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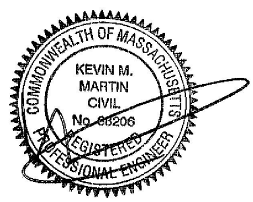
MEMORANDUM

TO: Picker Construction
33 Mystic Avenue
Somerville, MA 02145



FROM: Kevin M. Martin, P.E.
Geotechnical Engineer

DATE: September 19, 2025

RE: **GEOTECHNICAL SUMMARY REPORT**
PROPOSED MIXED-USE BUILDING
199 ELM STREET
SOMERVILLE, MASSACHUSETTS

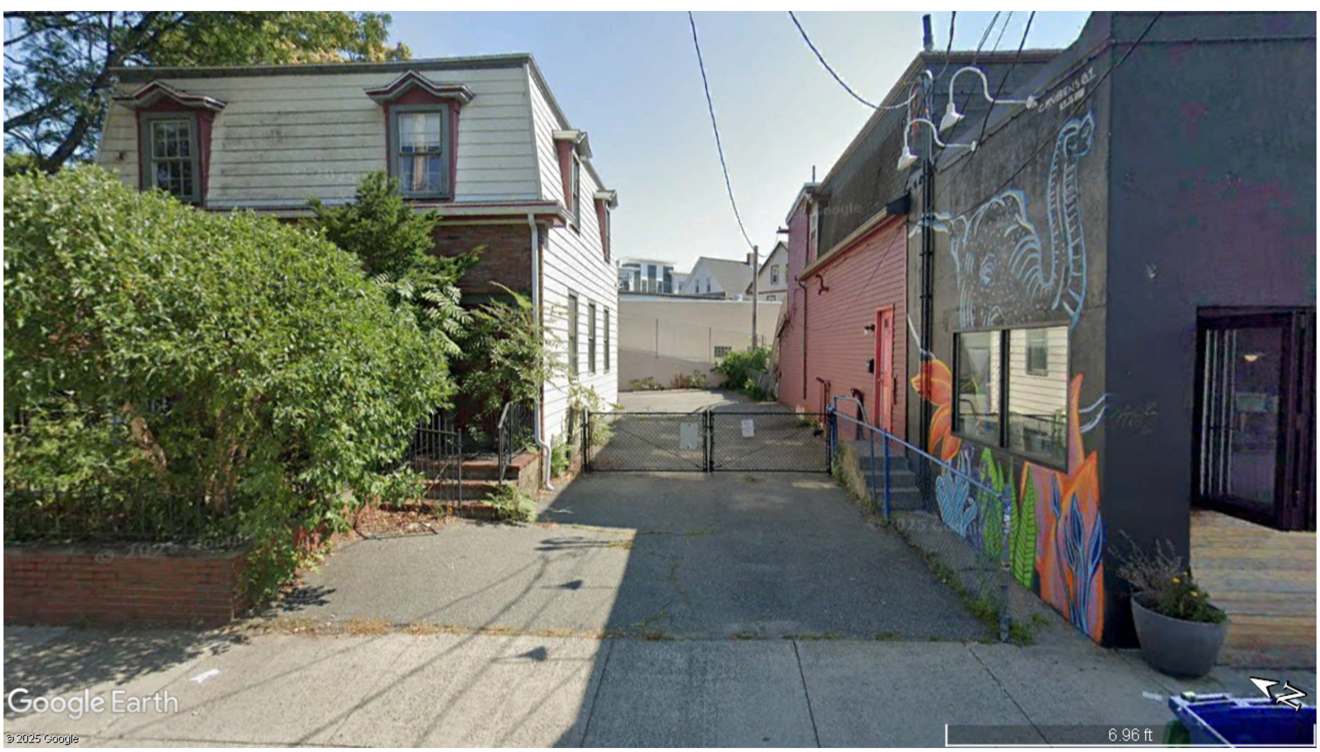
This memorandum serves as a Geotechnical Summary Report for the referenced project. The contents of this memorandum are subject to the attached ***Limitations***.

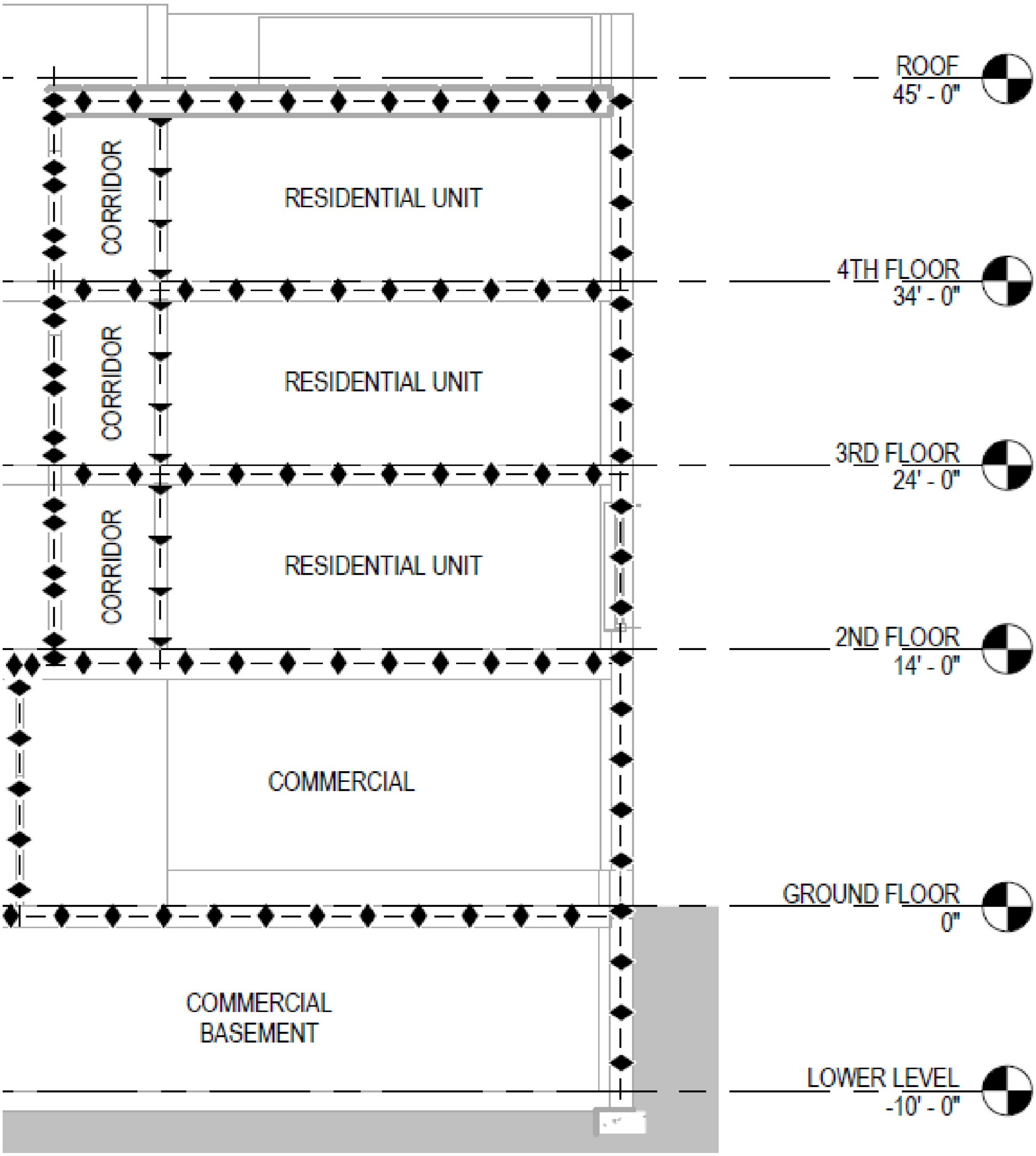
SITE & PROJECT DESCRIPTION

The site includes an urban lot about ≈3,609 ft² in area. Present development includes a residential building with associated parking and landscape. The building and associated construction will be razed to accommodate the project. KMM has no knowledge of past use, construction and/or development except what is visible or shown on the *Site Plan*. Based on the *Site Plan*, grades are relatively level near elevation ≈25-26 ft.

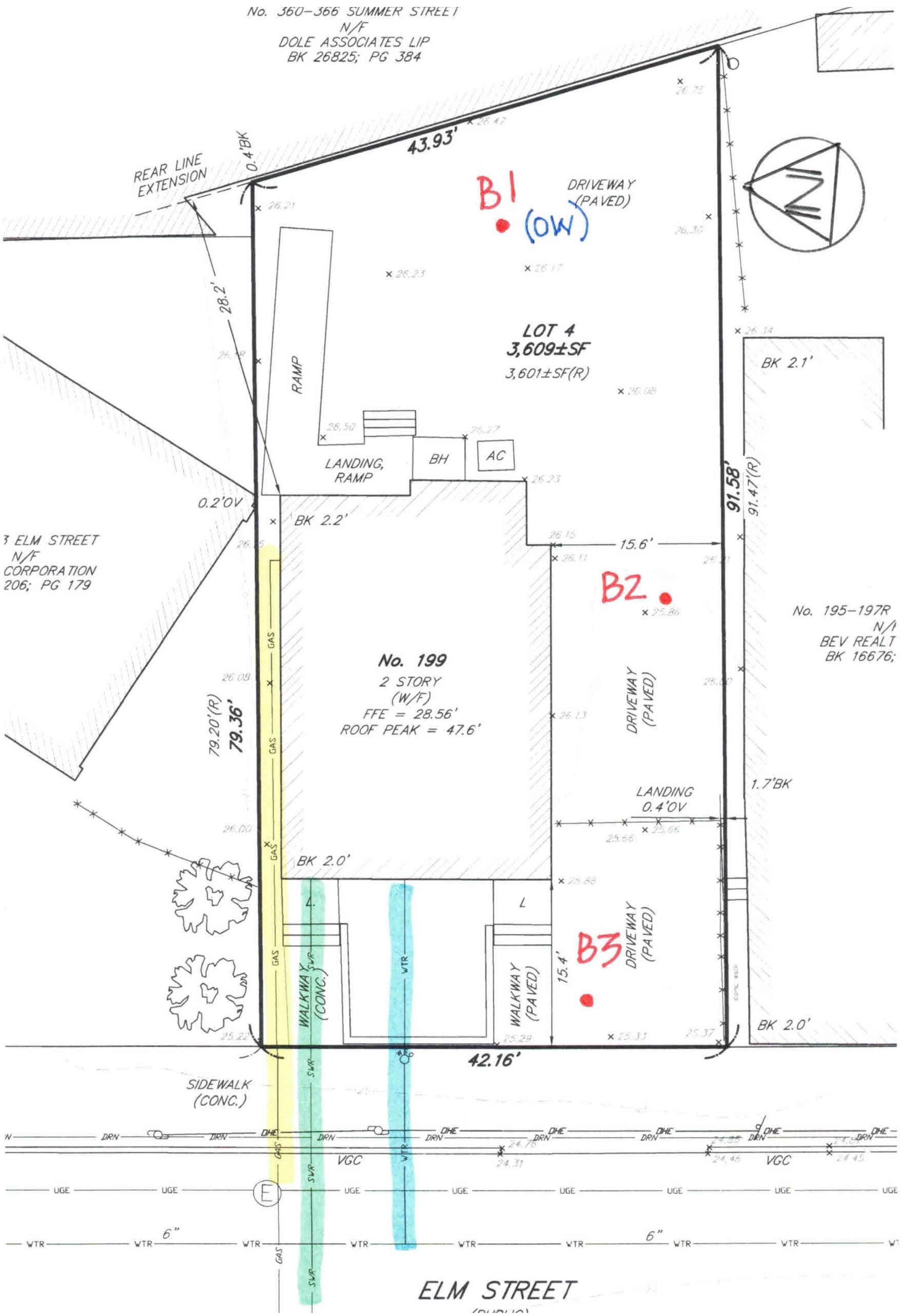
The project includes a four-story, steel and wood-framed building about ≈2,900 ft² in footprint. The building will occupy most of the lot. There is a proposed basement level (10 ft) for storage and mechanical. It is intended to support the building on a conventional spread footing foundation.

The purpose of this study is to review the subgrade conditions and provide a geotechnical evaluation related to foundation design and construction as required by the *Massachusetts State Building Code*. This report does not include an environmental assessment relative to oil, gasoline, solid waste and/or other hazardous materials. The environmental conditions of the property should be addressed by others as necessary. This study also does not include review of site design or construction issues such as infiltration systems, dry wells, retaining walls, excavation support, underground utilities, protection of surrounding buildings/utilities, crane pads or other site and/or temporary design unless specifically addressed herein.





BUILDING PROFILE


No. 360-366 SUMMER STREET
N/F
DOLE ASSOCIATES LIP
BK 26825; PG 384
43.93'
0.4'BK
REAR LINE EXTENSION
B1
(OW)
DRIVEWAY (PAVED)
28.2'
RAMP
LOT 4
3,609±SF
3,601±SF(R)
BK 2.1'
LANDING, RAMP
BH
AC
0.2'OV
BK 2.2'
15.6'
91.58'
91.47'(R)
ELM STREET
N/F
CORPORATION
206; PG 179
B2
No. 195-197R
BEV REALT
BK 16676;
No. 199
2 STORY
(W/F)
FFE = 28.56'
ROOF PEAK = 47.6'
DRIVEWAY (PAVED)
79.20'(R)
79.36'
GAS
LANDING
0.4'OV
1.7'BK
BK 2.0'
B3
15.4'
WALKWAY (CONC.)
WALKWAY (PAVED)
SWR
WTR
42.16'
SIDEWALK (CONC.)
DRN
OHE
VGC
UGE
6"
ELM STREET

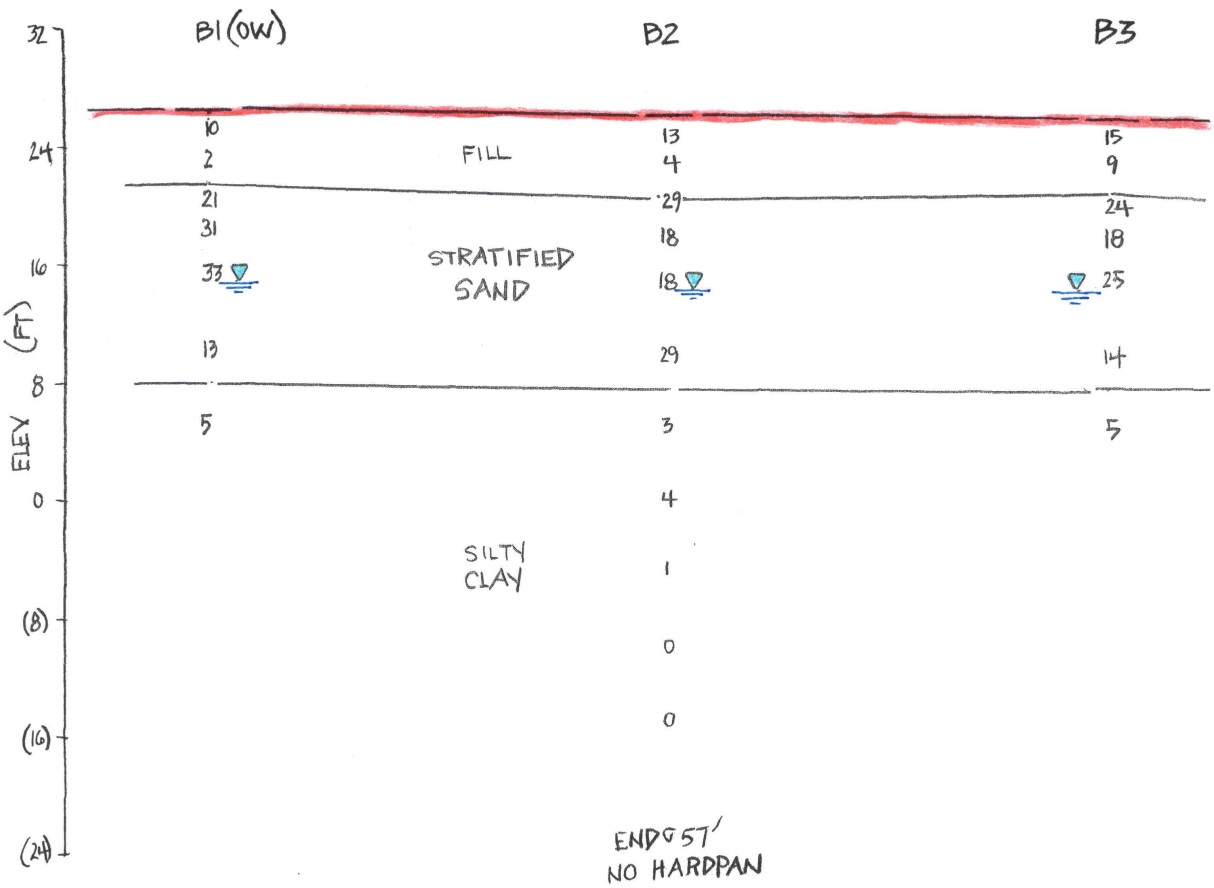
SUBSURFACE EXPLORATIONS

The exploration program for the project included three (3) test borings within the limits of the new building. The test borings (B1 to B3) were advanced to depths of ≈22-57 ft utilizing 3 inch pneumatically driven casing. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2 inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (*