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Our File: 119-4617
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Re: **Proposed Tank Replacement at
1005 West 59th Avenue (Firehall No. 22), Vancouver, BC
Geotechnical Recommendations**

1.0 INTRODUCTION

It is understood that the existing underground fuel storage tanks at the above-referenced site will be removed and replaced with a new, above-grade tank supported on a concrete pad. Horizon Engineering has been asked by AME Group to provide geotechnical recommendations for the project, as such, we have conducted a reconnaissance of the subject site and have reviewed architectural and structural design drawings for the existing firehall in order to assess the site and produce our recommendations, which are presented in this document.

2.0 REFERENCED DOCUMENTS

For the purpose of this letter, we have received and interpreted the following documents:

- Architectural Design Drawings, prepared by Henriquez & Partners Architects, dated March 5, 1981, and
- Structural Design Drawings, from Henriquez & Partners Architects, dated March 5, 1981.

3.0 BACKGROUND

As indicated on Map 1486A from the Geological Survey of Canada, the area in the vicinity of the subject site is expected to be underlain by Vashon Drift and Capilano Sediments. Specifically, typically up to 3 metres (10 feet) of Capilano Sediments comprising glaciomarine and marine stony to stoneless silt loam to clay loam would be expected to overlie Vashon Drift. This glacial drift would be expected to include lodgement and minor flow till, lenses and interbeds of substratified glaciofluvial sand to gravel, and lenses and interbeds of glaciolacustrine laminated stony silt.

Architectural drawings for the existing building indicate that two underground fuel storage tanks are located immediately to the north of the existing building. According to the drawings, the service access boxes associated with these buried tanks are located approximately 3.1 metres north of the north wall of the existing building. The dimensions of the two existing below grade tanks appear to be 1.2 x 2.5 metres and 1.2 x 3.5 metres in plan with both tanks located a minimum of 2.5



metres away from the building, according to the above-referenced architectural drawings; however, this has not been confirmed and the depths as well as the shapes of the tanks are not known.

After conversations between our office and the Mechanical Engineer, it is understood that the existing tanks are to be removed and the resultant void will be backfilled in order to support the new above-grade tank. The new tank is noted to have dimensions 48 x 96 x 85 inches (1.2 x 2.4 x 2.2 metres) and will be placed on a concrete pad in the backfilled area. Assuming the tank is filled with diesel fuel, the weight of the filled tank is expected to be approximately 60 kN.

4.0 OBSERVATIONS

We attended the subject site on September 9, 2019 to review the location of the proposed replacement storage tank with respect to the existing building and to assess any potential hazards with regards to the proposed excavation. At the time of our review, it was observed that the existing tanks are located beneath a concrete pad approximately 3.5 metres wide by 8.0 metres long, which extends adjacent to the northern exterior wall of the existing building.

The exterior walls of the existing building consist of Concrete Masonry Units with a brick facade. A cursory review of the exterior walls in the vicinity of the tanks has shown that they are in generally good condition, with minor vertical cracks in the expansion joint filler observable along the west wall.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Excavation

As mentioned in Section 2.0 above, the depth of the existing below grade storage tanks is not known; therefore, the extent of the excavation required to remove the existing tanks is yet to be determined.

Excavation slopes may be expected to move and should be monitored for movement by site personnel on an ongoing basis. Any deterioration in conditions should be reported to Horizon Engineering immediately. In general, excavations above the water table should be carried out with a slope gradient no steeper than 1.0 Vertical to 1.0 Horizontal. The crest of this excavation should not extend within 1 metre of the existing structure or below a line falling from 1.0 Vertical : 2.0 Horizontal from the foundations of the existing structure, as conceptually shown on the following figure. If the excavation extends beyond the aforementioned line, the excavation should not proceed until recommendations for detailed excavation are provided on-site by Horizon Engineering during construction. Any excavation with a depth in excess of 1.2 metres (4 feet) requiring worker access should be reviewed by the Geotechnical Engineer per WorkSafeBC requirements.

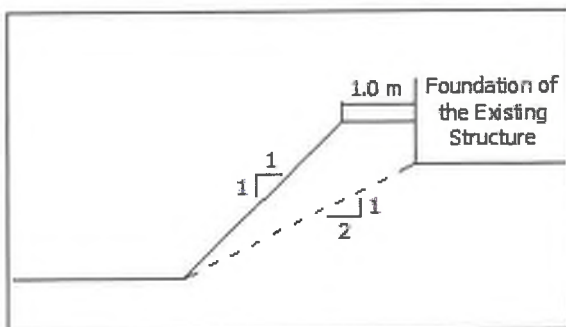


Figure 1: Excavation Schematic



After the removal of the existing concrete slab and below grade storage tanks takes place, the excavation base should be stripped of any loose, softened, disturbed, or otherwise deleterious materials to expose a natural, undisturbed subgrade prior to backfilling the excavation with Engineered Fill (refer to Section 4.2). Horizon Engineering should be provided with an opportunity to review the excavation in order to confirm the anticipated subgrade materials prior to backfilling.

If encountered, over-excavation requirements for the removal of contaminated materials will be determined by others. Horizon Engineering should be notified if over-excavation is required.

If the proposed excavation will exceed a depth equal to its horizontal distance away from the edge of the existing building foundation, the excavation will be at risk of undermining the existing building foundation. In this case, the structural engineer should determine whether the existing strip footing structure is able to 'bridge' the subject excavation width. If the structure is found to be unable to bridge the span of the excavation, underpinning of the building foundation may be required. If required, design drawings for underpinning can be provided under a separate cover upon request.

5.2 *Engineered Fill*

Within the context of this report, Engineered Fill should consist of select, clean, well-graded granular material with less than 5% fines content and 100% passing a 150 mm sieve. Engineered Fill should be placed in suitable lifts (generally 0.3 metre / 1 foot loose thickness or less) and compacted to the equivalent of at least 95% of its Maximum Dry Density determined in accordance with ASTM D1557 (Modified Proctor). Nuclear density testing should be carried out to ensure the compaction criteria are achieved and these test results should be forwarded to Horizon for review.

It should be noted that even fill materials compacted to the strictest criteria should be expected to experience post-construction settlement in the order of 1% of the total fill thickness. Therefore, if the footprint of the Engineered Fill is not the same as the footprint of the pad, differential performance should be expected.

Any imported fill proposed for use at the site should have associated documentation verifying that it is free of contaminants. This documentation should be provided to the environmental consultant for approval before the material is brought to the site.

5.3 *Pad Foundation*

As previously discussed in Section 2.0, it is understood that the proposed replacement tank will be placed on a concrete pad. For a foundation bearing on a subgrade of Engineered Fill as described above, we recommend that the pad be designed on the basis of a Serviceability Limit States (SLS) bearing capacity of 120 kPa (2,500 psf). Factored Ultimate Limit States (ULS) bearing capacity used for short term, transient loading conditions such as those induced by wind and earthquake can be taken to be 1.5 times the recommended SLS bearing capacity.

It is recommended that foundations be placed at least 0.45 metre below exterior grades for frost protection.



6.0 CLOSURE

We trust that the above is sufficient for your current requirements. Should you have any questions, or require additional information, please do not hesitate to contact us.

For
HORIZON ENGINEERING INC

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Geotechnical Engineer

For
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25 Sept 19