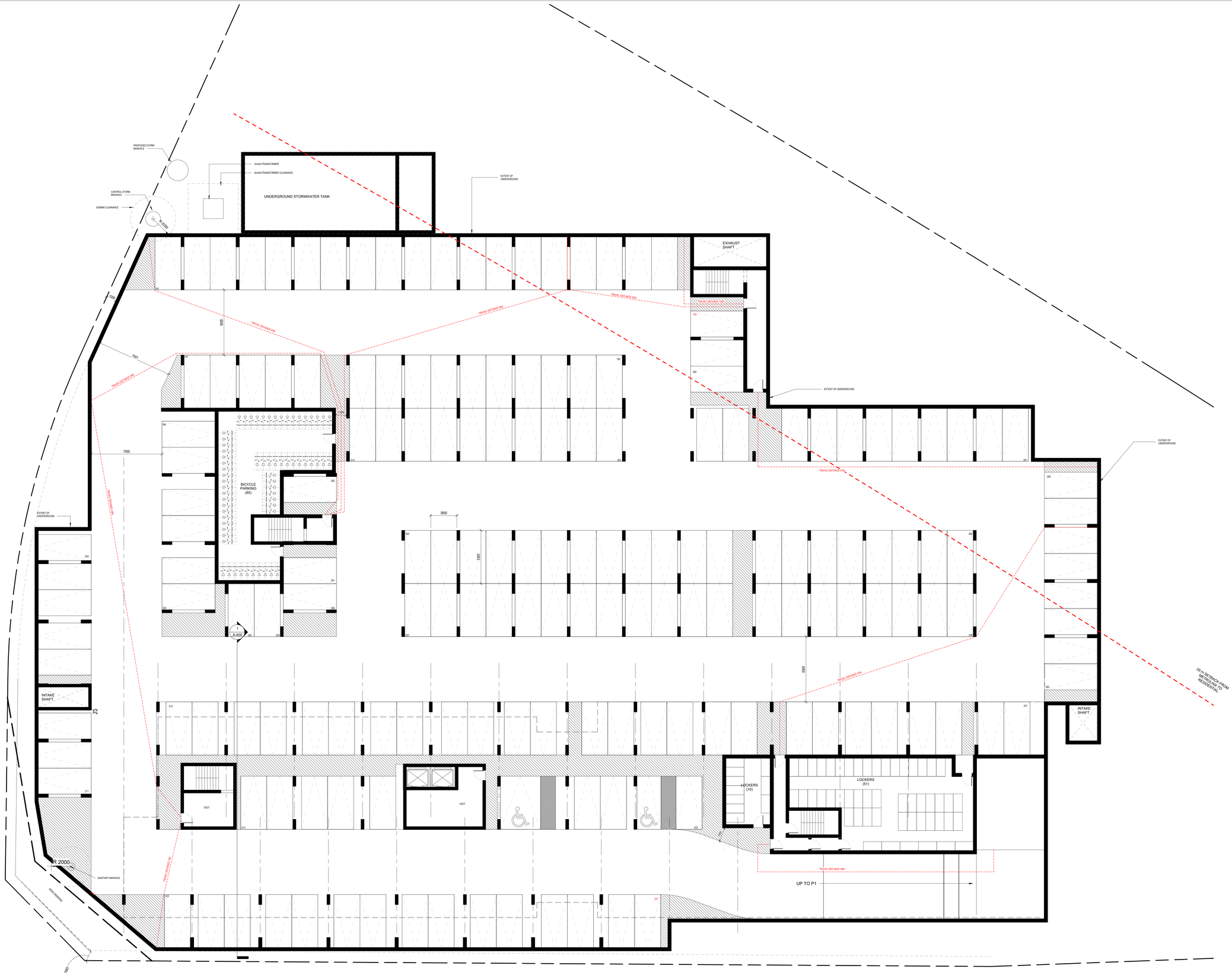
A-040



ARCHITECTURAL SYMBOL LEGEND

- DENOTES TRUE NORTH
- DENOTES PROJECT NORTH
- DENOTES 1 HR. FIRE RESISTANCE RATING
- DENOTES 1.5 HR. FIRE RESISTANCE RATING
- DENOTES 2 HR. FIRE RESISTANCE RATING
- DENOTES 3 HR. FIRE RESISTANCE RATING
- DENOTES WALL TYPE
- 000 DENOTES DOOR NUMBER
- 000 DENOTES ROOM NUMBER
- 000 DENOTES FLOOR ELEVATION
- 000 DENOTES WINDOW NUMBER
- AD DENOTES AREA DRAIN
- CFD DENOTES FLOOR DRAIN
- DENOTES DROPPED CEILING/BULKHEAD
- DENOTES FIRE RATED CEILING/BULKHEAD
- DENOTES EXTENT OF ACOUSTIC CEILING
- DENOTES EXTENT OF INSULATED CEILING
- DENOTES CONVEX MIRROR MOUNTED ON WALL/COLUMN AT MINIMUM 2100mm HIGH
- EP DENOTES SUITE ELECTRICAL PANEL
- CP DENOTES SUITE COMMUNICATIONS PANEL
- WM DENOTES SUITE WATER METER
- DENOTES MECHANICAL EXHAUST LOUVER
- DENOTES MECHANICAL INTAKE LOUVER
- PDO DENOTES POWER DOOR OPERATOR MOUNTED NOT LESS THAN 900mm AFF & NO MORE THAN 1100mm AFF
- DENOTES OPERABLE WINDOW
- DENOTES TACTILE ATTENTION INDICATOR
- FHC DENOTES FIRE HOSE CABINET
- DENOTES FIRE DEPARTMENT CONNECTION
- HB DENOTES BALCONY/TERRACE HOSE BIB
- GC DENOTES BALCONY/TERRACE GAS CONNECTION
- EC DENOTES BALCONY/TERRACE ELECTRICAL RECEPTACLE

