SCHEDULE

TERMS OF EASEMENT

1. GRANT The Corporation of the City of Brantford, as Transferor, hereby grants unto the Transferee, and its successors and assigns, a perpetual easement, for the purpose of access maintenance on, over, upon, along, across, and through the lands described as:

   Part of Lot A, East of Sydenham Street, Plan of the City of Brantford, dated September 7, 1892, being more particularly described as Part 1 on 2R-8106; Brantford City;
   Being part of the PIN 32160-0224 (LT) ("Easement Lands")

   together with the free and unencumbered right of entry and access for the Transferee, its servants, contractors, workmen and agents with or without vehicles, supplies and equipment which is necessary for, appropriate for or incidental to the purposes of this easement.

2. DOMINANT LANDS The Easement Lands constitute the servient lands for the benefit of the dominant lands identified as:

   Part Lot A, E/S Sydenham Street, Plan City of Brantford, September 7th, 1892, As in A304350; Brantford City;
   Being all of the PIN 32160-0222 (LT) ("Dominant Lands")

3. ACKNOWLEDGEMENT RE: CONCRETE CAP The Transferee acknowledges that the Easement Lands are subject to Risk Mitigation Measures as set out in Appendix J of "Final Report Risk Assessment, 17 Sydenham Street, Brantford, Ontario", a copy of which has been provided to the Transferee and is hereby incorporated by reference. ("Report"). Prior to the granting of this Easement, the Easement Lands were excavated, graded, and filled with a base of clean fill, compacted and re-graded. A concrete cap was then installed on the Easement Lands to a minimum of three inches thickness, meeting general requirements for anticipated cap applications at this site according to the Report. This prior work, completed to address the requirements of the Report, are hereinafter referred to as the Works.

4. MAINTENANCE & REPAIR OF CONCRETE CAP The Transferee shall maintain the Works installed on the Easement Lands, and repair the Works as may be needed from time to time, all at his own cost.

5. PROTECTION OF CONCRETE CAP The Transferee shall ensure that use of the Easement Lands by the Transferee, and its guests, invitees, agents, and other third parties entering on the Easement Lands, do not damage the Works; and in the event of any damage occurring to the Works from the Transferee's failure to ensure no damage occurs, the Transferee will defend, compensate, indemnify and save harmless the Transferor for all such damages.

6. NO ADDITIONAL WORKS The Transferee further covenants and agrees that no building or other structure may be erected or built on the Easement Lands and that the Easement Lands will remain unencumbered in perpetuity by any such building or other structure. This clause shall not prohibit the use of the Easement Lands for driveways, parking, vehicular access and manoeuvring.

7. RUN WITH LANDS The burden of this grant of easement is and shall be of the same force and effect for all intents and purposes as a covenant running with the lands described herein.

The Transferee acknowledges that the easement reserved herein constitutes a municipal public utility easement within the meaning of Section 91 of the *Municipal Act, 2001,* S.O. 2001, c.25.

FINAL Report

Risk Assessment 17 Sydenham Street, Brantford, Ontario

Prepared for

The Corporation of the City of Brantford

March 11, 2016

CH2MHILL®

72 Victoria Street South, Suite 300
Kitchener, ON N2G 4Y9

Appendix J
Risk Management Plan Engineering Report

Certification

This report was prepared under the direction of a professional engineer registered in the Province of Ontario. It is intended solely for the use of the individual, company, government, or other entity for which it was prepared, and for the purposes and within the limitations stated in the report.

Meggen Janes, M.Sc., PMP, P.Eng.
Senior Technical Consultant, CH2M HILL Canada Limited

Wayne Cooley, B.A.Sc., P.Eng.
Senior Technical Consultant, CH2M HILL Canada Limited

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APPENDIX J
Risk Management Measures

This engineering report presents the conceptual design of the risk management measures (RMMs) required to prevent direct exposure to impacted soils and to address the potential for intrusion of vapours generated through volatilization. The main categories of engineered RMMs required for the risk assessment (RA) Property include the following:

- Physical barriers (hard caps and fill caps) to eliminate or manage risk associated with direct exposure of human and ecological receptors to impacted soil that will remain on the RA Property.
- Vapour intrusion (VI) controls to eliminate or manage risks associated with human exposure via the potential migration of contaminants into the indoor air of new buildings (where a soil vapour survey does not indicate soil vapour indicator levels are met). See Section 7.2.1 in Section 7 of the main text).

The following sections present details on the conceptual design required to implement these RMMs given the various anticipated uses (that is, residential/parkland) at the RA Property. RMMs must be followed across all areas of the RA Property including new construction, interim construction, areas with no development, and areas with existing development. At a minimum, some form of RMM must be in place across all areas of the RA Property. In areas with no construction, the impacted soil must be covered by unimpacted fill to prevent human and ecological exposure. In areas with new construction, the presence of buildings is expected to prevent direct human and ecological exposure to the soils; however, based on the conclusions of the current RA, vapour migration may need to be controlled.

J.1 Physical Barriers

Contact with impacted soils currently present at the RA Property will result in risks to human and ecological receptors. The fundamental approach to preventing contact with contaminated soils is to institute physical barriers between both human and ecological receptors and the underlying impacted soils. The type of physical barriers that will be required at the RA Property depends on their compatibility with the redevelopment plans. Physical barriers can involve one or more of the following broader categories:

- Hard caps (including building envelopes)
- Fill caps

Specific site and building design has not been finalized at this stage of the project; consequently, conservative conceptual designs for physical barrier systems have been developed. These conceptual, performance-based physical barrier specifications provide a basis of design for likely building scenarios. The following sections present conceptual designs for physical barrier types. The architects and designers will refine the conceptual designs during preparation of site and building-specific plans.

The building(s) itself will provide an effective barrier for contact with soil by humans. In areas outside the building footprint(s), hard and fill caps are used to prevent direct contact between both human and ecological receptors and the impacted soil. In general, the caps discussed herein are not intended to limit or prevent surface water infiltration to mitigate leaching of contaminants from shallow unsaturated soils. Instead, the caps serve as barriers to direct human or ecological contact. Infiltration of surface water was not identified as requiring risk management.

The suitability and thickness of caps depend on the contaminant source and concentration, planned use of the area, and amount of infiltration required to achieve the desired stormwater drainage. Fill caps, also referred to as soil caps throughout this document, must be thicker than hard caps as they are susceptible to erosion and desiccation, prone to penetration by digging animals, and may support plant growth which may facilitate contaminant translocation from depth.

Both hard and fill caps can be used on the same RA Property, and the choice of hard cap or fill cap is dictated by the long-term use of the RA Property. A summary of the general requirements for anticipated cap applications at the RA Property has been included in Section 7 as Table 7-4.

J.1.1 Hard Caps

Common hard cap barrier materials include asphalt, concrete, paving stones and bedding granular, compacted granular, cobbles, armour stone, rubberized surfaces, and other materials that are resistant to erosion and burrowing animals. The thickness of the barrier depends on the physical characteristics of the material selected, such as resistance to mechanical damage, vandalism, weathering, cracking, or other effects that will result in exposure of the underlying contaminated soils. Minimum barrier thickness is 225 millimetres (mm) including the surface material (hard barrier) and unimpacted fill (fill barrier) required for construction. It is likely that unimpacted fill will serve as a structural base material and structural or geotechnical considerations will determine the type of unimpacted fill and the installed thickness (which may be greater than 225 mm).

Hard caps can be used for building footprints, walkways, parking areas, driveways, and other purposes on the RA Property provided additional administrative measures, such as Health and Safety Plans (HSPs) are implemented to prevent exposure to those who may have to work beneath the cap (for example, Construction/Utility Workers). Details on the application and specifications for fill caps can be found in the next section.

Surface barrier material should be designed and constructed such that it can resist cracking or formation of potholes. Cracks should be easily repairable with material compatible and consistent with the original barrier material and with non-destructive repair methods. It is expected that some minor cracking will occur, as is typical of hard surface treatments such as asphalt and concrete. Provided the surface material is not entirely compromised, the underlying structural base layer will provide additional isolation from the underlying impacted soils until repairs are required. The barrier material should be stable and resistant to frost heave, settlement, or other wear that would necessitate frequent repair.

Figure J-1 illustrates a typical profile of a hard cap application.

J.1.2 Fill Caps

In areas where there are potential risks to terrestrial plants, soil invertebrates, birds, and small mammals, and the land use requires unconsolidated material for vegetation growth, a fill cap should be used. As shown in Figures J-2 and J-3, fill cap thickness varies depending upon use, whether it will support vegetation, and if so, the type of plants to be grown in a specific area. Fill caps in City of Brantford (City) parks or condominium developments will be maintained regularly as part of general site maintenance activities. As a result, fill cap thickness is set at a 500-mm minimum, with greater thicknesses required depending on vegetation cover. Fill caps in free-hold residential areas may not be as well-maintained by homeowners, and may be penetrated at depths greater than 1,000 mm by the installation of fenceposts, deckposts, play structures, and so on. Consequently, the fill cap thickness for free-hold residential areas is set at 1,500 mm, regardless of vegetation cover.

Unimpacted fill is defined as soil that meets the Fill Cap Target Concentrations developed as part of this RA in accordance with Ontario Regulation (O. Reg.) 153/04 (as amended) and summarized in Table 7-3 of Section 7 of this RA. It includes loose, granular material from an Ontario Ministry of Natural Resources (MNR)-licensed quarry or other non-soil material or commercial products such as compost, bark chips, concrete, unshrinkable fill, crushed concrete, or concrete-based materials. Soil located on the RA Property may be used as unimpacted fill on the RA Property provided it meets the fill cap target concentrations (Table 7-3) developed as part of this RA. Soil located off the RA Property considered for importation to the RA Property as unimpacted fill must meet Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for residential/parkland use (MOE, 2011b). The fill materials used for the vegetated caps will need to be reviewed and deemed suitable by a Qualified Person for Environmental Site Assessments (QP_{ESA}), and potentially by a Landscape Architect to confirm they will be able to support plant growth.

A warning layer such as marking tape or lightweight geotextile should be placed on top of the site soil (impacted or not impacted) to identify the potential hazard to workers during excavation. The marker should be a made of a non-degradable material and placed continuously across the capped area or in strips at intervals no more than 1 m apart so it would be intercepted in a typical excavation or in the event that erosion reduces the cap thickness. The marker layer is only required if the cap is less than 1 m thick. Where the existing grade is to be maintained, impacted soils also can be excavated and cap material placed up to the original grade before excavation to achieve the necessary cap thickness. Existing site soil that is not impacted can remain in place as part of the Fill Cap or be reused elsewhere on the site as part of the Fill Cap.

The following materials are defined as Unimpacted Fill and can be placed on existing impacted soils as fill cap material where appropriate:

- Soil, such as topsoil or general earth fill, that meets the Fill Cap Target Concentrations
- Granular materials, such as: Granular A, Granular B, and crushed stone from a virgin source (that is, a commercial sand and gravel pit or quarry licensed by MNR)
- Structural fill materials, such as: grout, lean-mix concrete, and bentonite
- Inert non-soil materials, such as: crushed concrete that has been deemed suitable by a QP, as necessary
- Commercial landscaping products such as compost, bark chips, fertilizer, or other such products
- Stockpiled materials (for example, from other areas on the property) that meet Fill Cap Target Concentrations
- Material that meets specifications for aggregates, base, sub-base, and backfill materials, and also meets the Fill Cap Target Concentrations unless from a virgin source (that is, a commercial sand and gravel pit or quarry)

When Unimpacted Fill is a blend of materials, professional judgement should be used regarding whether the blended material or only the soil component is analyzed for comparison to Fill Cap Target Concentrations.

