December 6, 2023

The Owners, Strata Plan NW 3355
c/o FirstService Residential
700 – 200 Granville Street
Vancouver, BC V6C 1S4

Attn: Deb Lanzo, Property Manager Email: deb.lanzo@fsresidential.com

Re: The Metropolitan – 5885 Olive Avenue, Burnaby
Garage Evaluation

Sense's Project No. 18R085L

Dear Deb,

We are pleased to provide the following report summarizing the findings of our Garage Evaluation at The Metropolitan.

1.0 BACKGROUND

The Metropolitan is a 25-storey building with a total of 132 residential suites, constructed in 1991. The building is concrete with post-tensioned floor slabs. The building is constructed over a three-level parking garage.

Concrete has delaminated and fallen from the garage ceiling around concrete crack locations. The Strata would like the garage reviewed to better understand the extent of damage and the overall condition of the garage.

Photo 1: General photo of The Metropolitan.

2.0 SENSE ENGINEERING'S SCOPE OF REVIEW

As per our proposal dated May 15, 2023, we completed the following:

- Visually reviewed representative samples of exposed garage components, including foundation walls and slabs, slabs-on-grade, lighting, paint and drains.
- Completed a concrete damage survey by sounding (i.e., chain dragging or hammer tapping concrete surfaces) approximately 30% by area of the slab top surfaces and undersides.
- To test the concrete for potential corrosion, we performed the following with the assistance of our contractor, Skymark Projects:
    - Completed carbonation testing at three locations within the parking garage.
    - Collected concrete powder samples at three locations for water-soluble chloride ion content testing completed by Metro Testing and Engineering.
    - Removed overburden soil and visually reviewed the garage roof slab waterproofing at three locations.

We completed our site review on August 3, 2023. Our review was completed at representative sample areas that were made available for us to access during our site visit. The conditions may vary in areas that were not reviewed.

3.0 KEY FINDINGS

3.1 Parking Garage

3.1.1 General Construction

The Metropolitan has a three level, conventionally reinforced underground parking garage. There are several storage and service rooms at all levels of the garage. The P1 garage level is accessible by an exterior vehicular entrance ramp at the east side of the property from Olive Avenue. The parking levels gradually spiral down, connecting P1, P2, and P3 levels.

Based on our review and the building drawings, the parking garage structure generally consists of the following reinforced concrete components:

- 200-225mm thick suspended garage roof slab;
- 150-200mm thick suspended intermediate slabs;
- 125mm slab on grade;
- Foundation walls of varying sizes;
- Columns of varying sizes and orientation;

3.2 Garage Roof Slab

3.2.1 General Construction

The garage extends beyond the footprint of the building, which results in there being a buried garage roof slab at these areas. The garage roof slab is covered by paved driveways, walkways, and landscaping.

The P1 garage level is accessible by an exterior entrance ramp at the east side of the property from Olive Avenue. The entrance ramp driving surface is interlocking brick pavers.

Based on the investigative openings made over the garage roof slab, and the documents provided, the roof slab consists of the following:

- 60 mm interlocking brick pavers on 65 mm bedding sand or soil and landscaping;
- Granulated modified bitumen protection sheet;
- Hot rubberized asphalt waterproofing; and
- Concrete slab.

The garage roof slab waterproofing is original and 32 years old.

3.2.2 Condition and Performance

3.2.2.1 Original roof slab waterproofing is in fair condition for its age and should be reassessed for re-waterproofing within five years.

We made three roof slab inspection pits to review the roof slab waterproofing. Refer to Appendix B for roof slab inspection pit locations and Appendix D for more information on the openings.

The original garage roof slab waterproofing is generally well bonded to the concrete slab and flexible; however, the concrete was wet below the waterproofing at Inspection Pit #3, but no signs of failure of the waterproofing was observed within the inspection pit area, suggesting water ingress is likely from localized failure of the membrane near the inspection pit, or water is bypassing the waterproofing by another means, such as a concrete crack or joint.

There are areas of localized leakage; however, the amount of leakage through the roof slab overall is minimal, suggesting that the waterproofing is still generally performing well. Crack injection repairs have been completed to address some of the leaking cracks and are still performing satisfactorily.

Based on the current age of the waterproofing membrane (32 years) it is nearing its expected service life of 35 to 40 years; however, given that widespread leakage is not occurring, re-waterproofing the garage roof slab could continue to be deferred until leakage becomes more problematic. We recommend re-evaluating the garage roof slab in about five years to better plan the timing of when the roof slab should be repaired or replaced. Meanwhile, localized leaking cracks can continue to be addressed by injection waterproofing repairs.

Photo 2: Moisture below garage roof waterproofing.

Photo 3: Cracks with evidence of leakage on garage soffit.

3.2.2.2 There is evidence of drainage issues at the north-west walkway next to pool area.

There is evidence of drainage issues due to plugged area drains at the walkway on the north-west side of the pool areas. The area drains are blocked with debris and the pavers have dirt build-up and efflorescence staining on the surface, indicating that water is sitting on the surface for long periods of time of time. We recommend clearing the drains in the area to promote drainage and reduce the risk of water leaking into the pool area from the walkway.

Photo 4: Plugged walk-way drain at north-west side, next to pool area.

Photo 5: Staining on pavers near plugged drain indicating ponding water in the area.

3.2.2.3 The vehicular entrance ramp is leaking along the joint between the ramp and the wall.

There is a large amount of leakage staining at the cold joint between the entrance ramp slab and ramp walls, suggesting that the waterproofing does not extend over this joint or that the waterproofing is damaged at this location. To address the leakage, we recommend lifting the pavers along the ramp walls and extending the waterproofing upturn 200 mm above the paver surface and covering the waterproofing with sheet metal flashings.

Photo 6: Entrance leaking entrance ramp to wall joint.

Photo 7: Entrance ramp staining along bottom of wall.

3.3 Garage Suspended Slab

3.3.1 General Construction

The P1 and P2 garage suspended slabs are comprised of cast-in-place slabs, supported by cast-in-place concrete columns and slab bands. The suspended slabs are not protected by a vehicle traffic coating membrane (i.e., concrete surfaces are bare).

3.3.2 Condition and Performance

3.3.2.1 The suspended slab is unprotected, contributing to significant concrete deterioration.

The lack of a waterproofing membrane on the parking garage suspended slabs has allowed water to leak through many surface cracks in the P1 and P2 slabs. The leaking water is generally brought into the garage by vehicles. When the water is combined with chlorides from road salts or pre-existing chlorides in the concrete, it causes corrosion of the reinforcing steel when in contact. The resulting rust that forms from steel corrosion pushes against the concrete, resulting in loose concrete at the slab, which could fall and injure pedestrians or damage property.

Photo 8: Typical unprotected P1 level drive aisle.

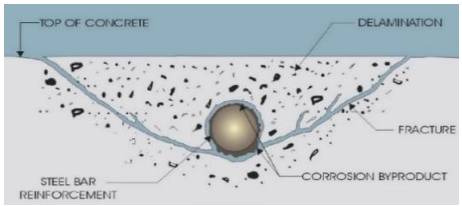


Photo 9: Diagram of concrete delamination at corroded reinforcement.

Concrete damage on the underside of the garage suspended slab of P1 and P2 is widespread with evidence of leakage. Also supported by the chloride testing results, chloride has penetrated past the reinforcement depth. Most of the concrete damage and leakage is concentrated along cracks that extend the width of the drive aisle and into the parking stalls. Based on our sounding survey, approximately 1% of the total suspended slab area has delaminated concrete.

At several locations, the concrete damage has caused concrete to spall from the underside of the slab, exposing the reinforcing steel. There are several locations where the concrete has delaminated, appears loose, and could eventually fall. There is also concrete delamination on the topside of the slab.

Installation of waterproofing on the topside of the suspended slab is recommended to mitigate ongoing leakage and concrete deterioration. Concrete repairs should be completed where the concrete is damaged and/or deteriorated, prior to installing the waterproofing. Concrete repairs include removing and repairing delaminated concrete, cleaning the steel of corrosion, and installing new concrete. We recommend these repairs be completed within the next 5 years.

Further, as the suspended slabs have been un-protected for a long period of time, there could be a high risk of corrosion continuing even after repairs are completed. Installing a waterproofing coating could act to trap moisture and chlorides in the slab and accelerate corrosion if corrosion potentials are high. As such, we recommend completing half-cell testing to check the active corrosion potential in the slabs before completing any repairs. Half-cell testing is an electrochemical technique commonly used to assess the severity of corrosion in reinforced concrete structures. Should we find active corrosion potentials are high, we would recommend steps to dry out the slab to reduce corrosion potentials before installing a waterproofing coating.

Should the Strata choose to phase and/or defer concrete repairs, the Stata should engage a contractor to locate and remove loose concrete from the underside of slabs, as there is a considerable amount, to reduce the risk of concrete falling on pedestrians and/or vehicles, until a repair project can be completed.

Photo 10: Efflorescence on soffit of suspended slab.

Photo 11: Typical delaminated concrete on suspended slab soffit.