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ADDRESS
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DRAWING
Parking Level - 2

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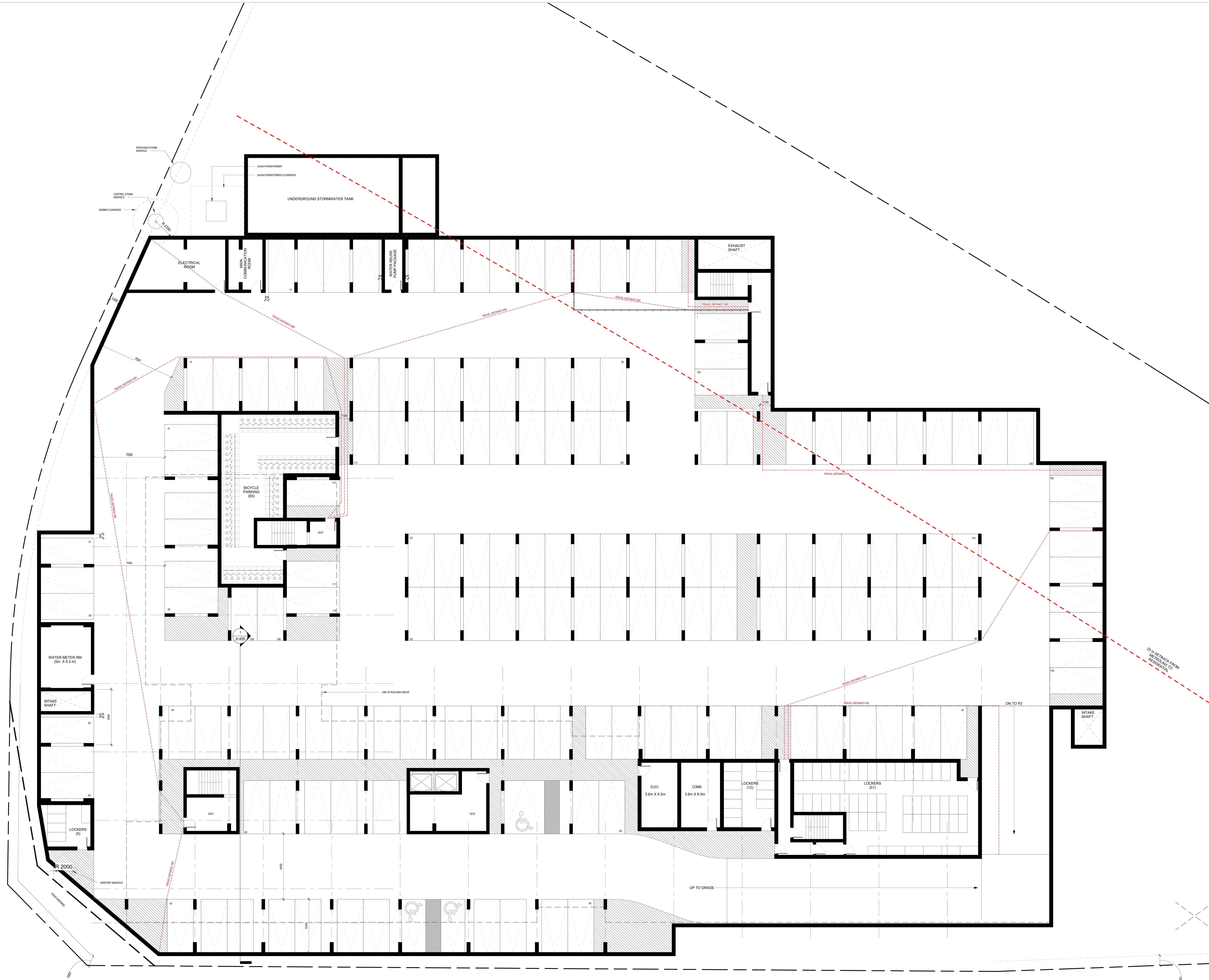

TRUE NORTH

PROJECT NORTH

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ADDRESS

720 Granite Court

Street
City, State Zip

DRAWING

Parking Level - 1

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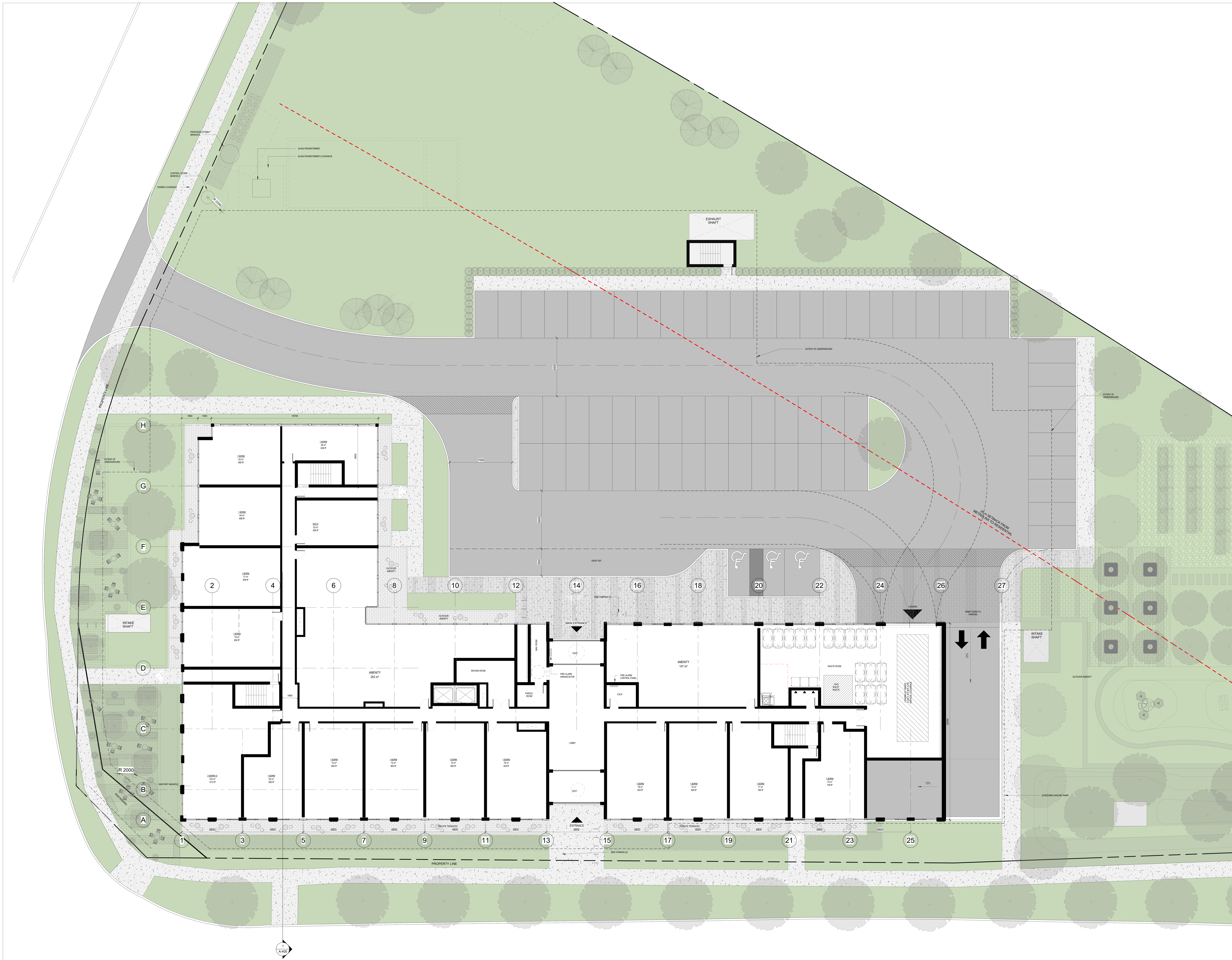

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DRAWINGS ARE INTENDED TO CONVEY SCOPE OF WORK AND INDICATE GENERAL AND APPROXIMATE LOCATION, ARRANGEMENT AND SIZES OF MATERIALS AND PRODUCTS.

ALL CONSTRUCTION TO BE ACCORDING TO BEST COMMON PRACTICE AND CONFORM TO THE ONTARIO BUILDING CODE IN EFFECT AT THE TIME.

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Level 1

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APPENDIX ‘B’

AECOM Guidelines

Submission Guidelines for Crash Walls

Crash walls may be required for the protection of overhead structures, and in some cases the Railway may consider a crash wall as an alternative to an earthen berm for the protection of structures or facilities adjacent to the track. When proposing or designing such a structure, the following components should be in the submission. Where there is a discrepancy between the requirements here and those provided by the client Railway or AREMA, the more stringent shall govern.

1. Covering Letter

- Summary of items enclosed,
- Location and date of previous, approved, similar designs by this designer, if any,
- Where the crash wall is proposed as an alternative to an earthen berm: alternative materials / configurations considered and benefits of this design,
- A Location or Key Plan. This will be used to identify the mileage and subdivision, the classification of the rail line, and the maximum speed for freight and passenger rail traffic, all obtained from AECOM Canada for CP and CN-owned corridors or from GO Transit for GO-owned corridors.
- Name, phone, fax and e-mail address of your contact.

2. Geotechnical Report - (2 copies)

- Soil properties used in design, and how determined,
- Borehole logs including location plan, if required to support these properties,
- Narrative report describing soil and ground water conditions, if required as above.

3. Design of Crash Walls

- One of the following methods may be chosen, or an alternative design load may be selected and if it can be justified by the engineer responsible for the design. The simplified approach of Method 1 may be used in most cases. Method 2 may be used to optimize the design, or where factors such as distance from the track to the wall, track speeds, side slopes along the track, consequences of collision or others may justify a different load.
- **Method 1**: The wall may be designed for a minimum point load of 600 kip (2700 kN) applied horizontally and normal to the face at any point along the wall
    - The point load shall be applied at a height of 6 feet (1.8 m) *above the top of rail* for walls up to 25 feet (7.6 m) from the centerline of track, or a height of 6 feet (1.8 m) *above the groundline* for walls farther than 25 feet (7.6 m) from the centerline of track.

  - This method may be applied where track speeds do not exceed 50 mph (80 km/hr) for freight or 70 mph (112 km/hr) for passenger trains; where speeds exceed these limits, Method 2 shall be used.

- **Method 2**: an energy balance approach considering collision by glancing blow and single car rotation may be used to determine the design load. The following four cases must be considered:

  - Freight Train Load Case 1 - Glancing Blow: nine cars weighing 143 tons (129 700 kg) each, impacting the wall at an angle, θ_G. The angle of impact will be a function of track curvature, and for tangent track may be taken as 3.5 degrees.

  - Freight Train Load Case 2 - Single Car Impact: single car weighing 143 tons (129 700 kg) impacting the wall as it undergoes rotation about its center. The angle of rotation at impact is:

    $$\theta_f = \text{asin}\left(\frac{d_{CL}}{8.5}\right) \quad [1]$$

    where d_{CL} is the distance from the crash wall to the centerline of track in m. The closest existing or future track is to be used. Where d_{CL} is greater than 8.5 m, this load case need not be considered.

  - Passenger Train Load Case 3 - Glancing Blow: eight cars weighing 74 tons (67120 kg) each impacting the wall at an angle, θ_G. The angle of impact will be a function of track curvature, and for tangent track may be taken as 3.5 degrees.

  - Passenger Train Load Case 4 - Single Car Impact: single car weighing 74 tons (67120 kg) impacting the wall as it undergoes rotation about its center. The angle of rotation at impact is:

    $$\theta_f = asin\left(\frac{d_{CL}}{13}\right) \quad [2]$$

    Where d_{CL} is greater than 13 m, this load case need not be considered.

  - The analysis should reflect the specified track speeds for passenger and/or freight trains applicable within the subject corridor.

  - To assist in designing the structure for the above load cases, use:

    - For the glancing blow load cases, the speed of derailed equipment impacting the wall is reduced from the track speed, v_o, to

      $$v_G = \sqrt{v_o^2 + 2a\left(\frac{d_{CL}-1.625}{\sin\theta_G}\right)} \text{ [m/s]} \quad [3]$$

      Where d_{CL} is the distance from the crash wall to the centerline of track in m.

      v_o is the track speed in m/s

      θ_G is the angle of impact

a is the acceleration in m/s, calculated as $-9.8(.25 + \mathrm{G})$

G is the grade in decimal unit of the groundline in the direction of travel defined by the angle of impact relative to the centerline of track; calculated as $\frac{Groundline\ at\ wall - Base\ of\ Rail}{d_{CL}/_{sin\theta_G}}$.

- For the single car load cases, the speed of derailed equipment impacting the wall is

$$v_A = \frac{2.3\theta_f}{\sqrt{1-cos\,\theta_f}}\left[\frac{m}{s}\right] for\ freight\ cars \quad [4]$$

$$v_A = \frac{2.9\theta_f}{\sqrt{1-cos\,\theta_f}}\left[\frac{m}{s}\right] for\ passenger\ cars \quad [5]$$

Where θ_f is the angle of impact, in radians, defined in [1] and [2].

- For energy dissipation, assume:
  - Contact with the wall stops all movement in the direction perpendicular to the wall, but not along its length
  - Plastic deformation of individual car due to direct impact is 1 foot (.3048 m) maximum,
  - Total compression of linkages and equipment of the 8 or 9 car consist is 10 feet (3.048 m) maximum,
  - Deflection of wall is considered negligible in equations [6] to [9]. Where the designer wishes to include it, those equations may be modified.
  - In lieu of more rigorous analysis, these energy balance equations may be used to determine the design load perpendicular to the wall. The design load acts along the given length of wall.
    - For the glancing blow load cases

$$F_G = \frac{\frac{1}{2}m(v_G \sin\theta_G)^2}{d_G} \quad [6]$$

And the load is considered to act along the length l_G in m:

$$l_G = \frac{3.048}{\cos\theta_G} \quad [7]$$

Where m is the mass of the derailed cars in kg.