The thickness of the cap depends on the area use and type of vegetation (considering the rooting depth) that is proposed to be planted in the area. Table J-1 outlines a typical example of required fill cap thicknesses based on plant type. Typical profiles for fill cap applications are illustrated in Figure J-2 and J-3.

TABLE J-1
Example Requirements for Fill Cap Thickness in City Parks and Condominium Residential Properties
17 Sydenham Street, Brantford, Ontario

Vegetation Type [a]	Fill Cap Thickness (Minimum) [b]	Figure
Manicured lawn/grass [c] – sports fields, trails	500 mm	J-2, Detail 1
Shrubs and wildflowers [c]	1,000 mm	J-2, Detail 2
New Trees [d]	1,000 to 1,500 mm	J-3, Detail 1
Existing Trees [d]	100 mm to drip line and 225 – 1,500 mm beyond (depending on the application)	J-3, Detail 2

Notes:
mm – millimetre
MOE – Ontario Ministry of the Environment
a. Examples of vegetation type including but not limited to manicured lawn/grass, shrubs and wildflowers/perennials and urban naturalized parklands.
b. Soil cap thickness requirements can be achieved by confirming presence of existing unimpacted fill over existing impacted soil, by placing additional unimpacted fill to make up thickness or by excavating impacted soil to the desired cap thickness and backfilling with unimpacted fill to the existing elevation. Minimum fill cap barrier thickness is 500 mm for City parks and condominium residential developments, or 1,500 mm for free-hold residential properties. Fill cap barriers less than 1,000 mm thick will be underlain by a marking tape or lightweight geotextile material, as outlined by the MOE (2011a) for the shallow cap risk management measure. Once the development plans are established, a QPESA should confirm that the hard and fill cap thicknesses, and in particular the shallow soil cap thicknesses, are appropriate for the intended future use. If there is uncertainty regarding the long term vegetation cover (shrubs and perennials versus lawn/grass), then the more conservative barrier thickness should be selected.
c. Fill cap barrier thickness may be increased by a landscape architect to reflect the specific types of vegetation (that is, rooting depths) to be planted on a site-specific and/or area-specific basis.
d. New trees will only be planted in areas containing a minimum soil cap thickness of 1,000 mm to 1,500 mm. For existing trees that will not be removed, a 100-mm protective layer will be installed over the impacted soil to prevent human and ecological exposure. Refer to Section J.1.3 for further details.

The minimum fill cap thicknesses required for other scenarios are specified in the following subsections.

J.1.3 Fill Caps around Trees

Within the RA Property, new trees expected are within landscaped areas.

For existing trees that will not be removed, a 100-mm protective barrier will be installed over the impacted soil to prevent human and ecological exposure. Existing soils are not to be disturbed, as depicted in Detail 2 of Figure J-3. This protective barrier must consist of permeable materials/products such as~~(for example,~~ river stone, pavers, grates (including~~,~~ a synthetic geonet [with cover][1]), or ~~all three~~a combination thereof~~)~~ to facilitate the passage of precipitation and air to the tree roots. The barrier will extend over the root zone outwards to the drip line of the tree. Fill cap thickness requirements beyond the drip line of the tree will be dictated by the end use of that area (for example, 225 mm for hard caps, 500 mm for manicured lawn/grass, 1,000 mm for shrubs and wildflowers, or 1,000 mm to 1,500 mm for new trees).

For areas that include new trees, a minimum 1,000-mm to 1,500-mm fill cap (fill barrier and protective layer) is required to address the risk of dermal contact, support tree growth, and adequately isolate roots from impacted subgrade as depicted in Detail 1 of Figure J-3. The fill materials must meet the Fill Cap Target Concentrations, be able to support plant growth, and be deemed suitable by a Qualified Person and Landscape Architect. Consistent with the use of the drip line for existing trees, the lateral extent of the 1,000-mm to 1,500-mm (minimum) fill cap barrier for newly planted trees should extend, at a minimum, to the expected width of the tree canopy at maturity. In areas where hardscaping will be installed around trees, permeable pavers or grates may be used to promote free passage of precipitation and air.

[1] A bi-axle, high density polyethylene (HDPE) or polypropylene (PP) geonet material may be placed at the base of a crushed rock or mulch layer to act as a deterrent barrier to human or animal digging, while the crushed rock or mulch layer acts as a visual indicator in locations where existing trees will remain in place. The bi-axle geonet would need to be adequately anchored to secure the material in place.

J.1.4 Utility Corridors

Any new utilities or subsurface infrastructure that is excavated for installation must be excavated and backfilled with the appropriate material for structural purposes from the material defined within the Unimpacted Fill.

Where new utilities in areas of impacted soil are connected to Corporation of the City of Brantford (City) utilities, low permeability barriers should be installed across the trench cross-section to prevent migration of contaminants in the permeable backfill material along the buried piping, cable, or duct banks. These barriers should consist of compacted clay or bentonite, or other low-permeability material such as concrete or unshrinkable fill. Clay seals should be compacted at appropriate moisture contents and extend for a minimum of 750 mm along the utility trench and across its full width. The plug should extend to the base of the overlying cap barrier. Utilities installed within the fill cap or above the high groundwater level that are less than 1 m deep, or are directionally drilled, do not require plugs.

Existing and new utility locations must be identified within the health and safety plan (HSP) and communicated to workers who may be affected. It is assumed that any subsurface work required on existing utility corridors within the RA Property will require an HSP.

J.1.5 Other Subsurface or Excavation Works

Refer to Section 7.2.4 of the RA for information regarding site-specific HSPs and other related requirements for protecting workers from exposure to impacted soil and groundwater associated with the RA Property during other subsurface or excavation works.

J.1.6 Equivalency

Cap or barrier materials can be replaced by any other cap or barrier materials that meet the Fill Cap Target Concentrations, or that is clean material from a virgin source (that is, from a sand and gravel pit or MNR-licensed quarry). In addition, the barrier must meet the dimensional requirements for separation from the existing impacted soils specified in Section J.1.

J.2 Vapour Intrusion Mitigation

As discussed in Section 7.2.1 of the RA, the results of the VI modelling (Section 4) using estimated maximum soil and groundwater concentrations predicted indoor air inhalation risks at levels exceeding the MOE acceptable target levels for generic residential buildings (that is, buildings that are 1,225 cm by 1,225 cm, with basements, with an enclosed space height of 366 cm) and a potential storage shed (that is, a slab-on-grade structure that is 305 cm by 366 cm, with an enclosed space height of 244 cm). The locations where buildings may be constructed on the RA Property have not yet been confirmed; nor have the design plans for the buildings to be constructed at the RA Property. Therefore, CH2M HILL cannot currently determine whether the buildings that will be constructed at the RA Property will correspond to the assumptions applied in the modelling completed in this RA. Additionally, remedial activities are currently planned for the site (CH2M HILL, 2012 and 2014) which will reduce the concentrations of volatile contaminants; this work could have implications for the completeness of VI pathway across the Site. The implications of the remedial work on the potential completeness of the VI pathway require further review once the remedial plans and remedial targets are confirmed. Until data demonstrating that the indoor air exposure pathway is not complete for a building planned for construction, or that the pathway does not present an unacceptable risk are available, a vapour mitigation system will be needed for all enclosed buildings. There are currently no buildings on the RA Property, so onsite VI mitigation is not required until the RA Property is redeveloped.

Specific building designs have not been finalized at this stage of the project; consequently, conservative conceptual designs for vapour mitigation systems have been developed. These conceptual performance-based vapour mitigation specifications provide a basis of design for likely building scenarios. The conceptual designs incorporate three key elements: 1) passive subslab/submembrane venting systems, 2) vapour-proof barriers, and 3) sealing of foundations and penetrations. Conceptual designs for these three key RMM types are presented in the following sections. The conceptual designs will be refined by the site developers, architects, and designers during preparation of building-specific plans.

The following sections describe the basis of design for the primary components of the VI mitigation (VI RMMs for the various building types). Based on the type of building and whether groundwater in contact with the foundation, different elements of the primary mitigation components will be required as part of the final design. These conceptual designs can be used in new buildings, as described in Section 7 of this RA.

J.2.1 Venting Layer Conceptual Design

The primary RMM to be applied to new buildings will be the construction of a venting layer. The venting layer is not required for parking garages, should parking garages be constructed below the occupied portion of the building as could occur with a condominium development. The venting layer is also not required for unoccupied buildings with slab on-grade construction and no vertical, belowgrade foundation walls (like a storage shed). The venting layer will act as a pressure relief, collection, and venting system that will dilute soil vapours in contact with the foundation, in addition to collecting and venting those vapours away from the structure. The conceptual design for passive venting is illustrated in cross-section and plan views in Figures J-4 and J-5, respectively. The plan view orientation illustrates a general layout of the pressure relief, collection, and venting components. Final orientation will depend on the size and footprint of the building. Venting component orientation should account for structural elements, including footings, piles, piers, foundation drainage systems, building envelope components, utility and site servicing infrastructure, and any other aspects of site redevelopment that may affect the passive venting of soil vapour to atmosphere.

The venting systems will operate in a passive manner, providing pressure relief, collection, and venting of soil vapours that may be present under the building foundation. Soil vapour is collected and conveyed away from the building footprint and vented to the atmosphere primarily as a result of diffusion or pressure-induced gas flow. The operation of the system has the effect of diluting the vapour concentrations in contact with the foundation.

The venting system will be connected to vent risers that exit to the exterior building as illustrated in Figure J-6 for new buildings. The vent risers will be a minimum of 100 mm in diameter, and are typically constructed of Schedule 40 (minimum) polyvinyl chloride (PVC). The discharge end of the vent risers will be completed with a pipe return bend and insect screen. Alternatively, the outlet can be outfitted with a rotary wind turbine, which will serve to impart a slight passive vacuum to the venting system when wind driven operation occurs.

Vent risers should be brought to the structure roofline or an appropriate height to avoid outdoor receptor exposure to venting vapours. Vent riser outlets should be located at least:

- 0.9 m above the roof-line
- 0.9 m away from any parapet
- 1.2 m away from any property line
- 1.5 m away from any electrical device
- 3.0 m above grade
- 3.0 m away from any windows, doors, roof hatch, opening or air intake into the building
- Or all of the above

Additionally, vent risers should be oriented around the foundation perimeter to avoid vapour discharge being drawn into building ventilation systems. An Environmental Compliance Approval (ECA), as required under Section 9 of the Ontario *Environmental Protection Act* may be required for emissions that exceed the applicable criteria set out in O. Reg. 419/05.

For new construction, the venting layer should be composed of a system of perforated collection piping within a coarse-grained layer comprised of coarse sand, pea gravel, clear crushed stone, or a geosynthetic three-dimensional (3D) vent core product that provides equivalent venting performance over the design life of the building. The collection pipes shall be a minimum 100-mm diameter, and are typically constructed of

Schedule 40 (minimum) PVC. Pipe joints shall be threaded or rubber-gasket bell and spigot, but, not solvent welded.

The venting layer components must be sufficiently permeable to allow unimpeded flow of soil vapour. Pipe perforations shall be holes (13 mm maximum diameter) or slotted, providing a minimum open area of 5,000 square millimeters per linear m (mm^2/linear m). Horizontal separation of the collection pipes will be determined at the time of Site-specific building design based on the system capacity, properties of the bedding/cover material, and soil conditions underneath the building.

Both during construction and in the long term, the permeability of the venting components must not be reduced by fine-grained material, building materials, concrete, or water entering the layer components, and geotextile filter fabric may need to be incorporated into the building-specific barrier system design to achieve this requirement. A non-woven geotextile layer will be installed under and over the venting system components before construction. The venting layer can also function as a monitoring layer, with soil vapour monitoring ports integrated into each of the vent risers. The monitoring ports will allow subslab/ submembrane vapour samples to be collected to monitor actual vapour concentrations in contact with the foundation and evaluate the performance of the venting system using the soil vapour monitoring approach shown in Table 7-8 and described in Section 7.4.1 of this RA.

The components of the passive venting system should be constructed such that the system may be made active if VI RMM monitoring (outlined in Table 7-8) indicates that the VI RMM is not effective in a passive configuration. An active venting system, or subslab depressurization (SSD) system, works in the same conceptual manner as a passive system. However, vapour collection and venting from beneath the slab is enhanced through the use of fans or blowers that increase air exchange volumes. The size and number of fans or blowers that may be needed if a system is converted to an active system will depend on the size and configuration of the structure, and will be specified once the building design has been finalized. Piping for the passive venting system is to be installed such that purchase and installation of the fan or blower can be completed, if required, based on the findings of the Baseline Performance Assessment. Venting layer depressurization systems typically should be capable of creating a vacuum on the order of 4 Pascals (Pa) or greater to overcome barometric pressure fluctuations. Because new construction should be able to readily integrate sufficiently permeable subslab bedding materials and an engineered venting system, active depressurization using low-pressure/high-flow active venting equipment can achieve sufficient air volume exchange to achieve the necessary depressurization vacuum.

J.2.2 Vapour-proof Barrier Conceptual Design

Background/Criteria

Water in its liquid form is easier to block than water vapour. Not all materials that are waterproof are vapour-proof; but vapour-proof membranes are inherently waterproof. Some organizations, consultants, and contractors differentiate between vapour retarders and vapour-proof barriers.

The ability of a material to retard the diffusion of water vapour is measured by units known as “perms”. Permeance is defined in ASTM International (ASTM) D1079 (Standard Terminology Relating to Roofing, Waterproofing, and Bituminous Materials) as the rate of moisture vapour per unit area at a steady state through a membrane or assembly, expressed in nanogram per second per square metre per pascal ng/Pa.s.m^2 (grains/ft^2.hr.in.Hg) or unit of perms. It is defined in terms of the weight of water per hour moving through a one square metre (m^2) (square foot) membrane at a given saturation pressure. In other words, it is the rate that water vapour moves through a membrane given a specific set of conditions.

There are numerous ASTM methods for determining permeance. Typical ones used for vapour retarders and vapour-proof barriers are ASTM E96/E96M-10 (Standard Test Methods for Water Vapour Transmission of Materials) which is specifically designed for single ply sheets of materials such as high-density polyethylene (HDPE), low-density polyethylene (LDPE), PVC, and other membranes.

Permeance is distinct from permeability. The moisture or water vapour transmission rate of a material is referred to as its “permeability”, typically stated in perm-inches; this number does not depend on the material’s thickness. Its “permeance”, on the other hand, depends on thickness, much like the R-value in heat transmission. The permeability of a material divided by its thickness produces the material’s permeance in perms. Permeance should be used to compare various membrane products with regard to their moisture or water vapour transmission resistance. The lower the permeance, the less moisture or water vapour will come through the membrane.

Any material with a perm rating of less than or equal to 1.0 is commonly considered a vapour retarder. A true vapour-proof barrier would have a perm rating of 0.0; however, for practical purposes, the membrane industry often considers any material with a perm rating of 0.1 perms, and sometimes 0.01 perms for specific applications that are extremely sensitive to vapour transmission, to be a vapour-proof barrier.

The American Concrete Institute (ACI) defines a vapour retarder as having a permeance of less than 0.3 perms, as determined by ASTM E96. Further, they indicate that any material proposed for use as a vapour retarder or barrier be in compliance with ASTM E1745-09 (Standard Specification for Plastic Water Vapour Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs) and have a thickness of not less than 10 mils (0.25 mm).

ASTM E1745-09 defines three performance classifications (Class “A”, “B”, and “C”) depending upon building requirements and installation demands. The minimum requirements under Class “A” serve to qualify/specify a resilient and effective underslab retarder/barrier for highly demanding installations and performance expectations. Class “B” and “C” rated products are intended for less demanding applications requiring less strength and puncture resistance. At a minimum, underslab gas barriers (including any vapour-proof barrier used for the VI RMMs proposed herein) should meet or exceed the following Class “A” permeance, strength and puncture requirements as vapour retarders/barriers per ASTM E1745-09 (also see ASTM E2121-12; Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings):

- Permeance of 0.1 or less (as determined by ASTM E96 and ASTM E154);
- Tensile strength of 7.9 kilonewton per metre (kN/m) (45 lbf/in) or better (as determined by ASTM E154); and
- Puncture resistance of 2,200 grams (g) (5 lbs) or better (as determined by ASTM D1079).

ASTM E1745-09 does not specify a minimum material thickness. However, it is recommended that any vapour-proof barrier used for the VI RMMs proposed herein should have a minimum thickness of 15 mils (0.38 mm) to protect against tears and punctures, and meet or exceed the Class “A” permeance, strength, and puncture requirements as vapour retarders/barriers per ASTM E1745. It is also recommended that the vapour-proof barrier have a permeance rating of 0.01 perms or less, which is lower than that specified in ASTM E1745, in order to provide an additional level of protection appropriate to the intended (residential) use of the building which is inherently sensitive to VI.

The actual vapour-proof barrier material/product selected for use as a VI RMM should meet the above-noted recommended requirements for permeance, strength, puncture resistance, and thickness, with the building designer also considering selecting a material/product that will exceed these minimum requirements (criteria) on the basis of protective needs (during all phases of installation/construction) and will reflect the soil gas vapour sensitivity of the material and its application. Although no specific criteria exists, the building designer should also consider whether or not the proposed vapour-proof barrier will provide adequate protection; that is, a ‘low enough’ transmission rate or diffusion co-efficient for the contaminants of concern (COCs). For a given material, increased thickness above the specified minimum will typically offer increased resistance to vapour transmission while providing greater durability during and after installation.

Conceptual Design

A vapour-proof barrier will be installed over the venting layer specified in Section J.2.1. An overlying sand or suitably graded crushed stone layer will also be required to prevent damage to the venting/barrier system components, in particular the immediately underlying vapour-proof membrane. The barrier should be a sealed, continuous geomembrane, such as a minimum 40-mil (1.02 mm) thickness HDPE liner, with seamed and welded joints as applicable to the material used. Alternatively, the barrier can consist of a cold-spray, fluid-applied, vapour-proof barrier material that will bond directly to a suitable geotextile, or to a new concrete surface. At a minimum, the underslab gas barrier (vapour-proof barrier used for the VI RMMs proposed herein) should meet or exceed the above-referenced Class “A” permeance, strength, and puncture requirements as vapour retarders/barriers per ASTM- E1745-09, and have a minimum thickness of 15 mils (0.38 mm) and permeance rating of 0.01 perms or less. The vapour barrier will need to be chemically resistant to the specific COCs at the RA Property.

Thinner polyethylene and polyolefin vapour barriers may satisfy the permeance, strength, and puncture resistance criteria previously indicated; however, they have some limitations, mainly that they may not be chemically resistant, and the available sealing tape (or mastic) and lapping (300 mm at minimum) procedures make them difficult to seal at perimeter walls and around pipe/utility penetrations. These thinner sheet products will often pull back from their attachment points during subsequent placement of fill, concrete pour, or both; as well as during the curing process, leaving significant gaps for VI.

Building designers must carefully check that the geomembrane ultimately selected for use is appropriate for its intended application, will satisfy the minimum requirements (criteria) specified above (that is, for permeance, strength, puncture resistance, and thickness); be chemically resistant; and not be subject to any of the aforementioned limitations.

Figure J-6 conceptually illustrates the installation of a vapour-proof barrier below a foundation slab as part of new construction. If a spray-applied membrane is installed, an appropriate base geotextile should be placed on the surface prior to application of the cold-spray, vapour-proof barrier material. Additionally, a protective coating should be applied over the cold-spray, vapour-proof barrier after application to provide durability and avoid damage during slab construction.

J.2.3 Sealing

For all new structures with foundations extending beneath the water table, waterproof and vapour-proof sealing of the interior of the foundation slab is a critical component of the VI RMM. Foundation joints or cracks may be sealed with a spray-on, vapour-proof-barrier material; urethane-based caulking; or expanding foam, depending on the need and application. Foundation penetrations, such as utility runs, floor drains, joints between slabs, or structural cracks in the foundation, will require sealing. The size and nature of the penetration or crack will dictate the sealing material and approach selected. As illustrated in Figure J-7, utility and pipe penetrations will be sealed using fusion-or-solvent welded geomembrane boots in the case of HDPE type liners, or sealing tape (or mastic) and lapping procedures for the thinner polyethylene and polyolefin vapour barriers.

J.2.4 Anticipated Construction Scenarios

Anticipated construction scenarios for the RA Property will employ combinations of sealing and newly installed passive venting layers and vapour-proof barriers. Specifics are discussed in this section.

J.2.4.1 New Building Construction – Occupied or Consisting of Vertical, Belowgrade Foundation Walls

For newly constructed buildings (other than parking garages) with slab-on-grade construction or basements above the water table that are to be occupied or constructed with vertical, belowgrade foundation walls, a passive subslab venting layer, as described in Section J.2.1 and illustrated in Figures J-4 and J-5 will be required. A vapour-proof barrier will be installed over the venting layer as described in Section J.2.2. Additionally, the foundations and all penetrations will be sealed as described in Section J.2.3. This conceptual design for this scenario is depicted in Detail 1 of Figure J-6.

For newly constructed buildings (other than parking garages) with basements below the water table, the VI RMM will include a passive venting layer above the sealed (waterproof) slab and below an additional vapour-proof barrier and the finished concrete flooring. This passive submembrane venting system is conceptually illustrated in Detail 2 of Figure J-6.

Also illustrated in this conceptual design drawing is additional peripheral venting that addresses soil vapours in the unsaturated zone adjacent to the building's foundation walls. For these systems, foundations will be sealed through the installation of a waterproof vapour barrier beneath the foundation before they are constructed, and penetrations will be sealed using the methods described in Section J.2.3 and illustrated in Figure J-7.

Sumps may be required for new building construction; these will require sealing. The venting system may require connection to a sump(s) for drainage purposes, and if so, the venting pipe itself and its inlet wall penetration must be sealed as indicated on Figure J-8. A vapour-proof, sealed shroud (cover) needs to be installed over the sump opening with vapour-proof seals around any piping or conduits that must enter or exit the sump. The sump should be vented to the outside, above the roofline, and may require active depressurization. However, if the foundation bottom is below groundwater, the sump will only be able to be vented because no air flow can be induced from the saturated sump if a vacuum is applied. All groundwater within sumps requires handling and treatment, as specified in the Groundwater Control Management discussion in Section 7.2.4 of this RA.