Photo 12: Loose concrete broken off when concrete sounding was completed during the garage evaluation.

Photo 13: Typical exposed reinforcing at concrete spall location.

Photo 14: Loose concrete that has fallen from soffits during concrete sounding that was completed during the garage evaluation.

Photo 15: Typical topside delamination with exposed reinforcing steel.

Photo 16: Typical topside delamination with exposed reinforcing steel.

3.3.2.2 Chloride concentration levels in the suspended concrete slab appear to increase the risk of steel reinforcing corrosion.

Concrete powder samples were taken at three locations on the suspended slabs and were tested in a laboratory to check the chloride content at the top, middle, and bottom of the slab. Refer to Appendix B for chloride test locations. Chlorides combined with water promote corrosion of the reinforcing steel. Chlorides in concrete can be pre-existing from the original concrete mix or introduced to the concrete from de-icing salts.

CSA A23.1-19, Section 4.1.1.2, Clause 4.1.1.2.1 “Limits on chloride ion content” states the water-soluble chloride ion content by mass of the cementitious material in the concrete before exposure shall not exceed 0.15% for reinforced concrete exposed to a moist environment of chlorides, meaning the chloride levels in the concrete should not exceed 0.15% at the time it was placed. As such, chloride results of over 0.15% Cl Content by Mass of Cementitious Material generally indicate undesirable levels of chloride in the concrete.

The test results indicate that there are generally high levels of chlorides at the top surface of the concrete at all test locations and high levels of chloride throughout the slab at Test Location 3, which was taken at Level P1, at the base of the garage entrance ramp. The chloride levels taper off further into the garage (i.e., away from the garage entrance), indicating the chlorides are likely being introduced into the garage from vehicles bringing in de-icing salts as they enter the garage. A waterproofing membrane should be installed on the suspended slab to:

1. Reduce the amount of water that enters the slab that can potentially cause concrete damage when mixed with the chlorides already in the slab, and

2. Reduce the amount of chlorides that enters the slab that increases the risk of future concrete damage.

The full chloride testing report can be found in Appendix C. Below is a summary of the results at each test locations.

Sample No.	Depth Increment (mm - mm)	% Cl^- Content by Mass of Concrete	Estimated % Cl^- Content by Mass of Cementitious Materials
Location 1	5 mm - 25 mm	0.129	1.032
	25 mm - 45 mm	0.019	0.152
	45 mm - 65 mm	0.011	0.088
	65 mm - 85 mm	0.010	0.080
Location 2	5 mm - 25 mm	0.060	0.480
	25 mm - 45 mm	0.027	0.216
	45 mm - 65 mm	0.013	0.104
	65 mm - 85 mm	0.015	0.120
Location 3	5 mm - 25 mm	0.447	3.576
	25 mm - 45 mm	0.268	2.144
	45 mm - 65 mm	0.059	0.472
	65 mm - 85 mm	0.032	0.256

NOTE: The above results are based on an assumed concrete density of 2400 kg/m³ and an assumed cementitious materials content of 300 kg/m³. Therefore, the chloride ion content results by mass of cementitious materials are estimates only.

Table 1: Water Soluble Chloride Content of hardened concrete.

3.3.2.3 Carbonation is likely not contributing to concrete deterioration.

We performed carbonation testing at three locations at all levels of the parking garage. The depth of concrete carbonation ranges as follows:

- Test Location 1: 5 mm
- Test Location 2: 10 mm
- Test Location 3: 5 mm

As carbonation has not reached the depth of the steel reinforcement, it is unlikely that carbonation is contributing to deterioration of the concrete in the garage currently.

Photo 17: Carbonation testing result.

Carbonation occurs when carbon dioxide from the air reacts with hydroxides in the concrete surfaces. This reaction can lower the pH of the concrete to a level that facilitates corrosion of the steel reinforcement. Carbonation is generally a slow process; it has been estimated that carbonation will proceed at a rate up to 1mm per year. When carbonation reaches the reinforcing, a marked increase in reinforcing steel corrosion and concrete delamination can occur.

Installing a coating on the concrete surface reduces the rate at which carbonation travels through the concrete and limits the risk of concrete deterioration where concrete is carbonated around steel by limiting the amount of water entering the structure. As such, installation of a waterproofing membrane on the suspended slab top surface is recommended.

3.4 Garage Slab-on-Grade

3.4.1 General Construction

The lowest level of the parking garage (P3 level) has a concrete slab-on-grade.

Based on the original drawings, the slab-on-grade in parking level P3 consists of the following (from top to bottom):

- 125 mm thick concrete slab-on-grade (i.e. there are no structures beneath it);
- 10M rebar @ 17” E.W. at mid-depth

3.4.2 Condition and Performance

3.4.2.1 Slab-on-grade is in good condition and performing adequately.

There are some cracks in the concrete slab-on-grade which is typical for most slab-on-grade construction over time. Some efflorescence staining was observed on the floor at base of wall nearby Stall 169 and 170. The efflorescence appears to be due to water seepage from groundwater below. However, there was no excessive cracking or significant differential settlement that would suggest there are sub-grade problems.

Photo 18: Typical condition of the Slab-on-grade at P3.

3.4.3 Miscellaneous

During our review we noted other conditions throughout the garage that we would like to bring to the strata's attention:

3.4.3.1 Leaking cracks are corroding sprinkler pipes.

Cracks throughout the parking garage are showing signs of leakage. Leaks from these cracks are starting to corrode the sprinkler pipes below those cracks. Electrical conduits are also starting to corrode from the leaks at the cracks, which is another reason why the leakage through the suspended slab should be address by installing a traffic coating membrane. As part of the waterproofing work an allowance should be carried to address replacement of electrical conduits and sprinkler pipes if found to be required during the work.

Photo 19: Typical corrosion on sprinkler pipes.

3.4.3.2 Exhaust fans are functioning; however, there are no carbon monoxide detectors in the garage.

Exhaust fans appear to be functioning correctly during our site visit and do not show any obvious signs of distress.

We did not note any carbon monoxide detectors within the garage. Carbon monoxide detectors, although not required by the Code if mechanical ventilation is present, can help to detect areas of stale air with pockets of poisonous carbon monoxide gases. Carbon monoxide is odourless and is unlikely to be noticed before its too late and becomes dangerous to occupants. We recommend installing CO detectors as precautionary safety items.

3.4.3.3 Peeling paint in the stairwells.

Peeling paint was observed on walls in some of the stairwells. This is an aesthetic item only and should not have any significant effect on the overall performance of the parking garage.

Photo 20: Typical peeling paint in the stairwells.

3.4.3.4 Foundation walls are performing satisfactorily.

The foundation walls are generally in satisfactory condition. Several hairline cracks were present in the foundation walls, but no evidence of leakage was observed.

3.4.3.5 Lighting levels appear adequate in the garage.

Lighting levels in the parking garage appear to be providing adequate illumination where reviewed.

4.0 DISCUSSION

The lack of a waterproofing membrane on the P1 and P2 suspended slabs has allowed water to leak through cracks and cause concrete deterioration. The amount of concrete delamination is still relatively small for the large number of leaking cracks there are throughout the garage, but the rate at which the concrete deterioration occurs could significantly increase as more water and chlorides are continually brought into the garage by vehicles, and as the carbonation front in the concrete advances towards the slab reinforcing steel.

The longer that waterproofing and concrete repairs are deferred, the higher the risk that concrete deterioration could spread to a point where the structural integrity of the slab is compromised, increasing the cost of repair. Risks of injury and property damage are additional reasons the strata should complete garage repairs. We recommend the strata plan to complete repairs within the next five years before carbonation reaches the level of the reinforcing steel withing the concrete, to reduce the risk of reinforcing steel and concrete deterioration.

To address the concrete deterioration, the damaged concrete needs to be removed, the corroded reinforcing steel repaired, and new concrete placed. Once the concrete repairs are completed, a waterproofing traffic coating should be applied to the top surface of the suspended slab including pre-treating all the cracks, so the membrane can adequately bridge over them.

Alternatively, there are temporary repairs that can be completed such as repairing the deteriorated concrete and deferring the installation of a waterproofing membrane; however, it would be more cost efficient and less disruptive to take advantage of the access related to completing the concrete and waterproofing repairs at the same time. Performing targeted repairs to the concrete without waterproofing leaves the original and repaired concrete unprotected against water and chlorides (salt), which can cause further damage the existing and repaired concrete and might require further repairs.

There are also injection repairs that can be completed at the garage roof slab to temporarily address active leakage through the concrete and onto property below; however, this repair only acts to plug the leakage, leaving the concrete unprotected and does not address structural deterioration. Injection repairs can also force the water to find other paths through the concrete, promoting new leaks in other areas, eventually making it difficult to capture all the leakage with this type of repair.

There are other methods of slowing deterioration of the structure other than repairing, but they are not as well suited for a garage having the construction and condition like at The Metropolitan. Other methods include impressed current protection where reinforcing is electrically charged to inhibit further reinforcing corrosion, sacrificial anode where another sacrificial metal is introduced to the structure to reduce reinforcing corrosion, and crystalline waterstops that work similar in principle to injection techniques where leaking cracks are blocked. These methods only slow further deterioration and do not address structural damage that has already occurred. Since waterproofing can easily be installed on the garage floors, and because damage structure should be repaired, we have not considered these alternative repair methods in this report.

The Strata could also choose to further defer the recommended repair work; however, this would likely result in an increase in the amount of concrete repairs required and related costs increases due to the larger work areas and inflation.

5.0 REPAIR OPTIONS

Two options for repairing the parking garage are presented below for your consideration. Breakdowns for the Opinion of Costs can be found in Appendix A. All budgets are presented in today's dollars. Over the past few years, construction costs have increased significantly due to the high demand for construction work. While our Opinion of Costs are based on recent pricing received for similar projects, it is very difficult to predict market conditions. Actual pricing may be much higher, depending on when contractor pricing is obtained.

We have carried an allowance for a Hazardous Materials Assessment which is required by WorkSafeBC when construction work will disturb existing materials. If you have already completed this survey for your building, then these costs may not apply. Budgets for abatement of hazardous materials have not been included in the Opinion of Cost.

We have included half-cell testing in the repair options with the assumption that half-cell testing results do not require the slab to be dried out prior to installing a waterproofing coating. However, should half-cell testing results indicate high corrosion potential, we will provide further recommendations on steps to dry out the slab to reduce corrosion potentials.

We understand that many of the vehicles will need to be relocated during the project, so doing repairs on P1 and P2 slabs simultaneously may not be the most feasible option. Option 2 presents a two-phased project for the Strata's consideration. Further phasing can be considered, but should be discussed, as too many phases may not be cost effective.

The repair options assume loose concrete removal would be completed as part of general garage repairs; however, should the Strata plan to defer the repairs beyond 2024, we recommend budgeting approximately $10,000 to engage a contractor to survey and remove loose concrete on the underside of suspended slabs.

5.1 Option 1 – Single Phase Garage Repairs (Complete all repairs at one time)

General Description:

This option completes all the recommended garage repairs at one time to reduce overall costs, inconvenience, and risk of property damage but increases the immediate financial burden on Strata members.

Scope of Repair:

Roof Slab, and P1 and P2 Suspended Slab Waterproofing in 2024

- Remove loose concrete on the underside of suspended slabs to reduce risk of falling concrete.
- Complete half-cell testing.
- Repair damaged concrete on the topside and the underside of the suspended slabs.
- Install new traffic waterproofing base coat, top coat, and wear course, including crack treatment.
- Clean undersides at leakage staining locations.
- Inject leaking roof slab cracks.
- Repair garage ramp waterproofing at wall upturns.
- Install carbon monoxide detectors.

Advantages/Benefits:

- Reduced overall repair cost.
- Less inconvenience to Strata.
- Reduced risk of property damage related to leakage.

Disadvantages/Risks:

- Increased immediate financial burden to Strata.
- More disruptive to residents due to more cars needing to be relocated at one time.

Opinion of Costs: $1,264,000

5.2 Option 2 – 2 Phase Repair (Complete work in 2 phases)

General Description:

This option is a repair deferral program that allows the Strata to spread repair costs over several years.

Scope of Repair:

Phase 1 in 2024 – Roof Slab and P1 Suspended Slab Waterproofing

- Remove loose concrete on the underside of all suspended slabs to reduce risk of falling concrete.
- Complete half-cell testing on all suspended slabs.
- Repair damaged concrete on the topside and the underside of the P1 suspended slab.
- Install new traffic waterproofing base coat, top coat, and wear course, including crack treatment.
- Clean slab undersides at leakage staining locations.
- Inject leaking roof slab cracks.
- Repair garage ramp waterproofing at wall upturns.
- Install carbon monoxide detectors.

Phase 2 in 2026 – P2 Level Suspended Slab Waterproofing

- Repair damaged concrete on the topside and the underside of the P2 suspended slab.
- Install new traffic waterproofing base coat, top coat, and wear course, including crack treatment.
- Clean and repaint slab undersides at leakage staining locations.

Disadvantages/Risks:

- Greater risk of increase structural deterioration to the roof slab and associated costs.
- Greater risk of water damage to property.
- Increased inconvenience of two repair projects.

Opinion of Costs:
Option 2 Phase 1 (2024): $792,000
Option 2 Phase 2 (2026): $714,000

6.0 CLOSING

We expect this report meets your immediate needs. Should you have any questions or concerns regarding our report, or you wish that Sense Engineering attend an information meeting with the Strata, please feel free to contact us at the numbers below. Should you require our assistance with implementing the recommended repairs, we would be pleased to assist.

Yours truly,
Sense Engineering

Tyson Mou, DipIT.
Project Associate (604) 561-7769

Alana Frost, DipIT., LEED AP
Senior Project Manager (778) 552-1245

Permit to Practice No. 1002213

PROFESSIONAL ENGINEER PROVINCE OF B.C. B. VOLLERING

2023-12-06

Brennan Vollering, M.A.Sc., P.Eng., LEED AP
Project Principal (604) 365-3664

Attachments:
Appendix A – Opinion of Costs
Appendix B – Garage Plans
Appendix C – Concrete Chloride Testing Report
Appendix D – Roof Slab Inspection Pits
Appendix E – Limitations

The following are our opinion of costs for the remedial work described in this report. They are calculated using quantities obtained from the building drawings and information we have obtained from similar projects. As *Sense Engineering* has no control over contractor pricing, actual costs will vary depending upon the time of tender, schedule of work and conditions under which the work must be carried out. Final construction costs may vary as concealed conditions may differ from assumptions made at the time of our evaluation.

Sense Engineering has not investigated the presence of pollutants, contaminants and hazardous materials that may be encountered during the work. Depending on the materials present, additional funds may be required for remediation measures.

As every project has its own peculiarities, actual costs can only be established by obtaining bids, preferably on the basis of competitive tenders, from specialized contractors. The costs provided herein should only be used for comparison of options and general budgeting.

Due to the age of the building, remedial work requiring a building permit may trigger other unrelated building upgrades. Whether these upgrades will be required depends on the authority having jurisdiction and often varies case by case. Budgets for unrelated building upgrades are not included in our opinion of costs.

We have provided our opinion of cost for Engineering Services During Construction, which may include Project Management, Construction Review, and Contract Administration. Unless otherwise indicated, our fees would be charged on a weekly basis. The total budgeted fees are based on an estimated construction duration. The actual total Engineering fees during construction may vary, depending on the contractor's schedule.

All costs have been rounded up to the nearest $1,000, unless otherwise shown.

All costs are in today's dollars. To escalate the cost of future repairs, we have used an annual inflation rate of 3%. This number is highly variable and could fluctuate in any given year.

Option 1 - Single Phase Garage Repairs

Item No.	Description	Opinion Of Cost
1	**General**	
1.1	Access and Mobilization	$30,000
1.2	Site Protection	$10,000
1.3	Traffic Control	$20,000
2	**Concrete Repairs**	
2.1	Concrete Survey	$5,000
2.2	Loose Concrete Removal	$7,000
2.3	Soffit Repairs	$46,000
2.4	Surface Repairs	$13,000
2.5	Through-Slab Repairs	$27,000
2.6	Epoxy coating reinforcing steel (Allowance)	$2,000
2.7	Shoring (Allowance)	$10,000
3	**Suspended Slab Waterproofing**	
3.1	Remove/Reinstate Concrete Wheel Stop Curbs at Stalls (Allowance)	$5,000
3.2	Repair Cracks Less than 1.5mm Wide	$5,000
3.3	Repair Cracks Greater than 1.5mm Wide	$5,000
3.4	Traffic Coating	$542,000
3.5	Parking Stall Lines	$13,000
4	**Inject Leaking Roof Slab Cracks**	$6,000
5	**Entrance Ramp Waterproofing Upturn Repairs**	$24,000
6	**Install Carbon Monoxide Detectors**	$6,000
7	**Other**	
7.1	Miscellaneous Repairs (Allowance)	$20,000
7.2	Trade and Street Permits (Allowance)	$5,000
7.3	Bonding (May Be Deleted by Owner)	$19,000
	Construction Cost Sub-Total:	$942,000
8	**Building Permit**	$15,000
9	**Engineering**	
9.1	Half-Cell Testing	$5,000
9.2	Prepare Specifications and Drawings	$10,000
9.3	Tendering	$3,000
9.4	Building Permit Application Assistance (Allowance)	$3,000
9.5	Project Management, Construction Review, and Contract Administration	$58,000
9.6	Structural Repair Design During Construction (Allowance)	$5,000
9.7	Reimbursable Expenses	$2,000
10	**Other Soft Costs**	
10.1	Hazardous Materials Assessment	$3,000
11	**Engineering and Construction Contingency (15%)**	$157,000
	Sub-Total Including Soft Costs:	$1,203,000
12	**Taxes**	$61,000
	Option 1 Total:	$1,264,000

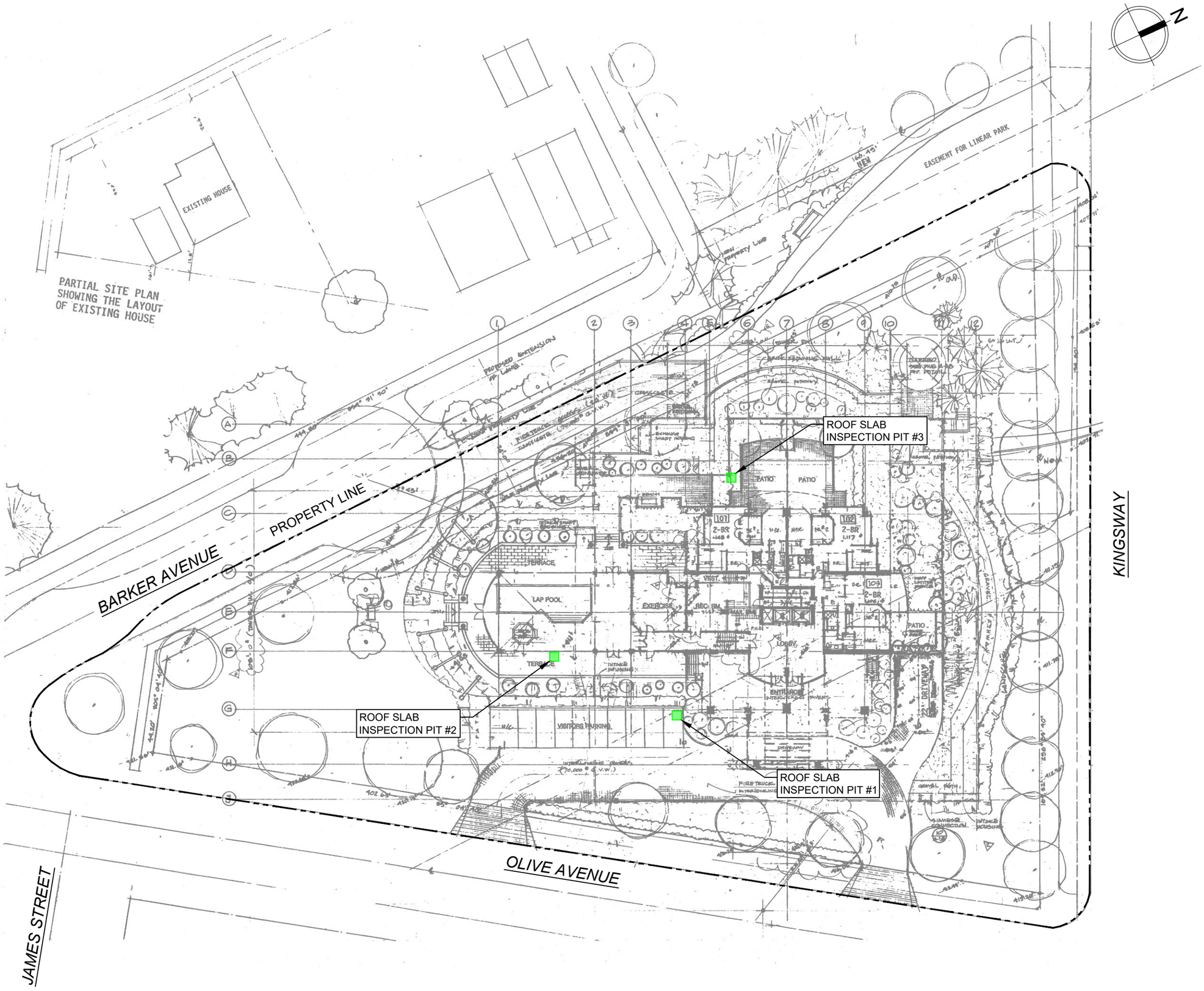
Option 2 - Phase 1 Garage Repairs

Item No.	Description	Opinion Of Cost
1	**General**	
1.1	Access and Mobilization	$18,000
1.2	Site Protection	$6,000
1.3	Traffic Control	$12,000
2	**Concrete Repairs**	
2.1	Concrete Survey	$5,000
2.2	Loose Concrete Removal	$7,000
2.3	Soffit Repairs	$23,000
2.4	Surface Repairs	$7,000
2.5	Through-Slab Repairs	$14,000
2.6	Epoxy Coating Reinforcing Steel (Allowance)	$1,000
2.7	Shoring (Allowance)	$5,000
3	**Suspended Slab Waterproofing**	
3.1	Remove/Reinstate Concrete Wheel Stop Curbs at Stalls (Allowance)	$2,500
3.2	Repair Cracks Less than 1.5mm Wide	$5,000
3.3	Repair Cracks Greater than 1.5mm Wide	$5,000
3.4	Traffic Coating	$271,000
3.5	Parking Stall Lines	$7,000
4	**Inject Leaking Roof Slab Cracks**	$6,000
5	**Entrance Ramp Waterproofing Upturn Repairs**	$24,000
6	**Install Carbon Monoxide Detectors**	$6,000
7	**Other**	
7.1	Miscellaneous Repairs (Allowance)	$15,000
7.2	Trade and Street Permits (Allowance)	$5,000
7.3	Bonding (May Be Deleted by Owner)	$12,000
	Construction Cost Sub-Total:	$578,500
8	**Building Permit**	$10,000
9	**Engineering**	
9.1	Half-Cell Testing	$5,000
9.2	Prepare Specifications and Drawings	$10,000
9.3	Tendering	$3,000
9.4	Building Permit Application Assistance (Allowance)	$3,000
9.5	Project Management, Construction Review, and Contract Administration	$35,000
9.6	Structural Repair Design During Construction (Allowance)	$5,000
9.7	Reimbursable Expenses	$2,000
10	**Other Soft Costs**	
10.1	Hazardous Materials Assessment	$3,000
11	**Engineering and Construction Contingency (15%)**	$99,000
	Sub-Total Including Soft Costs:	$753,500
12	**Taxes**	$38,000
	Option 2 - Phase 1 Total:	$792,000

Option 2 - Phase 2 Garage Repairs

Item No.	Description	Opinion Of Cost
1	**General**	
1.1	Access and Mobilization	$15,000
1.2	Site Protection	$5,000
1.3	Traffic Control	$10,000
2	**Concrete Repairs**	
2.1	Concrete Survey	$5,000
2.2	Loose Concrete Removal	$7,000
2.3	Soffit Repairs	$23,000
2.4	Surface Repairs	$7,000
2.5	Through-Slab Repairs	$14,000
2.6	Epoxy Coating Reinforcing Steel (Allowance)	$1,000
2.7	Shoring (Allowance)	$5,000
3	**Suspended Slab Waterproofing**	
3.1	Remove/Reinstate Concrete Wheel Stop Curbs at Stalls (Allowance)	$2,500
3.2	Repair Cracks Less than 1.5mm Wide	$5,000
3.3	Repair Cracks Greater than 1.5mm Wide	$5,000
3.4	Traffic Coating	$271,000
3.5	Parking Stall Lines	$7,000
4	**Other**	
4.1	Miscellaneous Repairs (Allowance)	$15,000
4.2	Trade and Street Permits (Allowance)	$5,000
4.3	Bonding (May Be Deleted by Owner)	$11,000
	Construction Cost Sub-Total:	$535,500
5	**Building Permit**	$9,000
6	**Engineering**	
6.1	Prepare Specifications and Drawings	$5,000
6.2	Tendering	$3,000
6.3	Building Permit Application Assistance (Allowance)	$3,000
6.4	Project Management, Construction Review, and Contract Administration	$29,000
6.5	Structural Repair Design During Construction (Allowance)	$5,000
6.6	Reimbursable Expenses	$1,000
7	**Engineering and Construction Contingency (15%)**	$89,000
	Sub-Total Including Soft Costs:	$679,500
8	**Taxes**	$34,000
	Option 2 - Phase 2 Total:	$714,000

APPENDIX B – GARAGE PLANS



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

ROOF SLAB OPENING

Permit to Practice No. 1002213

2023-12-06

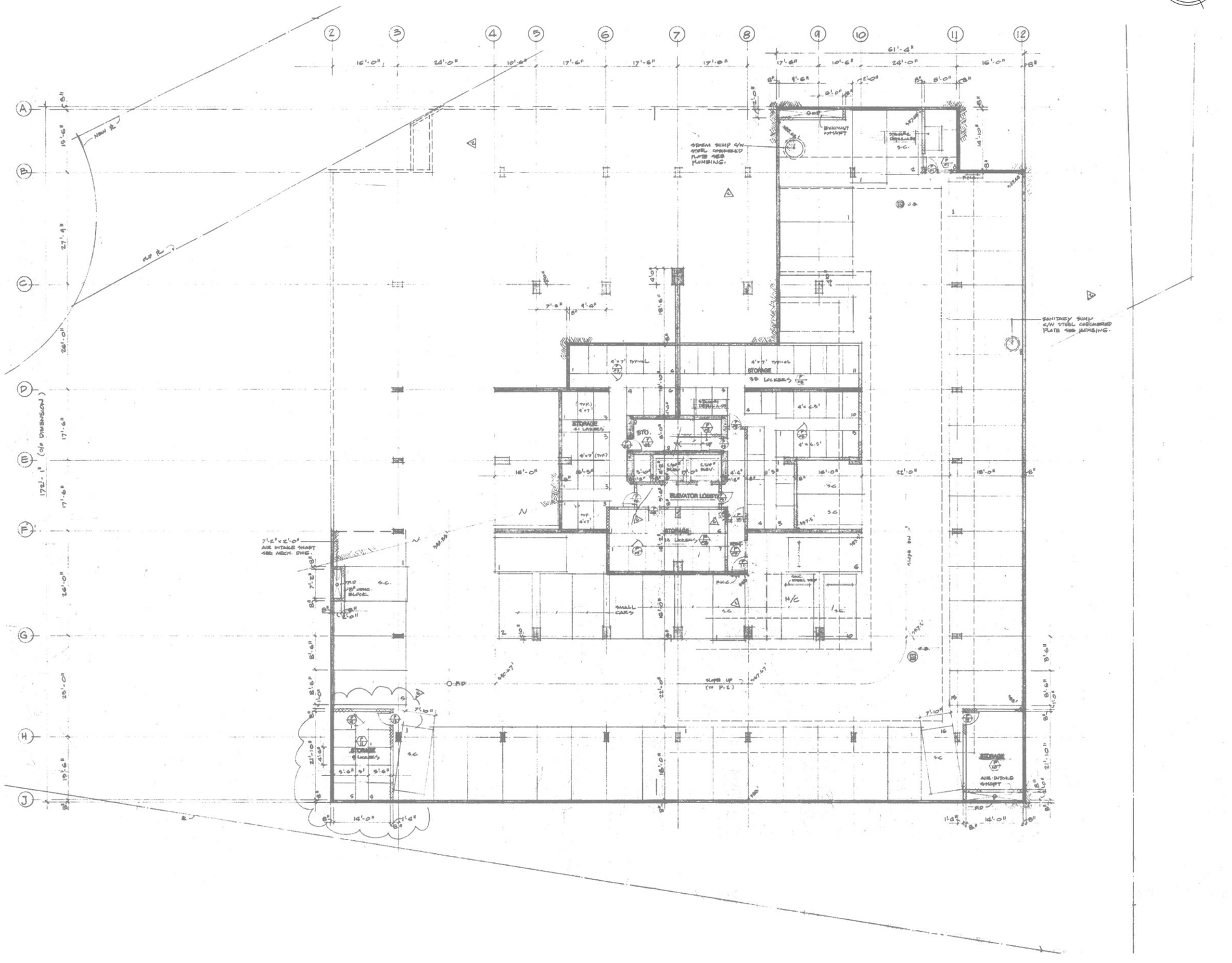
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN
GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
SITE PLAN

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:500	DRAWING NUMBER: A-1.01
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

DELAMINATION

CRACK

Permit to Practice No. 1002213

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA B. G. VOLLEMING

2023-12-06

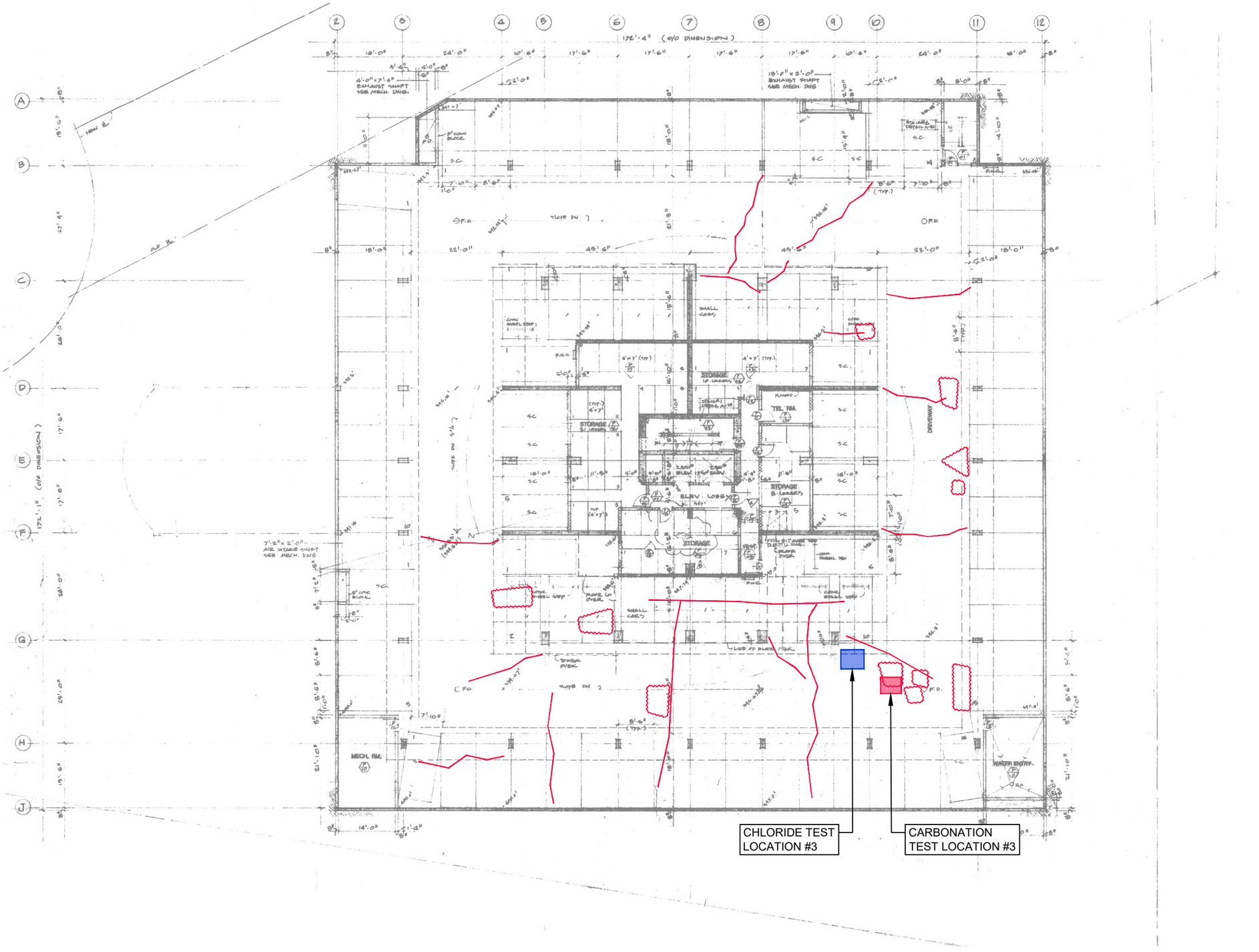
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 3 PLAN (TOPSIDE)

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:300	DRAWING NUMBER: A-1.02
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

- DELAMINATION
- CRACK
- CHLORIDE TESTING LOCATION
- CARBONATION TESTING LOCATION

Permit to Practice No. 1002213

2023-12-06

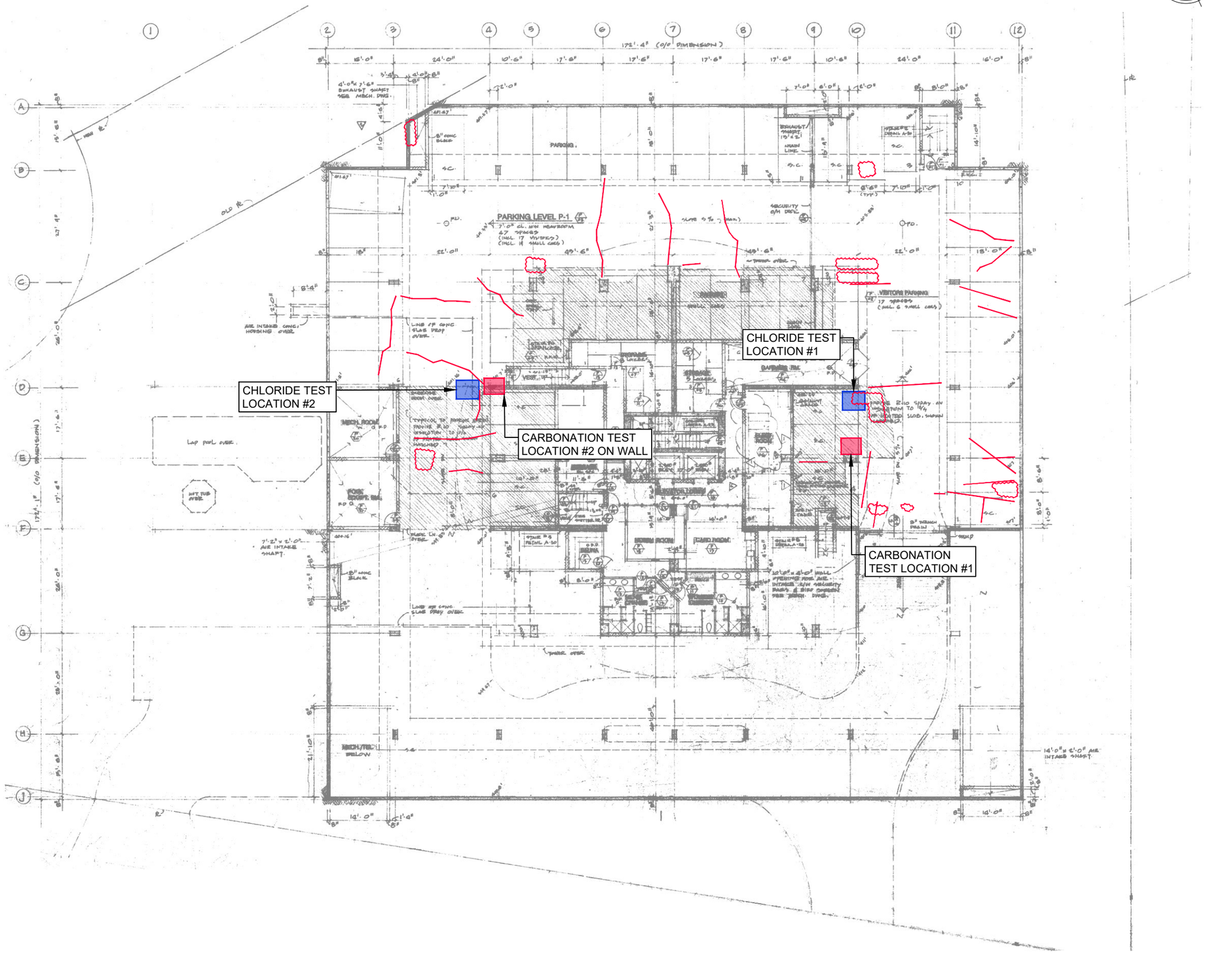
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 2 PLAN (TOPSIDE)

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:150	DRAWING NUMBER: A-1.03
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

- DELAMINATION
- CRACK
- CHLORIDE TESTING LOCATION
- CARBONATION TESTING LOCATION

Permit to Practice No. 1002213

2023-12-06

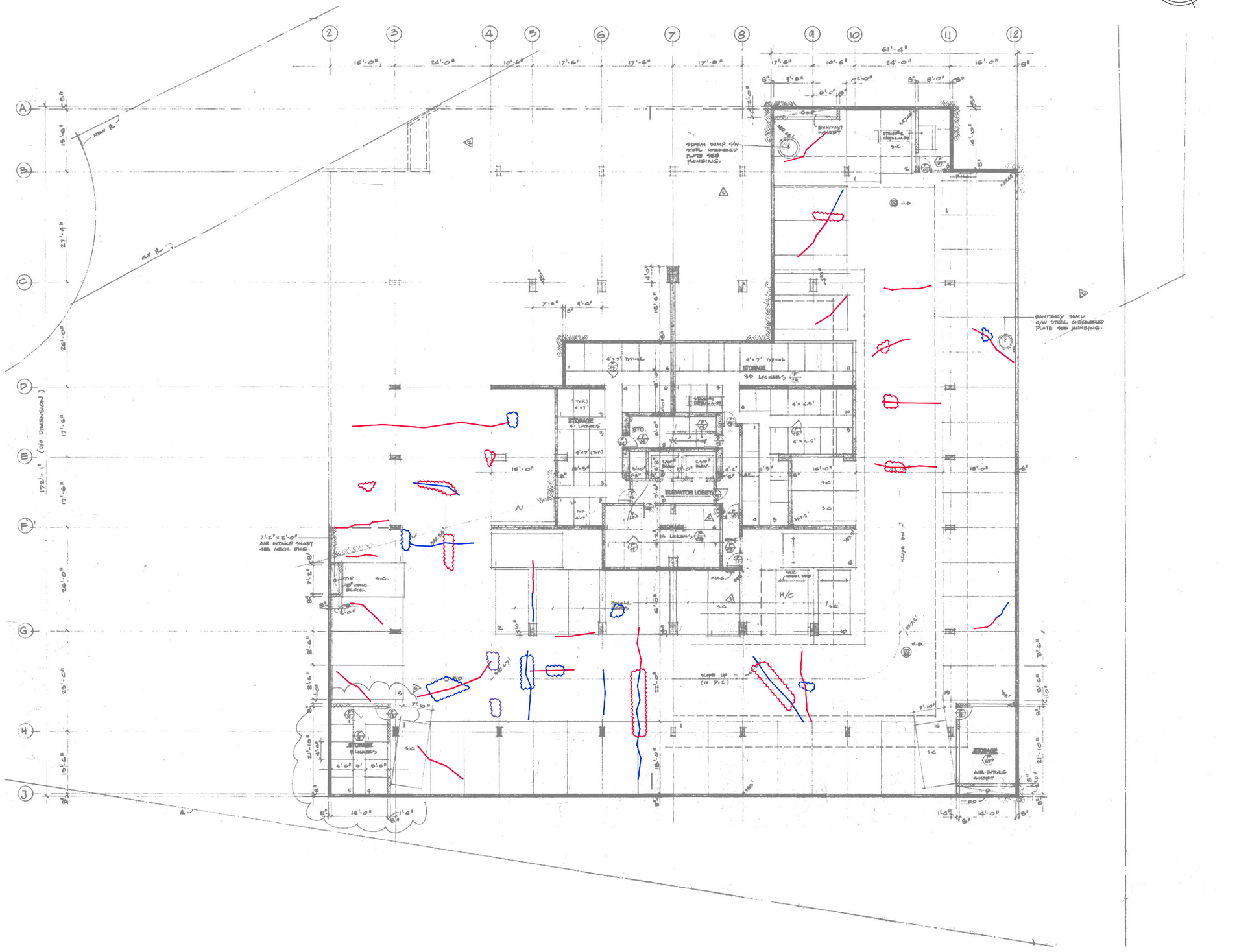
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 1 PLAN (TOPSIDE)

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:150	DRAWING NUMBER: A-1.04
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

- DELAMINATION
- SPALLING
- PREVIOUS REPAIR INJECTION WATERPROOFING
- POOR COMPACTION OF AGGREGATE
- CRACK
- CRACK WITH EVIDENCE OF LEAKAGE

Permit to Practice No. 1002213

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA B. G. VOLLERING

2023-12-06

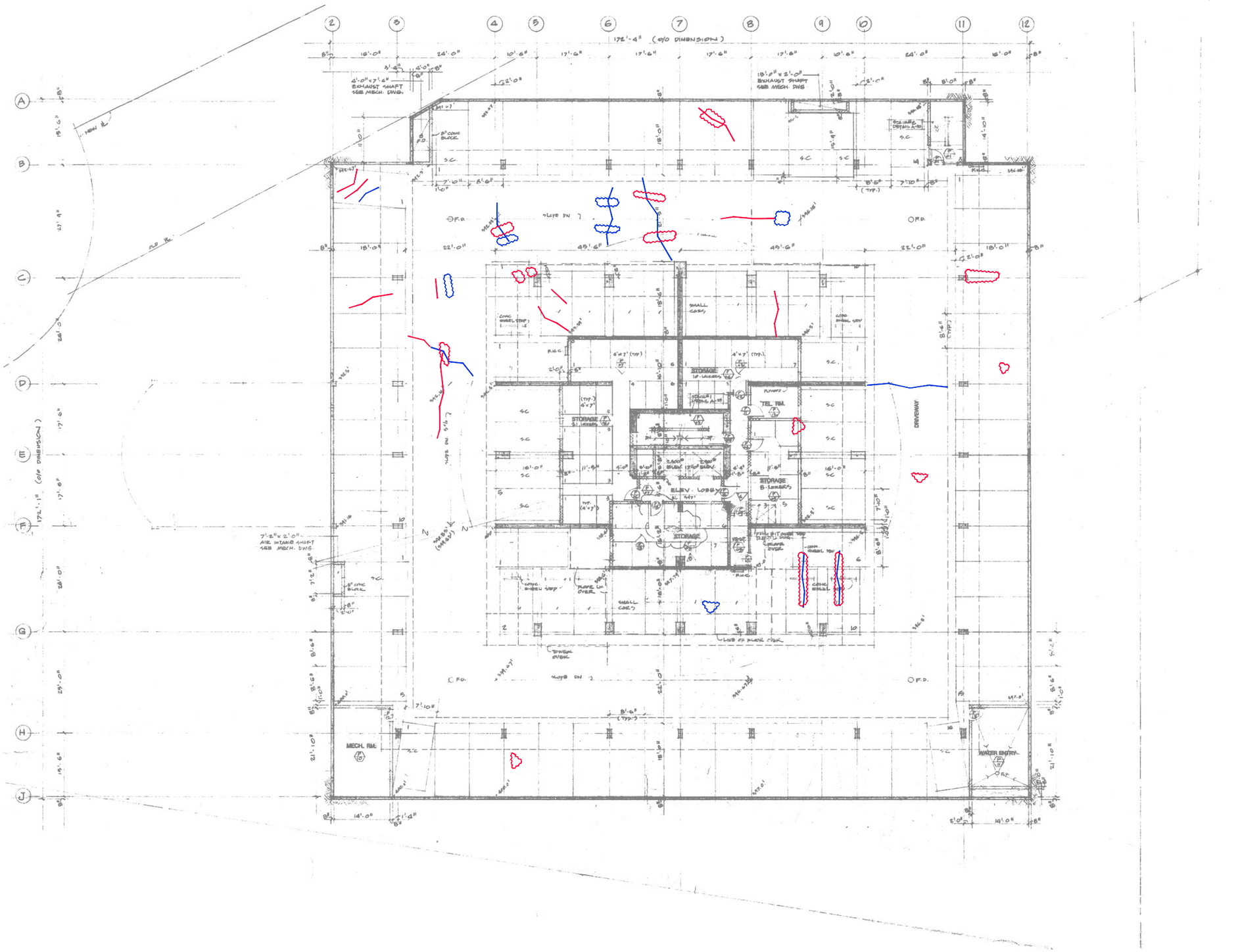
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 3 PLAN (TOPSIDE)

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:300	DRAWING NUMBER: A-1.05
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

- DELAMINATION
- SPALLING
- PREVIOUS REPAIR INJECTION WATERPROOFING
- POOR COMPACTION OF AGGREGATE
- CRACK
- CRACK WITH EVIDENCE OF LEAKAGE

Permit to Practice No. 1002213

2023-12-06

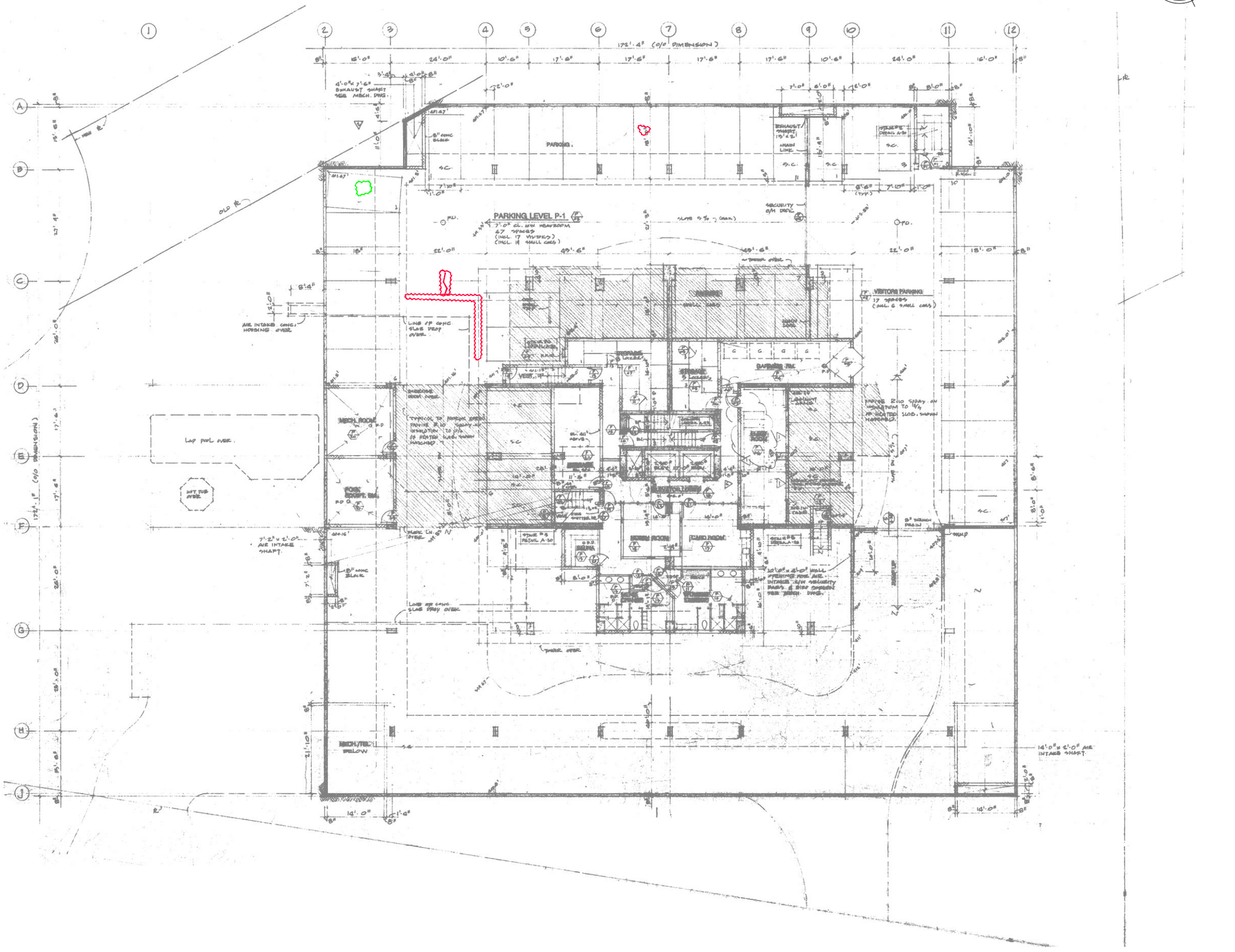
sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 2 PLAN (SOFFIT)

DRAWN BY: MJI	PROJECT NUMBER: 18R085L
CHECKED BY: BGV	
SCALE: 1:300	DRAWING NUMBER: A-1.06
DATE: 2023-12-01	



No.	REVISION/ISSUE	Date MM/DD/YY
1	ISSUED FOR DRAFT	09/08/23

LEGEND:

- DELAMINATION
- SPALLING
- PREVIOUS REPAIR INJECTION WATERPROOFING
- POOR COMPACTION OF AGGREGATE
- CRACK
- CRACK WITH EVIDENCE OF LEAKAGE

Permit to Practice No. 1002213

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

2023-12-06

sense engineering
104-788 COPPING STREET NORTH
VANCOUVER, BC V7M 3G6
www.senseengineering.com

PROJECT:
THE METROPOLITAN GARAGE EVALUATION

ADDRESS:
5885 OLIVE AVENUE, BURNABY

DRAWING TITLE:
PARKING LEVEL 1 PLAN (SOFFIT)

DRAWN BY:	PROJECT NUMBER:
MJI	18R085L
CHECKED BY: BGV	
SCALE: 1:300	DRAWING NUMBER: A-1.07
DATE: 2023-12-01	

APPENDIX C – CONCRETE CHLORIDE TESTING REPORT

401 6741 Cariboo Road, Burnaby BC V3N 4A3
Phone: 1-604-436-9111 or Toll Free: 1-877-436-9117 Email: info@metrotesting.ca

To: Sense Engineering
Unit 104, 788 Coping Street,
North Vancouver, BC V7M 3G6

Project #: MB44847
Date: 31 August 2023

Attention: Tyson Mou **Email:** tmou@senseengineering.com

Project: The Metropolitan - Garage Evaluation- 5885 Olive Avenue, BC
Re: Determination of water-soluble chloride ion content in concrete samples

Metro Testing and Engineering Ltd. (Metro) received 12 powdered concrete samples extracted at the above referenced site for water-soluble chloride ion content test. The Samples were sent to Caro Analytical for Chemical analysis.

This report summarizes the water-soluble chloride ion content test results obtained from these powder samples. Table 1 below summarizes the test results.

CSA A23.1-19, Section 4.1.1.2 "Limits on chloride ion content", Clause 4.1.1.2.1 states the following:

"The water-soluble chloride ion content by mass of the cementitious material in the concrete before exposure shall not exceed the following values for the indicated applications:

a) for prestressed concrete: 0.06%;
b) for reinforced concrete exposed to a moist environment or chlorides, or both: 0.15%; and
c) for reinforced concrete exposed to neither a moist environment nor the chlorides: 1.0%."

401 6741 Cariboo Road, Burnaby BC V3N 4A3
Phone: 1-604-436-9111 or Toll Free: 1-877-436-9117 Email: info@metrotesting.ca

Table1 - Water Soluble Chloride Content of hardened concrete

Sample No.	Depth Increment (mm - mm)	% Cl^- Content by Mass of Concrete	Estimated % Cl^- Content by Mass of Cementitious Materials
Location 1	5 mm - 25 mm	0.129	1.032
	25 mm - 45 mm	0.019	0.152
	45 mm - 65 mm	0.011	0.088
	65 mm - 85 mm	0.010	0.080
Location 2	5 mm - 25 mm	0.060	0.480
	25 mm - 45 mm	0.027	0.216
	45 mm - 65 mm	0.013	0.104
	65 mm - 85 mm	0.015	0.120
Location 3	5 mm - 25 mm	0.447	3.576
	25 mm - 45 mm	0.268	2.144
	45 mm - 65 mm	0.059	0.472
	65 mm - 85 mm	0.032	0.256

NOTE: The above results are based on an assumed concrete density of 2400 kg/m^3 and an assumed cementitious materials content of 300 kg/m^3. Therefore, the chloride ion content results by mass of cementitious materials are estimates only.