v_G is the impact speed in m/s, defined in [3]

$\theta_G$is the angle of impact

d_G is the deformation of the consist in the direction of the applied force, and $d_G = 3.048 \sin \theta_G$, in m

- For the single car impact

$$F_A = \frac{\frac{1}{2} m (v_A \cos \theta_f)^2}{d_A} \quad [8]$$

And the load is considered to act along the length l_A in m:

$$l_A = \frac{.3048}{\sin \theta_f} \quad [9]$$

Where m is the mass of the derailed cars in kg.

v_A is the impact speed in m/s, defined in [4] or [5]

θ_f is the angle of rotation at impact defined in [1] or [2]

d_A is the deformation of the consist in the direction of the applied force, and $d_A = .3048 \cos \theta_f$, in m

Where the influence areas of two sequential cars in an accordion style of derailment overlap, the wall must be designed for the simultaneous impact of both cars.

- Regardless of the method selected, the following guidelines must be followed:
    - The minimum thickness for walls up to 25 feet (7.6 m) from the centerline of track shall be 2'-6" (.760 m); minimum thickness for walls farther than 25 feet (7.6 m) from the centerline of track shall be 18 inches (.45 m).
    - Crash walls less than 12 feet (3.6 m) from the centerline of track shall be a minimum of 12 feet (3.6 m) above the top of rail. Crash walls between 12 feet (3.6 m) and 25 feet (7.6 m) from the centerline of track shall be a minimum of 7 feet (2.135 m) *above the top of rail*. Crash walls greater than 25 feet (7.6 m) from the centerline of track shall be a minimum of 7 feet (2.135 m) *above the adjacent groundline*.
    - The face of the crash wall shall be smooth and continuous, and shall extend a minimum of 6 inches (0.15 m) beyond the face of the structure (such as a building column or bridge pier) parallel to the track.
    - The design must incorporate horizontal and vertical continuity to distribute the loads from the derailed train.
    - The wall must be of solid, heavy construction, and separate precast blocks or stones will not be permitted.

4. Drawings - (2 hard copies as well as .pdf format)

- Site plan clearly showing property line, location of wall structure, centerline and elevation of nearest rail track,
- Layout and structural details of proposed structure, including all material notes and specs and construction procedures/phasing. All drawings signed and sealed by a professional engineer registered in the province having jurisdiction at the project location.
- Extent and treatment of any temporary excavations on railway property.

5. Cheque

- A cheque payable to AECOM will be required for the cost of this review. Please contact AECOM for current pricing. Cost will take into consideration number of submissions, site visits, meetings, and alternative or unusually complex designs.

6. Post-Construction Certificate - (1 copy)

- Engineer's certificate of completion describing actual construction, and certifying that the structure was built as per approved drawings,
- Copy of as-built drawings, as part of the engineer's certification of completion.

Access to Railway Operating Rights-of-Way

Permits **MUST** be obtained before entering into any Railway Operating right-of-way.

Some or all of the following may also be required: - proper railway flagging protection, cable locates, liability insurance, release of liability, safety training.

AECOM Canada Ltd. will provide guidance as to the proper process to be followed in this regard. Fees will be established based on the nature and extent of the work being proposed.

Communication for Submissions

All correspondence during the review process should be directed to AECOM Canada Ltd.

Upon completion of our review, a confidential report on our findings will be made to the railway company, who will subsequently contact the applicant.

The applicant will be notified when the report has been submitted to the railway.

Liability and Responsibility

The review will be undertaken with the understanding that neither the railway nor AECOM Canada Ltd. shall have any responsibility nor liability whatsoever for the design or adequacy of the crash wall, notwithstanding that any plans or specifications may have been reviewed by the railway nor AECOM Canada Ltd. No such review shall be deemed to limit the applicant's full responsibility for the design and construction adequacy of the works.

AECOM Canada Ltd.

Mississauga, Ont.

July 2005 Revised July 29, 2014

APPENDIX ‘C’

Risk Assessment

Risk Assessment Matrix

Table No. 4.0

Prepared by (name & company):	JSW+ Associates
Site:	720 Granite Court, Pickering, Ontario
Adjacent Rail Corridor:	Metrolinx, Principle mainline
Date:	June-10-22
Revision:	0

General Notes

1) The railway corridor is a principal mainline freight and passenger corridor.
2) Dangerous good trains operate at reduced mainline speeds compared to other freight trains.
3) Track speeds on this corridor are 100mph for passenger and 65 mph for freight.
4) There are no switches adjacent the site (nor in close proximity).

#	Frequency	Severity
1	Improbable	Negligible
2	Remote	Marginal
3	Occasional	Serious
4	Probable	Critical
5	Frequent	Catastrophic

	Initial Risk						Current (Residual) Risk						
Ref	**Hazard**	**Consequence**	**Frequency**	**Severity**	**Initial Risk**	**Risk Classification**	**Safeguard/ Mitigation Measure** (Describe the measure put in place which results in a reduction in likelihood and/or severity of the hazard)	**Assumptions/Comments** (Provide additional information relevant to the assessment of the revised ratings for Frequency and severity, as relevant)	**Frequency**	**Severity**	**Current Rank**	**Risk Classification**
1	Derailment of freight train carrying flammable or hazardous materials.	On collision with proposed berm/wall on site, rail cars with flammable/hazardous materials cause explosion ignite, explode or are released adjacent to the building causing injuries and/or fatalities to occupants.	3	2	6	Tolerable	Subject site possess a principal derailment protection feature (natural earth berm) as well as providing adequate horizontal and vertical setback requirements.	1) Dangerous good trains operate at reduced mainline speeds compared to other freight trains. 2) Emergency services may decide evacuation is required in this event. 3) Historical data of fires on the corridor are infrequent and have yet to result in a fatality.	3	2	6	Tolerable
2	Derailment of freight or passenger train at speed greater than maximum line speed with berm/crash wall in place.	Collision of freight or passenger train with berm/crash wall. The Berm/Crash wall deflects more than design allowance. The Berm/Wall and connecting sacrificial structures experience more damage than design expectation.	4	2	8	Tolerable	The earthern berm is a 6 meter high natural berm which should provide adequate energy attentuation. Additional setback requirements are also satisfied by providing a minimum total setback of 30m (although this varies from building to building).	Based on historical data, there has been low number of injuries within this rail corridor and there has yet to be a fatality in the Kingston subdivision. Note that train speeds in excess of posted maximum mainline speeds can only be mitigated through the action by the railway company.	4	2	8	Tolerable
3	Derailment of freight train	Transfer of derailment loads/forces to the auxiliary and principal building structures causes moderate to significant damage and possible collapse.	4	2	8	Tolerable	Firstly, the site will be safeguarded with a derailment protection feature (earth berm) that is to mitigate and/or minimize significant damage to the building structure. Secondly, the site is also providing a minimum total setback of 30.0m for additional protection.	The protection feature is designed to provide the energy attenuation required in the event of a train derailment. Furthermore, the high occupancy area is setback the appropriate amount to further safegaurd the site. The protection feature is independant of any structural feature of the subject site. Therefore, the loads applied on the earth berm will be dissipated prior to being transferred to the buildings.	4	2	8	Tolerable
4	Energy of derailed train deflected back from the crash wall into rail cars.	Transfer of forces caused by sudden deceleration results in higher risk of equipment rupture and/or sparking, potentially causing fire or explosion.	2	4	8	Tolerable	The site is not equipped with a crash wall. Therefore, the risk of a train deflection into the rail corridor is significantly less.	Historical data on this rail corridor suggests that the event depicted in Ref. #4 is extremely rare and resulted in 0 casualties thus far in the Kingston subdivision.	2	4	8	Tolerable
5	Derailment of freight train into corners of proposed development property or berm/crash wall.	Derailed freight cars or passenger cars enter the site from an angle (i.e. either from east or west approaches), bypassing the protection along the property line, and colliding with buildings on the site or hitting the corner of the crash wall.	3	2	6	Tolerable	The site has natural protection at the flank in that existing berm or grade separations provide additional protection to the site. Therefore, no return walls or berms are required.	The site is safegaurded with a natural berm along the propety line. The berm will provide the energy attentuation required to protect the site.	3	2	6	Tolerable
6	Top level of sea-can (double stack intermodal) freight car becomes airborne in a derailment.	Airborne freight car over sails the crash wall and collides with the building.	1	5	5	Tolerable	The site is set back at a minimum of 30 meters from the property line and railway corridor is located in a cut condition of 6 meters.	The development is setback (at least) 30.0 meters from the wall, so damage to the building is unlikely and/or minimal. Also, since the corridor is in a cut condition, it is unlikely it will clear the natural berm and collide with a building. Double stack freight cars are also locked in place during the loading phase. If the locks are rigid during impact, the double stack shipment would act as a single unit.	1	5	5	Tolerable
7	Trespassing onto railroad	Interference with railway operations, vandalism, and danger to the trespasser(s) from moving trains.	4	5	20	Intolerable	Chain link fencing is proposed to prevent trespassing from the subject site to the rail corridor along the property line - this will provide additional measure of security to the corridor.	No access from the site to the rail corridor is possible in the future condition, as the development will be providing no-cut and no-climb fencing that separates the two properties.	1	5	5	Tolerable

Table 1 - Risk Classification Matrix

			SEVERITY				
			Catastrophic	Critical	Serious	Marginal	Negligible
			5	4	3	2	1
FREQUENCY	Frequent	5	25	20	15	10	5
	Probable	4	20	16	12	8	4
	Occasional	3	15	12	9	6	3
	Remote	2	10	8	6	4	2
	Improbable	1	5	4	3	2	1

Table 1 - Risk Category & Mitigation Strategy

Risk (Frequency x Severity)		Risk Category	Mitigation Strategy
Low	1 to 4	Broadly Acceptable	Risk is acceptable. No further mitigation required.
Medium	4 to 10	Tolerable	Risk is considered tolerable if agreed that the risk is reduced to a level considered ALARP*
High	10 to 25	Intolerable	Risk shall be eliminated/reduced.