If contingency VI RMMs are required at new buildings per Section 7 of this RA, then active venting of these systems can be initiated (subslab depressurization for unsaturated conditions and submembrane depressurization for saturated conditions). The size and number of fans and blowers required to achieve the necessary depressurization such that monitoring results indicate that the system is operating effectively, will depend on the size and configuration of the structure and its intended occupancy.

J.2.4.2 New Building Construction – Unoccupied Slab-on-grade and No Vertical, Belowgrade Foundation Walls (Like a Storage Shed)

For an unoccupied slab-on-grade structure that does not contain any vertical, belowgrade foundation walls (like a storage shed), a vapour-proof barrier will be installed under the slab, as described in Section J.2.2. All penetrations will also be sealed as described in Section J.2.3. This conceptual design for this scenario is depicted in Figure J-10.

Structures meeting this definition cannot be used for other purposes (that is, cannot be occupied) unless they are upgraded to include a passive venting layer, as described in Section J.2.1.

J.2.4.3 Parking Garages

An unoccupied parking garage (either above-grade or below-grade) beneath a structure that is constructed to meet the requirements of the Ontario Building Code (OBC) will be considered an RMM. For parking garages, the primary requirement of the RMM will be to assure that the foundation is both waterproof and vapour proof. Figure J-9 illustrates a conceptual design of this VI RMM. The following supplements or exceptions to the OBC will be necessary for all unoccupied parking garages on the RA Property where a parking garage is a RMM:

- The installed barrier will be designed to be impermeable to soil vapours, and must be tested to demonstrate that no measurable air leakage will occur at a differential air pressure of 75 Pa.

If contingency VI RMMs are required at parking garages, per Section 7 of this RA, a continuous supply of outdoor air should be added to the parking garage space (if enclosed) at a rate of not less than 3.9 litres per second (L/s) for each m^2 of floor area. This supply of outdoor air must be operated 24 hours per day, 365 days per year.

Parking garages cannot be used for purposes other than parking, unless they are upgraded to include a passive venting layer, as described in Section J.2.1.

J.2.4.4 Temporary Structures

The RA Property's future use as a City park may involve the placement of temporary structures (that is, raised tents and pedestal-mounted trailers) within the RA Property for short-term special events (that is, less than 12 months in duration). The current Ontario Building Code (OBC) (2012 version) recognizes "temporary structures;" however, it does not explicitly define them. Previously, under Building Code Commission (BCC) ruling 96-29-512 (June 12, 1996), Section 3.1.6.2, Application, indicated "Temporary Structure" meant a building or structure intended to be erected and used for a period of not more than 12 months. However, Section 3.1.6 has since been superseded in the current OBC, and any reference or use of this definition was abandoned. The OBC no longer contains a clear definition for "Temporary Structure," and does not adopt or use definitions or durations previously used or defined by other codes. In the absence of a definition for "Temporary Structure" in the current OBC, the definition of "Temporary Structure" applied herein is from the BCC ruling 96-29-512 (June 12, 1996), and notes these structures would be used for a period of not more than 12 months.

All temporary structures on the RA Property will include one of the following components:

1) Hard cap surfaces that are sealed, along with a subslab venting RMM
2) Granular fill, soil meeting the Fill Cap Target Concentrations in Table 7-3 in Section 7, or unimpacted fill along with a vapour barrier and subslab venting RMM

Figure J-11 provides conceptual details for the subslab venting in a temporary tent structure, and shows a typical tent wall section and raised floor concept. A subslab venting system is designed by a professional engineer. It operates passively but can be converted into an active system if necessary, providing pressure relief by collecting soil vapours that are present under the foundation, and venting them away from a building footprint to the atmosphere, as described in the RA. The passive subslab venting for a temporary structure is accomplished through a raised floor for the tent structures, or through the trailer floor – effectively, the foundation, below which is an air space that is partially or fully enclosed along the perimeter of the tent or trailer footprint with side-skirting. Louvers installed in the side-skirting provide passive ventilation through the air space, which provides the characteristics of subslab venting. If necessary, the system can be converted to an active one by setting fans in the air space to provide pressure relief, and to collect and vent soil vapours from between the ground and the raised floor.

For ground-level tents, impermeable barriers, combined with high volumes of outside air intrusion (that is, ventilation) that are typical during the spring and summer weather in which tents are expected to be used, are effective temporary VI RMMs. These measures mitigate VI on a temporary basis by controlling flux of soil vapours and providing sufficient ventilation to be effective during short-term occupancies. The approach is similar to an at-grade parking garage scenario and therefore, is considered to be appropriately protective of occupants during temporary use of these structures.

J.2.5 Equivalency

Design concepts presented are conceptual. Other building-specific designs that meet the intent of the designs presented herein and achieve equivalent objectives, as determined by an appropriately skilled and qualified individual (as in a Professional Engineer registered in the Province of Ontario), can be used.

J.2.6 Quality Assurance/Quality Control Plan

In addition to specifying the adequate membrane thickness, strength requirements, puncture resistance, and permeance for the vapour-proof barrier with respect to its intended application, a Quality Assurance/ Quality Control (QA/QC) plan for the installation of the vapour barrier should be established to mitigate the potential for defects that may arise from improper installation as well as damage to the membrane that may arise during installation, subsequent concrete pours, and general construction activities. Protocols for addressing installation defects and membrane damage should also be developed and included in the QA/QC plans and installation/construction specifications, where appropriate. The QA/QC plans and specifications should include such activities as thorough inspection of liner seals along all edges and at penetrations, detailed examination for liner holes and tears, observations during subsequent concrete pouring or soil/granular filling, and detailed procedures for testing the efficacy of the vapour-proof barrier upon its installation and after the slab is placed (for example, pressure tests, smoke tests, post-construction indoor air tests). Where damage or defects are identified, appropriate repairs should be undertaken and the associated inspection/testing procedures repeated to verify that the repair was completed in a satisfactory manner. The QA/QC plan and installation/construction specifications must be developed once site-specific project requirements are known. The manufacture of the membrane typically has a quality assurance manual that specifies installation procedures.

J.2.7 Summary

The conceptual engineered systems for managing exposure risk associated with impacted soils and groundwater within the RA Property will require additional detailed design elements as specific uses and designs for roadways, boulevards, buried utilities, and new buildings are developed. The conceptual designs presented herein have considered constructability issues, as well as long-term issues, and should be readily applicable to detailed designs for any planned redevelopment.

J.3 Key References

ASTM International (ASTM). 2009. *ASTM E1745 - 09 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.*

ASTM International (ASTM). 2010a. *E96 – 10 Standard Test Methods for water Vapour Transmission of Materials.*

ASTM International (ASTM). 2010b. *D1079 – 10 Standard Terminology Relating to Roofing and Waterproofing.*

ASTM International (ASTM). 2012. *E2121-12 - Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings.*

ASTM International (ASTM). 2013. *E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.*

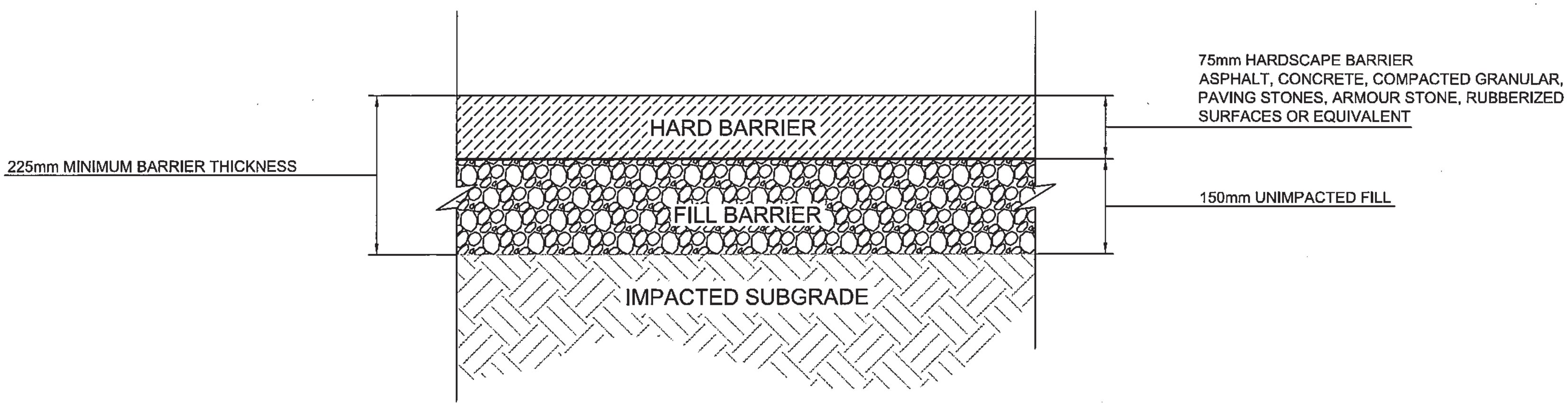
CH2M HILL Canada Limited (CH2M HILL). 2012. *Final Report, Remedial Options Feasibility Study, 17 Sydenham Street, Brantford, ON*. Prepared for the Corporation of the City of Brantford. October.

CH2M HILL Canada Limited (CH2M HILL). 2014. *Draft Addendum, Remedial Options Feasibility Study, 17 Sydenham Street, Brantford, ON*. Prepared for the Corporation of the City of Brantford. In progress.

Ontario Ministry of the Environment (MOE). 2011a. *Modified Generic Risk Assessment Model. Excel Spreadsheet*, revised April 15, 2011, effective July 1, 2011.

Ontario Ministry of the Environment (MOE). 2011b. Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. April 15.