We trust this report meets your present requirements. Should you have any questions, please contact us.

Yours truly,
Metro Testing + Engineering Ltd.

M.K

Mona Kavianipour, M.A.Sc.
Materials Consultant

401 6741 Cariboo Road, Burnaby BC V3N 4A3
Phone: 1-604-436-9111 or Toll Free: 1-877-436-9117 Email: info@metrotesting.ca

Appendix

CERTIFICATE OF ANALYSIS

REPORTED TO	Metro Testing & Engineering (Burnaby) 401-6741 Cariboo Rd Burnaby, BC V3N 4A3		
ATTENTION	Mona Kavianipour	**WORK ORDER**	23H3496
PO NUMBER		**RECEIVED / TEMP**	2023-08-28 11:45 / 22.0°C
PROJECT	18R058L	**REPORTED**	2023-08-30 09:25
PROJECT INFO	The Metropolitan Garage Eval	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at TeamCaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO Metro Testing & Engineering (Burnaby)
PROJECT 18R058L

WORK ORDER 23H3496
REPORTED 2023-08-30 09:25

Analyte	Result	RL	Units	Analyzed	Qualifier
CHL Test Area #1 5mm-25mm (23H3496-01) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.129**	0.010	% dry	2023-08-29	
CHL Test Area #1 25mm-45mm (23H3496-02) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.019**	0.010	% dry	2023-08-29	
CHL Test Area #1 45mm-65mm (23H3496-03) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.011**	0.010	% dry	2023-08-29	
CHL Test Area #1 65mm-85mm (23H3496-04) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.010**	0.010	% dry	2023-08-29	
CHL Test Area #2 5mm-25mm (23H3496-05) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.060**	0.010	% dry	2023-08-29	
CHL Test Area #2 25mm-45mm (23H3496-06) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.027**	0.010	% dry	2023-08-29	
CHL Test Area #2 45mm-65mm (23H3496-07) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.013**	0.010	% dry	2023-08-29	
CHL Test Area #2 65mm-85mm (23H3496-08) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.015**	0.010	% dry	2023-08-29	
CHL Test Area #3 5mm-25mm (23H3496-09) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.447**	0.010	% dry	2023-08-29	

TEST RESULTS

REPORTED TO	Metro Testing & Engineering (Burnaby)	**WORK ORDER**	23H3496
PROJECT	18R058L	**REPORTED**	2023-08-30 09:25

Analyte	Result	RL	Units	Analyzed	Qualifier
CHL Test Area #3 25mm-45mm (23H3496-10) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.268**	0.010	% dry	2023-08-29	
CHL Test Area #3 45mm-65mm (23H3496-11) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.059**	0.010	% dry	2023-08-29	
CHL Test Area #3 65mm-85mm (23H3496-12) | Matrix: Solid | Sampled: 2023-08-03					
General Parameters					
Chloride, Water-Soluble	**0.032**	0.010	% dry	2023-08-29	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Metro Testing & Engineering (Burnaby)	**WORK ORDER**	23H3496
PROJECT	18R058L	**REPORTED**	2023-08-30 09:25

Analysis Description	Method Ref.	Technique	Accredited	Location
Chloride, Water-Soluble in Solid	CSA A23.2-4B	Hot Water Extraction / Potentiometric Titration		Richmond

Glossary of Terms:

RL	Reporting Limit (default)
% dry	Percent (dry weight basis)
CSA	Canadian Standards Association Chemical Test Methods

General Comments:

The results in this report apply to the received samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Caro will dispose of all samples within 30 days of sample receipt, unless otherwise agreed.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:TeamCaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Metro Testing & Engineering (Burnaby)	**WORK ORDER**	23H3496
PROJECT	18R058L	**REPORTED**	2023-08-30 09:25

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in “batches” and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B3H2959										
Blank (B3H2959-BLK1)				Prepared: 2023-08-28, Analyzed: 2023-08-29						
Chloride, Water-Soluble	< 0.010	0.010	% dry							
Duplicate (B3H2959-DUP1)			**Source: 23H3496-01**	Prepared: 2023-08-28, Analyzed: 2023-08-29						
Chloride, Water-Soluble	0.102	0.010	% dry		0.129			24	25	

Opening No.	Opening Type	Date of Opening	Weather
1	Inspection Pit	August 3, 2023	Sunny (25ºC)

Notes/Observations

Handicap visitor parking stall at the east side of the building. The assembly is as follows (top to bottom):

- 60 mm interlocking brick pavers;
- 65 mm bedding sand;
- Granulated modified bitumen protection sheet;
- ~175mils hot applied rubberized asphalt waterproofing; and
- Concrete slab.

The waterproofing is generally well bonded to the concrete slab and flexible. The concrete is dry below the waterproofing.

Photo 1: Opening location.

Photo 2: Close-up view of membrane sample.

Opening No.	Opening Type	Date of Opening	Weather
2	Inspection Pit	August 3, 2023	Sunny (25ºC)

Notes/Observations

East of the pool area, in the walkway. The assembly is as follows (top to bottom):

- 60 mm interlocking brick pavers;
- 130 mm bedding sand;
- Granulated modified bitumen protection sheet;
- ~175mils hot applied rubberized asphalt waterproofing; and
- Concrete slab.

The waterproofing is generally well bonded to the concrete slab and flexible. The concrete is dry below the waterproofing.

Photo 3: Opening location.

Photo 4: Close-up view membrane test cut.

Opening No.	Opening Type	Date of Opening	Weather
3	Inspection Pit	August 3, 2023	Sunny (25ºC)

Notes/Observations

West side of the building, in the gravel path next to the patio. The assembly is as follows (top to bottom):

- 100 mm gravel;
- 170 mm bedding sand;
- Filter fabric;
- 70 mm drain rock;
- Granulated modified bitumen protection sheet;
- ~175mils hot applied rubberized asphalt waterproofing; and
- Concrete slab.

The waterproofing is well bonded to the concrete slab and flexible. The concrete is wet below the waterproofing.

Photo 5: Opening location.

Photo 6: Close-up view of membrane sample.

- In issuing this report, *Sense Engineering* does not assume any of the duties or liabilities of the designers, builders or owners of the subject property. Owners, prospective purchasers, tenants or others who use or rely on the contents of this report do so with the understanding as to the limitations of the documents reviewed and understand that *Sense Engineering* cannot be held liable for damages which may be suffered with respect to the purchase, ownership, or use of the subject property.

- The scope of our work and responsibilities related to our work are defined in our project authorization ("Conditions of Assignment").

- Any user accepts that decisions made or actions taken based upon interpretation of our work are the responsibility of only the parties directly involved in the decisions or actions.

- No party other than the Client shall rely on the Consultant's work without the express written consent of the Consultant, and then only to the extent of the specific terms in that consent. Any use which a third party makes of this work, or any reliance on or decisions made based on it, is the responsibility of such third parties. Any third party user of this report specifically denies any right to any claims, whether in contract, tort and/or any other cause of action in law, against the Consultant (including Sub-Consultants, their officers, agents and employees). The work reflects the Consultant's best judgement in light of the information reviewed by them at the time of preparation. It is not a certification of compliance with past or present regulations. Unless otherwise agreed in writing by *Sense Engineering*, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity; it is written to be read in its entirety.

- Only the specific information identified has been reviewed. No physical or destructive testing and no design calculations have been performed unless specifically recorded. Conditions existing but not recorded were not apparent given the level of study undertaken. Only conditions actually seen during examination of representative samples can be said to have been appraised and comments on the balance of the conditions are assumptions based upon extrapolation. Therefore, this work does not eliminate uncertainty regarding the potential for existing or future costs, hazards or losses in connection with a property. We can perform further investigation on items of concern if so directed.

- The Consultant is not responsible for, or obligated to identify, mistakes or insufficiencies in the information obtained from the various sources, or to verify the accuracy of the information.

- No statements by *Sense Engineering* are given as or shall be interpreted as opinions for legal, environmental or health findings. *Sense Engineering* is not investigating or providing advice about pollutants, contaminants, hazardous materials or communicable diseases/viruses.

- The Client and other users of this report expressly deny any right to any claim against *Sense Engineering*, including claims arising from personal injury related to pollutants, contaminants or hazardous materials, including but not limited to asbestos, mould, mildew or other fungus.

- Budget figures are our opinion of a probable current dollar value of the work and are provided for approximate budget purposes only. Accurate figures can only be obtained by establishing a scope of work and receiving quotes from suitable contractors.

- Time frames given for undertaking work represent our opinion of when to budget for the work. Failure of the item, or the optimum repair/replacement process, may vary from our estimate.