**As low as reasonably practicable.*

Table 3 - Definition of Safety Hazard Severity Criteria

Hazard Rating		Consequence to Personnel or General Public	Consequence to the Environment	Consequence to the Rail System and Operation
1	Negligible	Non-reportable injury	None	Monetary loss less than $10k.
2	Marginal	Single minor injury	Reversible minor environmental impact	Minor operational delays Dangerous goods involved without release of product; Monetary loss between $10 k and $100 k.
3	Serious	Single permanent partial or temporary total disabling injury; Multiple minor injuries.	Reversible moderate environmental impact	Significant system loss, severely restricting operations; Dangerous goods release not resulting in evacuation; Monetary loss between $100 k and $1 million.
4	Critical	Single fatality; Single instances of permanent total disability; Multiple instances of permanent partial or temporary total disabling injuries.	Reversible significant environmental impact	Major loss of system / sub-system resulting in not being able to continue operations; Dangerous goods release resulting in evacuation; Monetary loss between $1 million and $10 million.
5	Catastrophic	Multiple fatalities; Multiple instances of permanent total disability	Irreversible significant environmental impact	Total loss of services; Dangerous goods release resulting in major evacuation; Monetary loss esceeding $10million.

Table 4 - Definition of Hazard Frequency Criteria

Rating		Qualitative Interpretation	Interpreted for Lifecycle
1	**Improbable**	Unlikely to occur, but possible. It can be assumed the event is unlikely to occur.	100 years to 1000 years
2	**Remote**	Likely to occur sometime in the rail system lifecycle. It can reasonably be expected to occur several times.	10 years to 100 years
3	**Occasional**	Likely to occur several times. The event can be expected to occur several times.	Yearly to every 10 years
4	**Probable**	Will occur several times. The event can be expected to occur frequently.	Monthly to yearly
5	**Frequent**	The event will be continually experienced	Daily to monthly

APPENDIX ‘D’

Chain Link Fence Specifications

High Security Fencing

The high security fence height above ground shall be 2.4 m.

The panel mesh shall consist of a minimum 4mm diameter high tensile wire, with aperture sizes (openings) 76.2mm x 12.7mm on centre or smaller fastened to suitable posts that allow for a minimum foundation depth of 1200 mm. The fence panels shall be strengthened with factory formed undulations within each mesh panel. Mechanical Fasteners shall be tamperproof, and factory galvanized. Fastening hardware shall be concealed from the face of each panel and post. The mesh, posts, clamps and associated hardware are to be galvanized with an exterior finish coating capable of withstanding repeat climate variances within Southern Ontario.

1.1 High Security Fence

(a) When directed by Metrolinx the Contractor shall install high security fencing at ROW limits, at layover yards and at other locations instructed by Metrolinx. The manufacturer and product name of approved High Security fencing are listed below. Proposed equivalents recommended by the contractor will be subject to approval by Metrolinx prior to installation.

(i) Cochrane–ClearVu

(ii) BETAFENCE- Securifor 3D

(iii) CLD- Securus Profiled

(iv) Bear Mountain – Bear Securi Mesh Barrier

(b) The high security fence height above ground shall be 2.4 m.

(c) The panel mesh shall consist of a minimum 4mm diameter high tensile wire, with aperture sizes (openings) 76.2 x 12.7 mm centers or smaller fastened to suitable posts that allow for a minimum foundation depth of 1200 mm.

(d) The fence panels shall be strengthened with factory formed undulations within each mesh panel. Mechanical Fasteners – Shall be tamper proof and mechanically galvanized. Fastening Hardware shall be concealed from the non-rail side of each panel and post.

(e) Mesh to be galvanized with an exterior finish coating capable of withstanding typical climate variances within Southern Ontario.

(f) Specification sheets and breach testing results for any proposed alternate products and materials shall be submitted to Metrolinx staff for approval.

APPENDIX ‘E’

Metrolinx Correspondence

From: Harrison Rong <Harrison.Rong@metrolinx.com>
Sent: June-13-22 2:30 PM
To: Shyakaran Baskaran <sbaskaran@jsw.ca>
Cc: Rail Data Requests <RailDataRequests@metrolinx.com>
Subject: RE: Rail Data Request for 720 Granite Court

Good afternoon Shyakaran,

The Passenger Track design speed for GO is 100mph(161 km/h) and the freight speed is 65mph (105 km/h).

Best regards,
Harrison Rong
Project Coordinator, Third Party Projects Review
Metrolinx
20 Bay Street | Suite 600 | Toronto | Ontario | M5J 2W3
T: 416.202.7517 C: 647.328.4891

From: Shyakaran Baskaran <sbaskaran@jsw.ca>
Sent: June 10, 2022 10:13 AM
To: Rail Data Requests <RailDataRequests@metrolinx.com>
Subject: RE: Rail Data Request for 720 Granite Court

Hello Tara,

Please check with Harrison Rong as to what the speeds are for passenger and what the speed is for freight, this is typical practice to indicate which is which.

Thanks.