January 23, 2015



1 TYPICAL HARD CAP BARRIER

NTS

NOTES:
1. FINAL HARD CAP DESIGN REQUIREMENTS SHOULD BE DETERMINED BY A GEOTECHNICAL ENGINEER WITH LAYERS EQUALING OR EXCEEDING THE MINIMUM REQUIREMENTS SHOWN ON THIS DRAWING.
2. UNIMPACTED FILL AS DEFINED IN SECTION J.1.2 OF APPENDIX J.
3. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-1

Conceptual Design of Typical Hard Cap Barrier

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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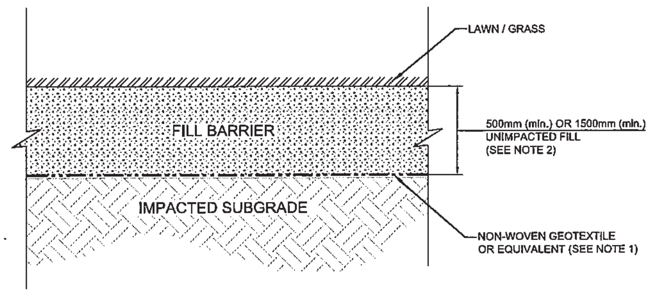

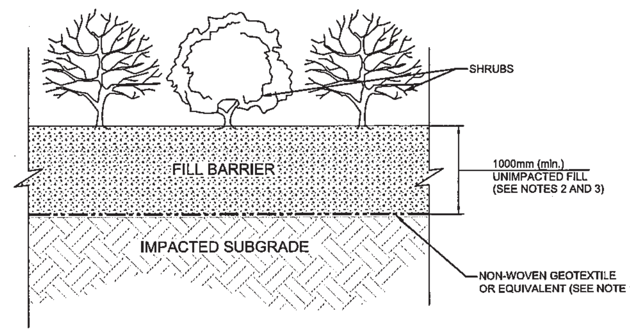

(1) TYPICAL FILL CAP BARRIER - LAWN / GRASS COVER

NTS

NOTES:

1. MARKER LAYER OR GEOTEXTILE IS REQUIRED AT INTERFACE WITH EXISTING SUBGRADE IF TOTAL BARRIER THICKNESS IS LESS THAN 1m.
2. UNIMPACTED FILL AS DEFINED IN SECTION J.1.2 OF APPENDIX J. THE MINIMUM THICKNESS OF UNIMPACTED FILL FOR CITY PARKS AND CONDOMINIUM RESIDENTIAL PROPERTIES IS 500mm. THE MINIMUM THICKNESS OF UNIMPACTED FILL FOR FREE-HOLD RESIDENTIAL PROPERTIES IS 1500mm.
3. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

(2) TYPICAL FILL CAP BARRIER - SHRUBS AND PERENNIAL PLANTINGS

NTS

NOTES:

1. MARKER LAYER OR GEOTEXTILE IS REQUIRED AT INTERFACE WITH EXISTING SUBGRADE IF TOTAL BARRIER THICKNESS IS LESS THAN 1m.
2. UNIMPACTED FILL AS DEFINED IN SECTION J.1.2 OF APPENDIX J.
3. FILL BARRIER THICKNESS MAY BE ADJUSTED BY A LANDSCAPE ARCHITECT TO REFLECT THE SPECIFIC TYPES OF VEGETATION (i.e., ROOTING DEPTHS) TO BE PLANTED ON A SITE-SPECIFIC AND/OR AREA-SPECIFIC BASIS.
4. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

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FIGURE J-2
Conceptual Design of Typical Fill Cap Barrier
Vegetation Protective Cover

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

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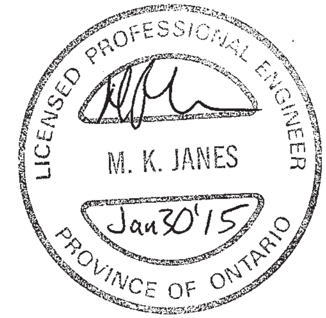
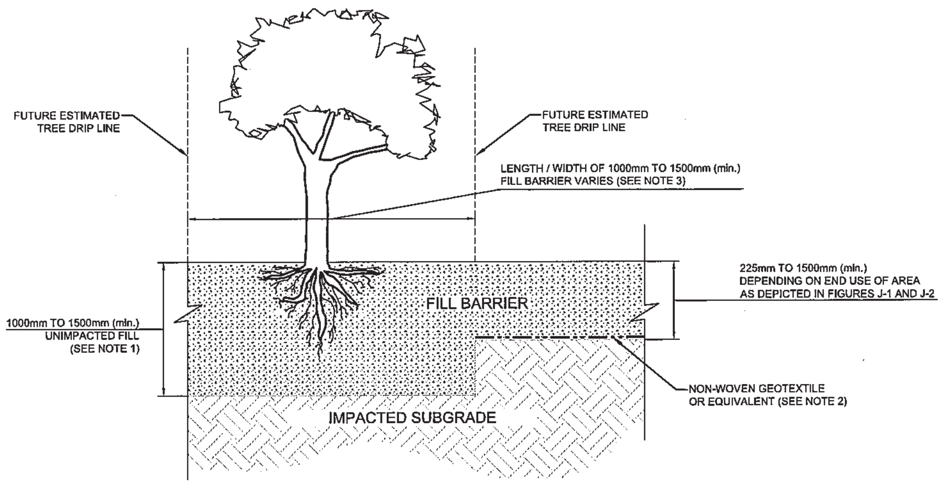
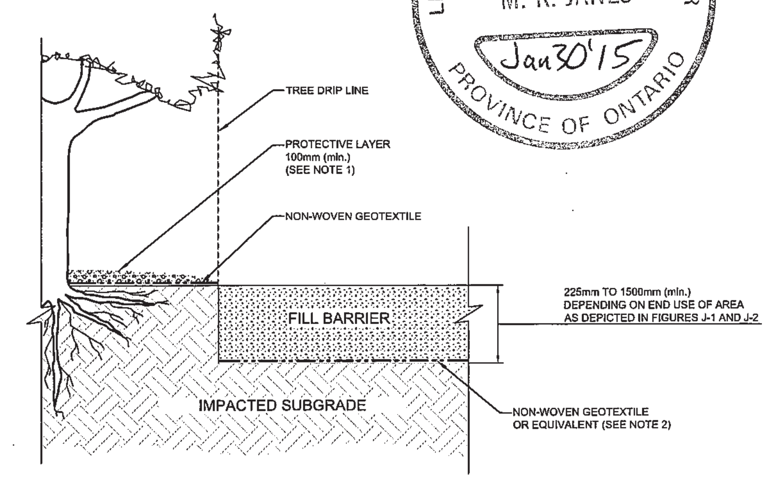




TYPICAL FILL CAP BARRIER - FOR NEW TREES

1 NTS

NOTES:
1. UNIMPACTED FILL AS DEFINED IN SECTION J.1.2 OF APPENDIX J. FILL BARRIER THICKNESS MAY BE ADJUSTED BY A LANDSCAPE ARCHITECT TO REFLECT THE SPECIFIC TYPES OF VEGETATION (ie., ROOTING DEPTHS) TO BE PLANTED ON A SITE-SPECIFIC AND/OR AREA-SPECIFIC BASIS.
2. MARKER LAYER OR GEOTEXTILE IS REQUIRED AT INTERFACE WITH EXISTING SUBGRADE IF TOTAL BARRIER THICKNESS IS LESS THAN 1m.
3. CONSISTENT WITH THE USE OF THE DRIP LINE FOR EXISTING TREES (DETAIL 2), THE LATERAL EXTENT OF THE 1000mm TO 1500mm (min.) FILL BARRIER FOR NEWLY PLANTED TREES SHOULD EXTEND, AT A MINIMUM, TO THE EXPECTED WIDTH OF THE TREE CANOPY AT MATURITY.
4. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.



TYPICAL FILL CAP BARRIER - EXISTING TREED AREAS

2 NTS

NOTES:
1. MATERIALS COULD INCLUDE RIVERSTONE WITHOUT FINES OR APPROVED CRUSHED CONCRETE OR OTHER PROTECTIVE HARDSCAPING WHICH ALLOWS AIR AND WATER TO PENETRATE SOIL (GRATES, PERMEABLE PAVEMENT, PAVERS, etc.), DEEMED APPROPRIATE BY A LANDSCAPE ARCHITECT TO SUPPORT / MAINTAIN TREE HEALTH.
2. MARKER LAYER OR GEOTEXTILE IS REQUIRED AT INTERFACE WITH EXISTING SUBGRADE IF TOTAL BARRIER THICKNESS IS LESS THAN 1m.
3. UNIMPACTED FILL AS DEFINED IN SECTION J.1.2 OF APPENDIX J.
4. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-3
Conceptual Design of Typical Fill Cap Barrier
New and Existing Treed Areas

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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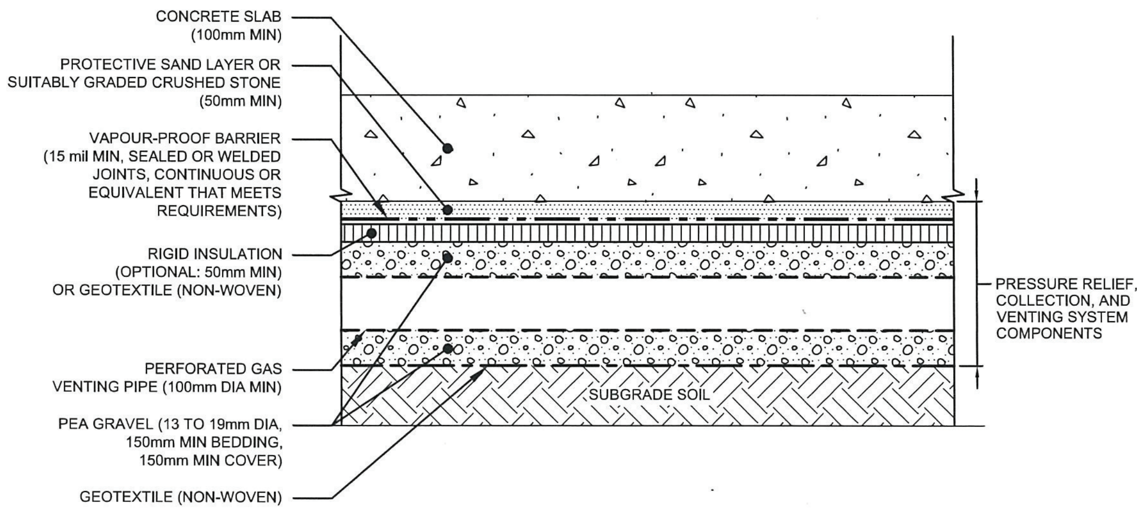

NOTES:

1. GAS VENTING PIPE PERFORATIONS TO BE HOLES (13 mm MAX DIAMETER) OR SLOTTED, PROVIDING A MINIMUM OPEN AREA OF 5,000 mm^2/LINEAR METRE.
2. ACTUAL DIAMETER OF PERFORATED GAS VENTING PIPE TO BE DETERMINED BASED ON THE SYSTEM DESIGN CAPACITY, THE PROPERTIES OF THE BEDDING / COVER MATERIAL, AND THE SOIL CONDITIONS UNDERNEATH THE BUILDING.
3. PERFORATED GAS VENTING PIPE TO BE CENTERED HORIZONTALLY WITHIN THE LAYER OF PEA GRAVEL.
4. PEA GRAVEL TO BE CLEAN, NON-CALCAREOUS (<3% LIMESTONE) AND FREE OF FINES PRIOR TO PLACEMENT.
5. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-4
Conceptual Design in Cross-Section View
Passive Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

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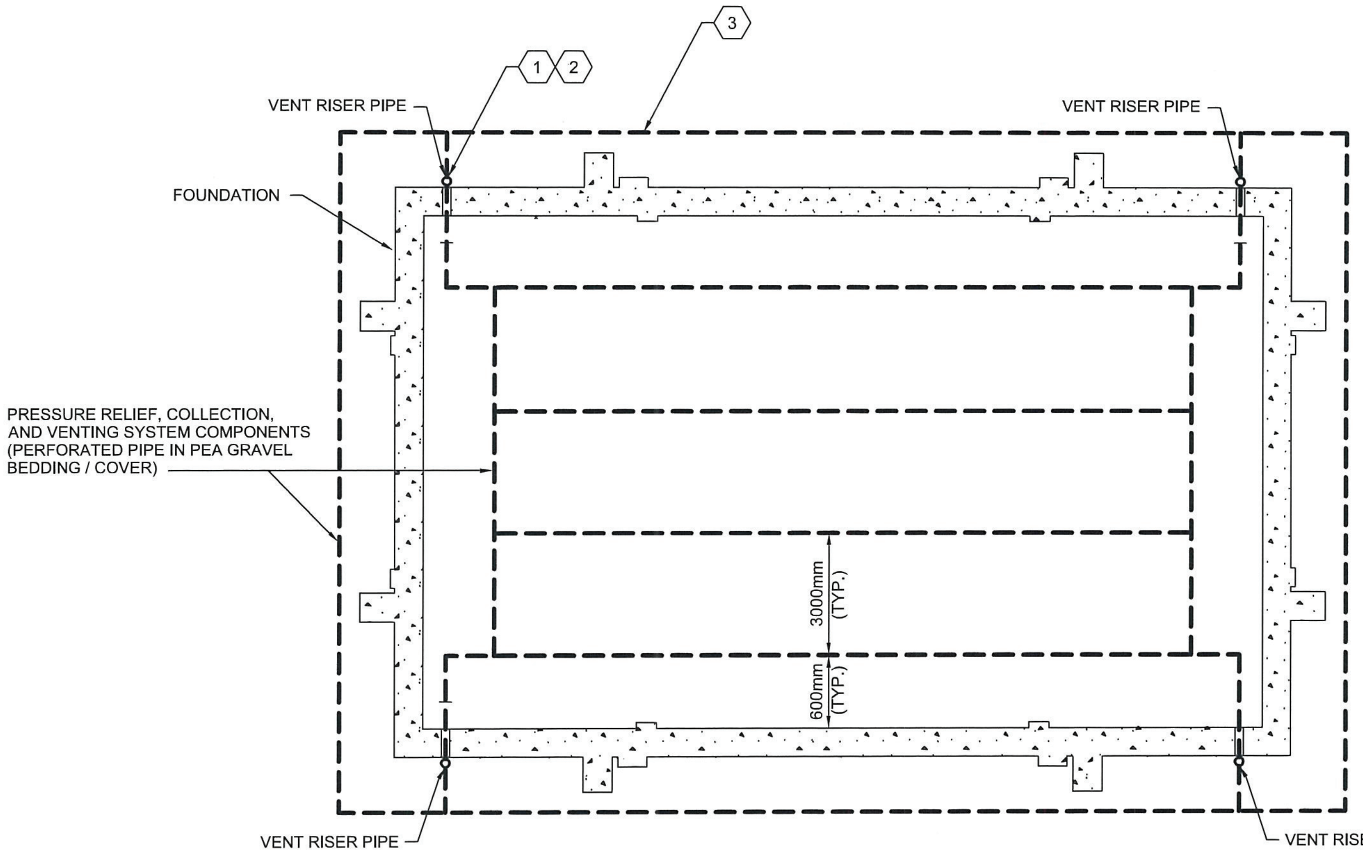

KEYED NOTES:

1. RISER PIPE EXTEND TO ABOVE STRUCTURE ROOFLINE (SEE FIGURE J-6).
2. PIPING TO ALLOW FOR CONTINGENCY CONVERSION TO ACTIVE VENTING IF REQUIRED.
3. PERIPHERAL VENTING WOULD NOT BE USED AS A VENTING COMPONENT FOR EXISTING STRUCTURES OR TEMPORARY FACILITIES

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NOTES:
1. PERFORATED GAS VENTING PIPE SHALL BE SLOPED TO A 1% MIN GRADE AND PROVIDE POSITIVE DRAINAGE TO A FREE DRAINING AREA(S) BENEATH THE PIPE.
2. ACTUAL HORIZONTAL SEPARATION OF GAS VENTING PIPE TO BE DETERMINED BASED ON THE SYSTEM DESIGN CAPACITY, THE PROPERTIES OF THE BEDDING / COVER MATERIAL, AND THE SOIL CONDITIONS UNDERNEATH THE BUILDING.
3. THE LENGTH OF TRANSITION FROM A PERFORATED GAS VENTING PIPE TO A SOLID VERTICAL VENT RISER PIPE SHALL NOT BE MORE THAN 1.5 m.
4. EACH VERTICAL VENT RISER PIPE IS TO SERVICE NO MORE THAN 400 m² OF AREA FOR A 100 mm DIAMETER RISER PIPE OR 1,400 m² OF AREA FOR A 150 mm DIAMETER RISER PIPE. ACTUAL SERVICE AREA TO BE DETERMINED BASED ON THE SYSTEM DESIGN CAPACITY, THE PROPERTIES OF THE BEDDING / COVER MATERIAL, AND THE SOIL CONDITIONS UNDERNEATH THE BUILDING.
5. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED .

FIGURE J-5
Conceptual Design in Plan View
Pressure Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

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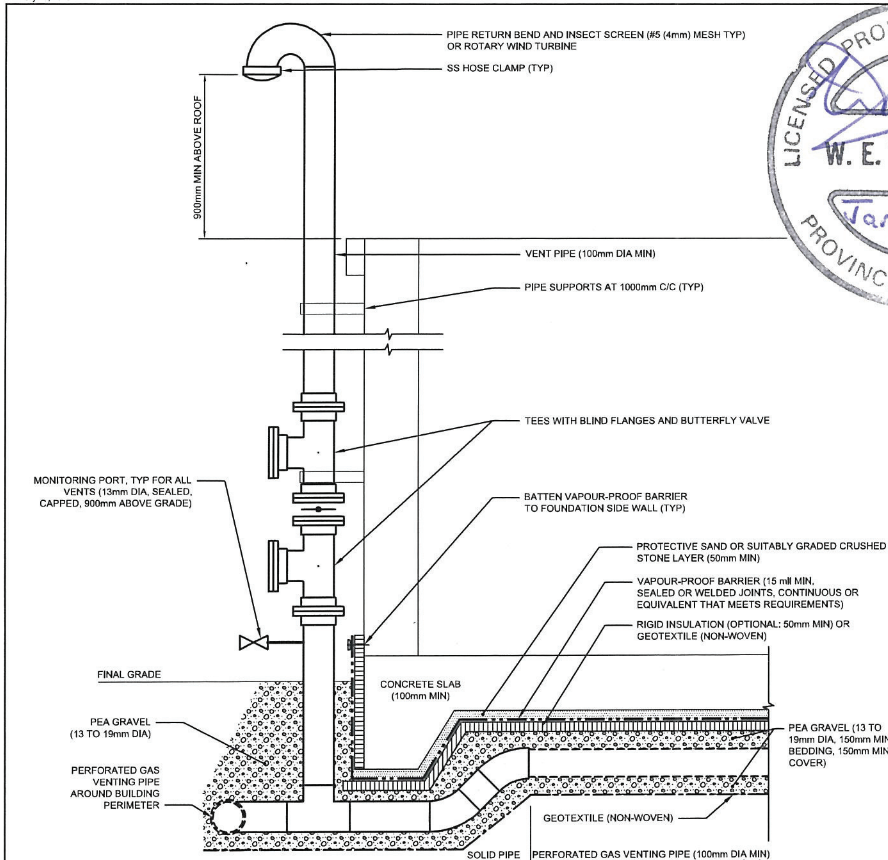

1 SECTION FOR A NON-SUBMERGED FOUNDATION

NTS

NOTES:
1. VAPOUR BARRIER UNDER FOUNDATION TO BE BATTENED TO SIDE OF FOUNDATION.
2. PERFORATED VENT PIPE TO BE CENTRED HORIZONTALLY WITHIN LAYER OF PEA GRAVEL.
3. PEA GRAVEL TO BE CLEAN, NON-CALCAREOUS (<3% LIMESTONE) AND FREE OF FINES PRIOR TO PLACEMENT.
4. ACTUAL VENT PIPE DIAMETER TO BE DETERMINED BASED ON THE SPECIFICS OF THE FOUNDATION AND BUILDING WALL DESIGN, THE SYSTEM DESIGN CAPACITY, THE PROPERTIES OF THE BEDDING / COVER MATERIAL, AND THE SOIL CONDITION UNDERNEATH THE BUILDING.
5. VENT PIPING TO BE INSTALLED ABOVE HIGH WATER TABLE AND ISOLATED FROM AND VERTICALLY ABOVE FOUNDATION DRAINAGE PIPING AND BEDDING MATERIAL.
6. ACTUAL COLLECTION PIPE DIAMETER AND ITS HORIZONTAL SEPARATION TO BE DETERMINED BASED ON THE SYSTEM DESIGN CAPACITY, THE PROPERTIES OF THE BEDDING / COVER MATERIAL, AND THE SOIL CONDITION UNDERNEATH THE BUILDING.
7. VAPOUR BARRIER, GEOTEXTILE AND PEA GRAVEL LAYERS TO EXTEND ACROSS FULL EXTENT OF BUILDING FOUNDATION.
8. VENTING HEADER ENGINEERED TO PASS THROUGH OR BENEATH FOUNDATION (WALLS OR FOOTER).
9. VENT RISERS CAN ALSO BE LOCATED TO INTERIOR OF BUILDING IF ARCHITECTURAL / MECHANICAL CONDITIONS DICTATE. HOWEVER, INTERIOR VENT RISER MUST BE MAINTAINED ACCESSIBLE FOR MONITORING PURPOSES AND RETROFITTING TO AN ACTIVE SYSTEM IF REQUIRED IN THE FUTURE.
10. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

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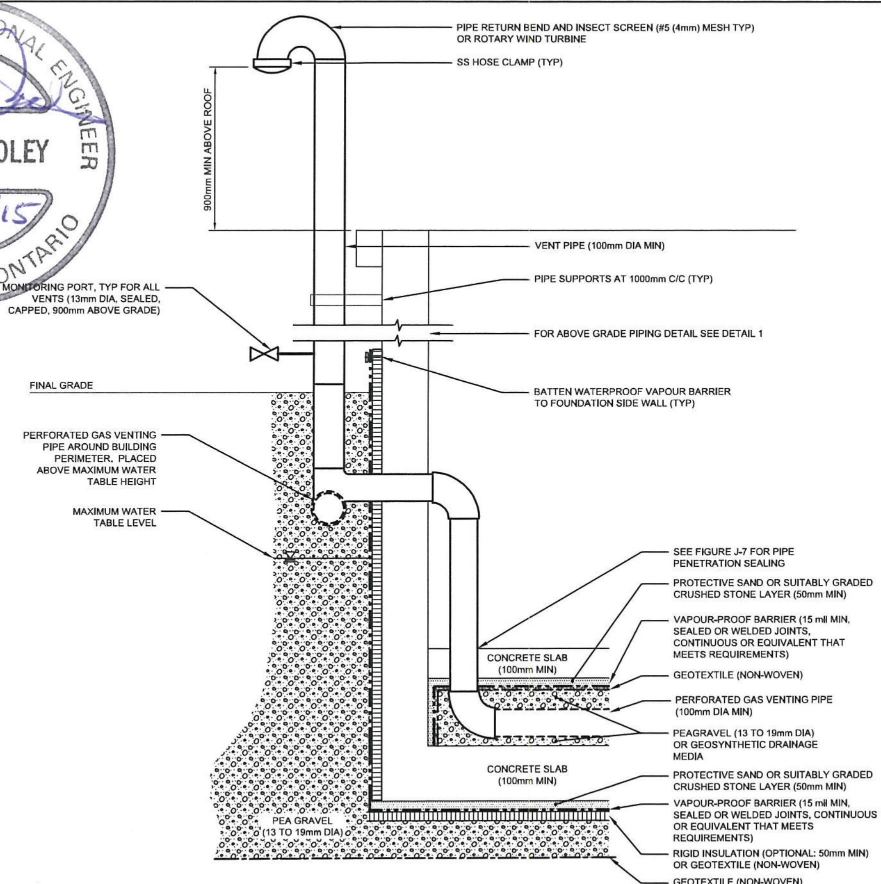