From: Rail Data Requests <RailDataRequests@metrolinx.com>
Sent: June-10-22 9:54 AM
To: Shyakaran Baskaran <sbaskaran@jsw.ca>
Subject: RE: Rail Data Request for 720 Granite Court

Hi,

The current track design speed near the subject lands is 100 mph (161 km/h).

Hope this helps you.

Thanks,

Tara

From: Shyakaran Baskaran <sbaskaran@jsw.ca>
Sent: June 9, 2022 3:25 PM
To: Rail Data Requests <RailDataRequests@metrolinx.com>
Subject: RE: Rail Data Request for 720 Granite Court

Hello Tara,

What is the speed for passengers and freight?

Thanks

From: Rail Data Requests <RailDataRequests@metrolinx.com>
Sent: June-07-22 1:36 PM
To: Shyakaran Baskaran <sbaskaran@jsw.ca>
Subject: RE: Rail Data Request for 720 Granite Court

It looks between 314.76 and 314.95.

Hope this helps.

Tara

From: Shyakaran Baskaran <sbaskaran@jsw.ca>
Sent: June 7, 2022 1:34 PM
To: Rail Data Requests <RailDataRequests@metrolinx.com>
Subject: RE: Rail Data Request for 720 Granite Court

Hi Tara,

Thank you for the information. Can you also indicate what the milage of our site is in relation to this subdivision?

Thank you.

From: Rail Data Requests <RailDataRequests@metrolinx.com>
Sent: June-07-22 1:27 PM
To: Shyakaran Baskaran <sbaskaran@jsw.ca>
Subject: RE: Rail Data Request for 720 Granite Court

Hi Shyakaran,

Further to your request dated June 07, 2022, the subject lands (720 Granite Court in Pickering) are located within 300 metres of the Metrolinx Kingston Subdivision (which carries Lakeshore East GO rail service).

It's anticipated that GO rail service on this Subdivision will be comprised of diesel and electric trains. The GO rail fleet combination on this Subdivision will consist of up to 2 locomotives and 12 passenger cars. The typical GO rail weekday train volume forecast near the subject lands, including both revenue and equipment trips is in the order of 236 trains. The planned detailed trip breakdown is listed below:

	1 Diesel Locomotive	2 Diesel Locomotives	1 Electric Locomotive	2 Electric Locomotives		1 Diesel Locomotive	2 Diesel Locomotives	1 Electric Locomotive	2 Electric Locomotives
Day (0700-2300)	35	35	88	42	Night (2300-0700)	8	2	18	8

The current track design speed near the subject lands is 100 mph (161 km/h).

There are no *anti-whistling by-laws* in affect near the subject lands.
With respect to future electrified rail service, Metrolinx is committed to finding the most sustainable solution for electrifying the GO rail network and we are currently working towards the next phase.
Options have been studied as part of the Transit Project Assessment Process (TPAP) for the GO Expansion program, currently in the procurement phase. The successful proponent team will be responsible for selecting and delivering the right trains and infrastructure to unlock the benefits of GO Expansion. The contract is in a multi-year procurement process and teams have submitted their bids to Infrastructure Ontario and Metrolinx for evaluation and contract award. GO Expansion construction will get underway in late 2022 or 2023.
However, we can advise that train noise is dominated by the powertrain at lower speeds and by the wheel- track interaction at higher speeds. Hence, the noise level and spectrum of electric trains is expected to be very similar at higher speeds, if not identical, to those of equivalent diesel trains.
Given the above considerations, it would be prudent at this time, for the purposes of acoustical analyses for development in proximity to Metrolinx corridors, to assume that the acoustical characteristics of electrified and diesel trains are equivalent. In light of the aforementioned information, acoustical models should employ diesel train parameters as the basis for analyses. We anticipate that additional information regarding specific operational parameters for electrified trains will become available in the future once the proponent team is selected. Operational information is subject to change and may be influenced by, among other factors, service planning priorities, operational considerations, funding availability and passenger demand.

It should be noted that this information only pertains to Metrolinx rail service. It would be prudent to contact other rail operators in the area directly for rail traffic information pertaining to non-Metrolinx rail service.

I trust this information is useful. Should you have any questions or concerns, please do not hesitate to contact me.
Regards,

Tara Kamal Ahmadi
Junior Analyst
Third Party Projects Review, Capital Projects Group
Metrolinx | 20 Bay Street | Suite 600 | Toronto | Ontario | M5J 2W3

METROLINX

From: Shyakaran Baskaran <sbaskaran@jsw.ca>
Sent: June 7, 2022 10:35 AM
To: Rail Data Requests <RailDataRequests@metrolinx.com>
Cc: Harrison Rong <Harrison.Rong@metrolinx.com>
Subject: Rail Data Request for 720 Granite Court

Hello,

I am looking for rail data for the site location at 720 Granite Court in Pickering, Ontario. If you can, kindly provide this information to me that would be great. Thank you in advance!

Best regards

Shyakaran Baskaran,
JSW+ Associates
Civil Engineer in Training
Cell.647.996.9757
www.jsw.ca