2 SECTION FOR A PARTIALLY SUBMERGED FOUNDATION

NTS

NOTES:
1. FOR A PARTIALLY SUBMERGED BUILDING FOUNDATION THE PASSIVE RELIEF, COLLECTION, AND VENTING SYSTEM COMPONENTS ARE CONFINED TO THE FOUNDATION AREAS ABOVE THE WATER TABLE. SIMILAR COMPONENTS AND CONFIGURATIONS FOR UNSATURATED CONDITIONS (SEE DETAIL 1) ARE USED, HOWEVER, THE VENTING PIPE SURROUNDS THE BUILDING PERIMETER ADJACENT TO THE UNSATURATED PORTION OF THE FOUNDATION.
2. VENT RISERS CAN ALSO BE LOCATED TO INTERIOR OF BUILDING IF ARCHITECTURAL / MECHANICAL CONDITIONS DICTATE. HOWEVER, INTERIOR VENT RISER MUST BE MAINTAINED ACCESSIBLE FOR MONITORING PURPOSES AND RETROFITTING TO AN ACTIVE SYSTEM IF REQUIRED IN THE FUTURE.
3. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-6
Conceptual Design for Saturated and Unsaturated Conditions
Passive Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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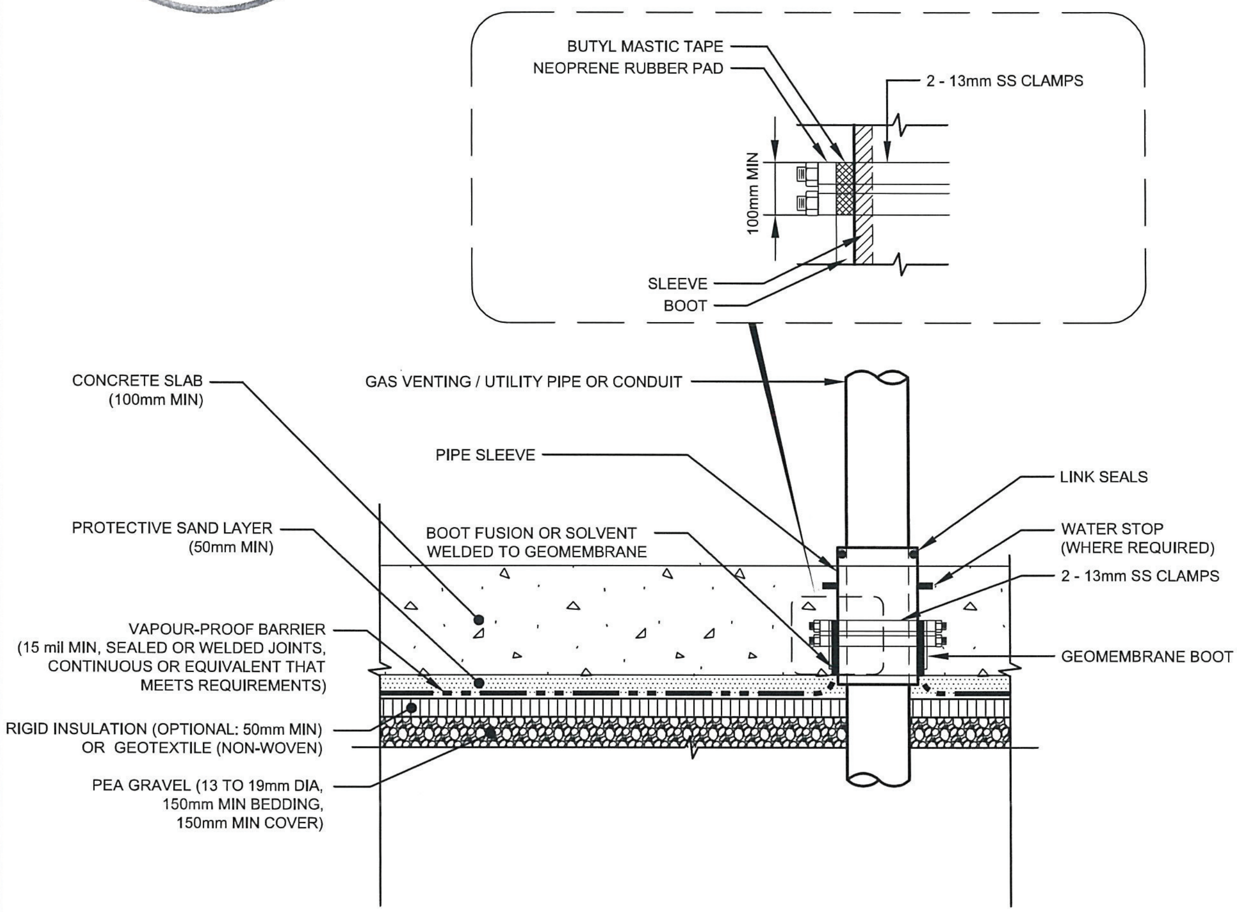

NOTES:

1. ONLY GEOMEMBRANE REQUIRES CONNECTION TO BOOT. CUT GEOTEXTILE OPENING 12mm GREATER THAN PIPE OD.
2. BUTYL MASTIC TAPE AND NEOPRENE RUBBER PAD APPLIED CONTINUOUSLY AROUND SLEEVE.
3. BOOT SHALL BE FABRICATED FROM SAME MATERIAL AS VAPOUR-PROOF BARRIER.
3. FORM BOOT WITH SUFFICIENT MATERIAL TO PREVENT OVERSTRESSING DURING BACKFILLING, BUT WITHOUT FOLDS OR WRINKLES.
4. DETAIL IS APPLICABLE TO THICKER (20 mil PLUS) HDPE TYPE LINERS FOR VERTICAL PENETRATIONS THROUGH FLOOR SLABS AND HORIZONTAL PENETRATIONS THROUGH FOUNDATION OR BUILDING WALLS. THINNER POLYETHYLENE AND POLYOLEFIN VAPOUR BARRIERS MAY USE SEALING TAPE (OR MASTIC) AND LAPPING (300mm MIN.) PROCEDURES.
5. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-7

Conceptual Design for Conduit and Pipe Penetrations
Passive Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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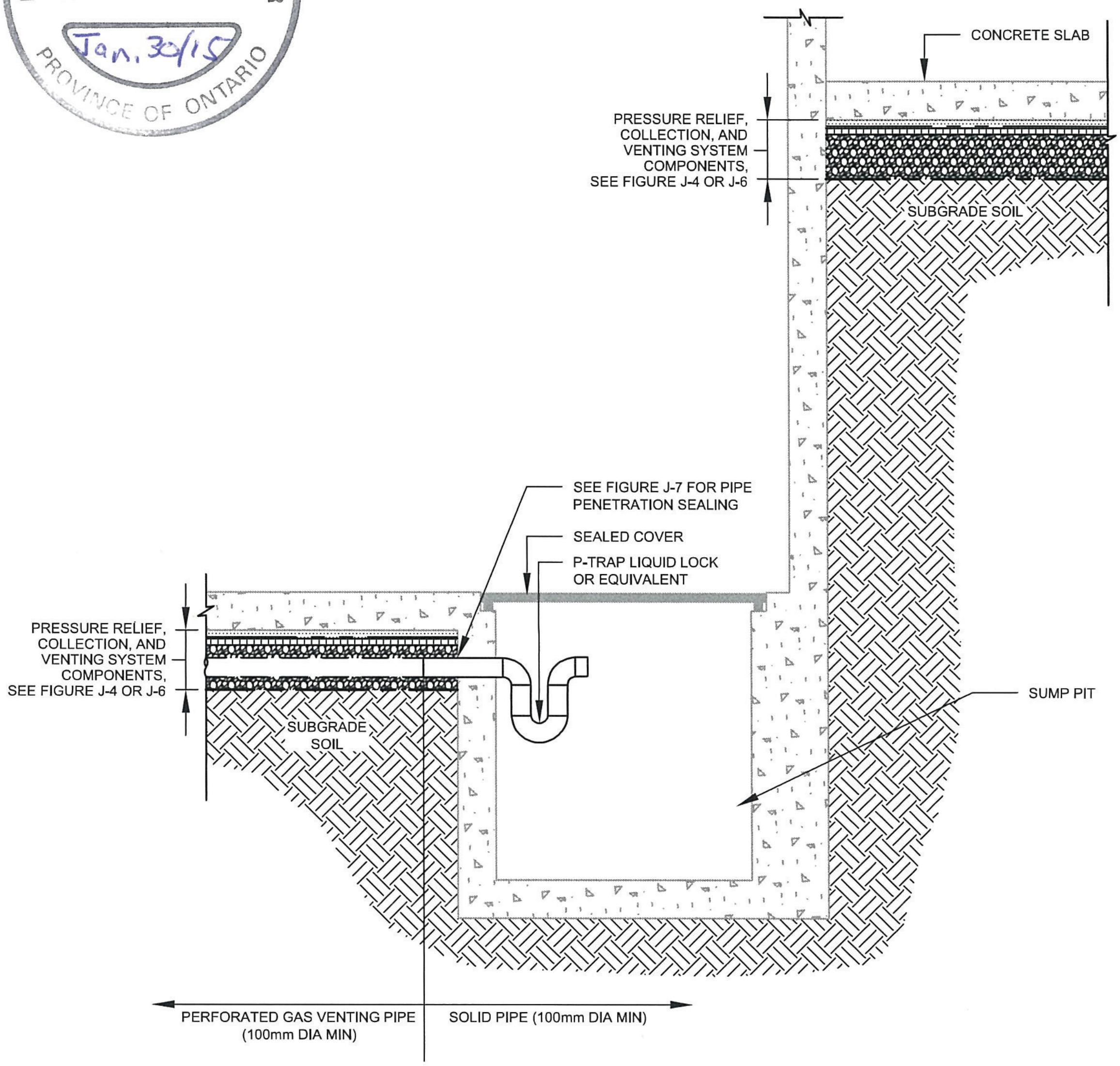

NOTES:
1. SURFACE OF SUMP PIT WALLS / SLAB TO BE SEALED (WATER AND VAPOUR PROOF, CONTINUOUS).
2. SUMP PIT SHALL BE PROVIDED WITH A SEALED, AIR-TIGHT COVER.
3. SUMP PIT SHALL BE PROVIDED WITH A VENT PIPE, WHICH SHALL EXTEND UP AND THROUGH ROOF.
4. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-8
Conceptual Design for Pipe Entry Into Sump Passive Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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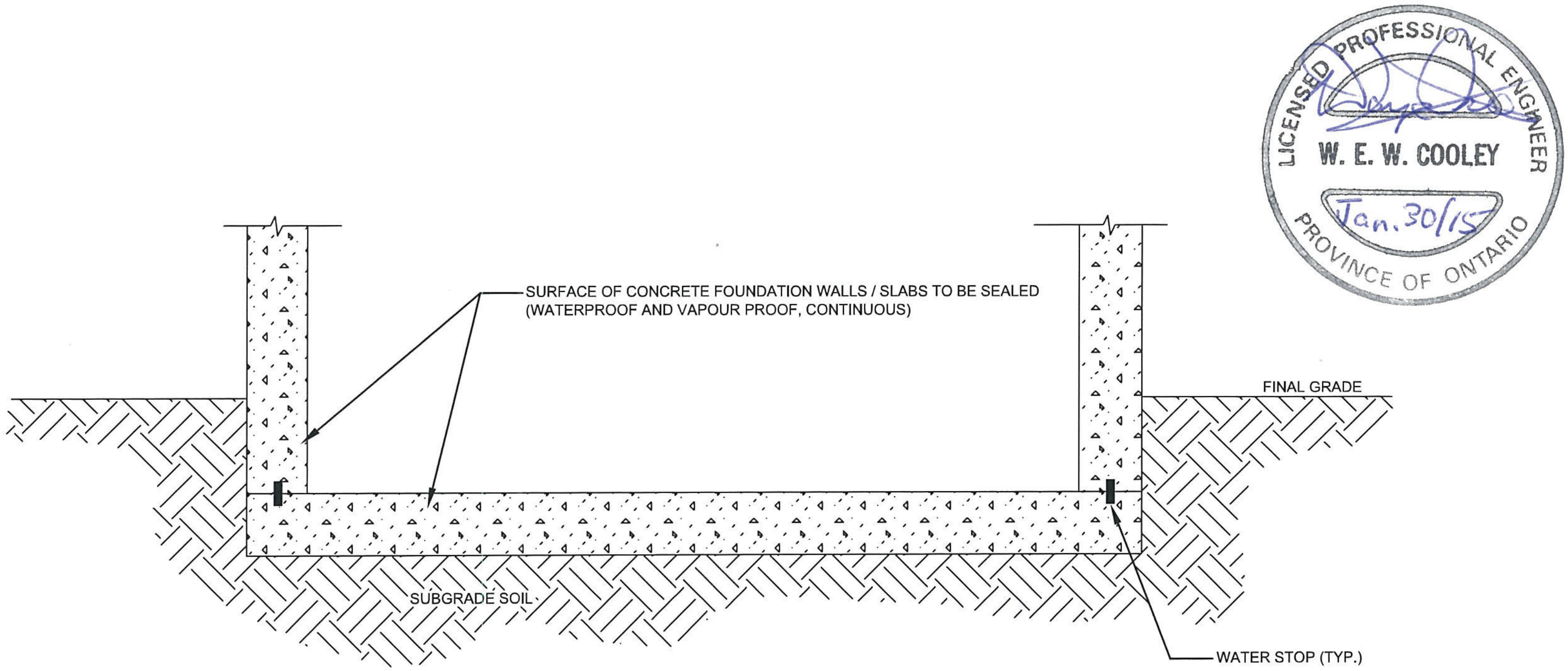
January 23, 2015



NOTE:
1. IF CONTINGENCY VI RMM IS DETERMINED TO BE REQUIRED FOR A PARKING GARAGE, THEN A CONTINUOUS SUPPLY OF OUTDOOR AIR SHOULD BE ADDED TO THE PARKING GARAGE SPACE (IF ENCLOSED) AT A RATE OF NOT LESS THAN 3.9 L/SEC FOR EACH SQUARE METRE OF FLOOR AREA. THIS SUPPLY OF OUTDOOR AIR MUST BE OPERATED 24 HOURS/DAY, 365 DAYS/YEAR.

FIGURE J-9
Conceptual Design for Parking Garage VI RMM
Passive Relief, Collection, and Venting System

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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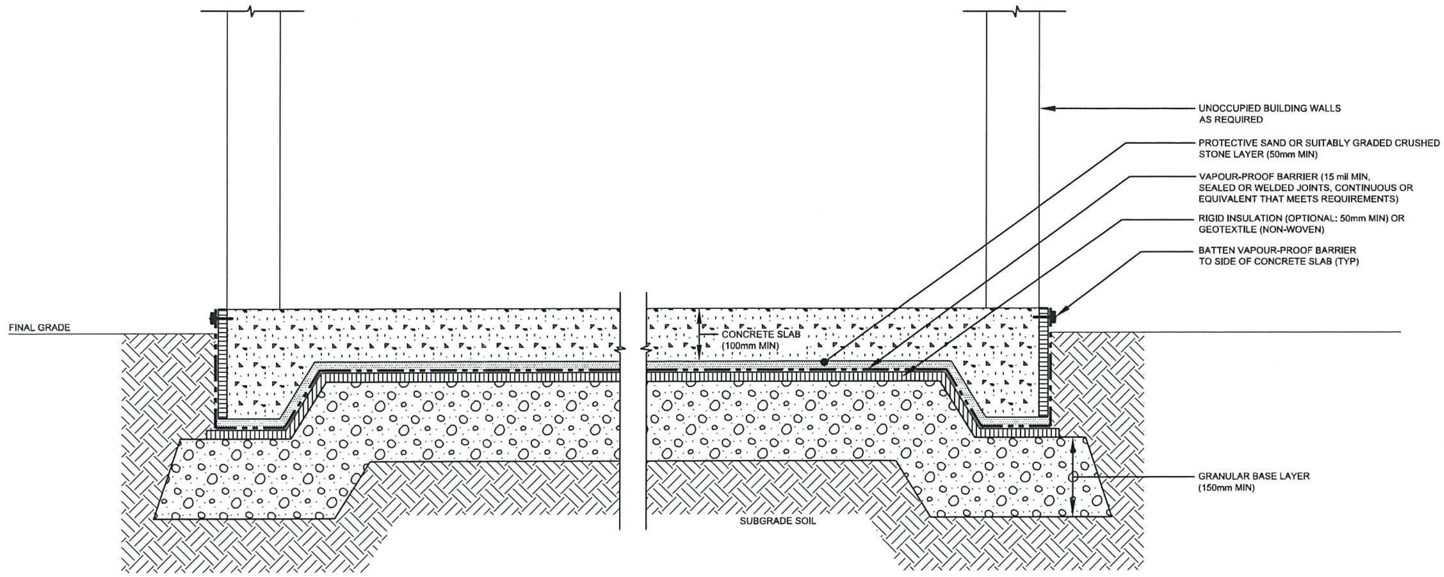
Janauary 23, 2015



NOTES:
1. VAPOUR BARRIER UNDER SLAB-ON-GRADE TO BE BATTENED TO SIDE OF CONCRETE SLAB.
2. FINAL GRANULAR BASE DESIGN REQUIREMENTS SHOULD BE DETERMINED BY A GEOTECHNICAL ENGINEER WITH LAYER(S) EQUALING OR EXCEEDING THE MINIMUM REQUIREMENTS SHOWN ON THIS DRAWING.
3. DESIGN IS CONCEPTUAL. DESIGN APPROACHES THAT MEET THE INTENT OF THE CONCEPTUAL DESIGN AND ACHIEVE THE DESIGN OBJECTIVES DESCRIBED IN APPENDIX J MAY BE USED.

FIGURE J-10
Conceptual Design for Unoccupied Slab-on-Grade Building without Vertical, Below Grade Foundation Walls VI RMM

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

NOT TO SCALE

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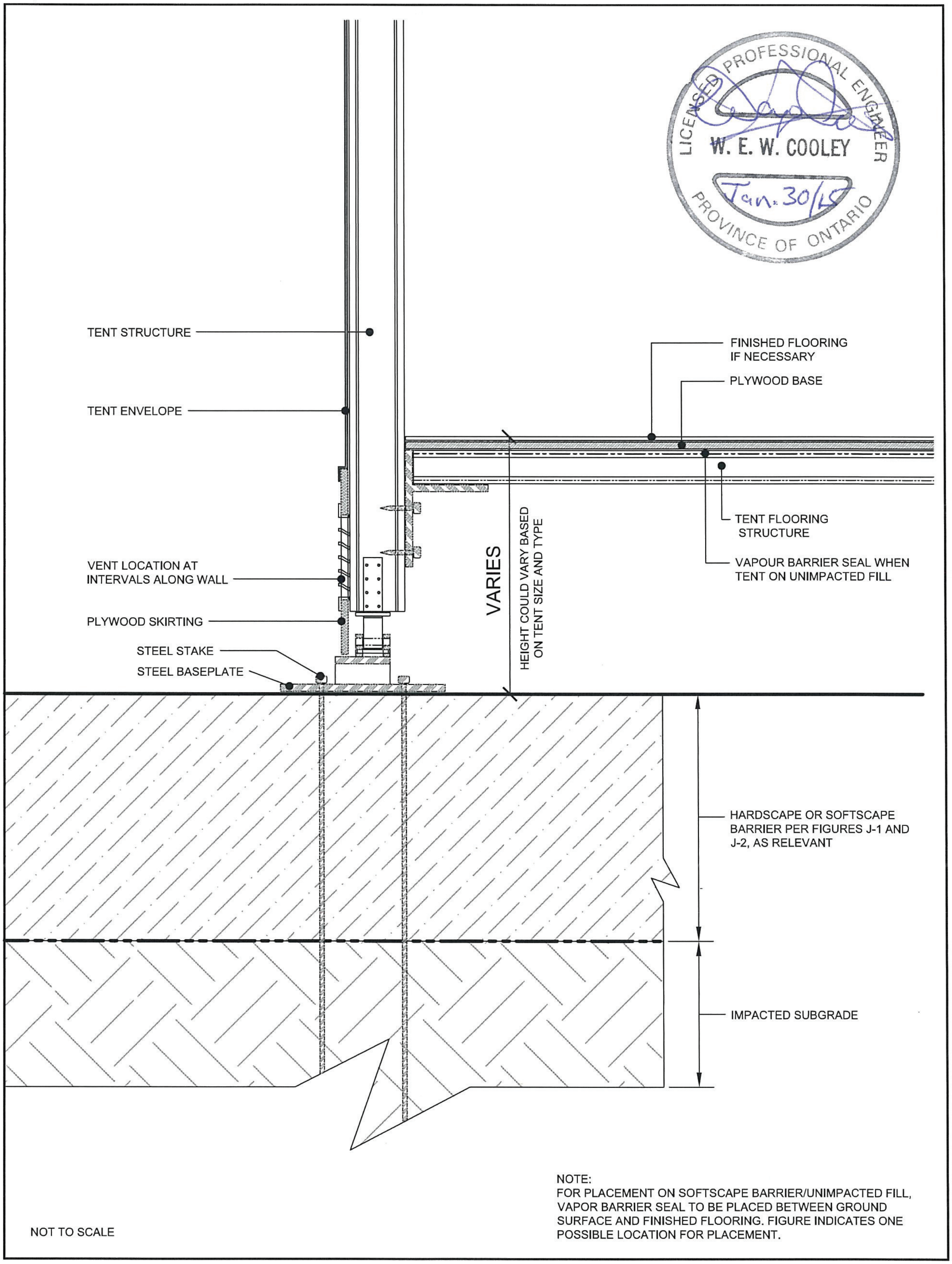

FIGURE J-11
Conceptual Design of Vapour Mitigation System for Temporary Tent Structures

Sydenham-Pearl Brownfield
17 Sydenham Street, Brantford, Ontario

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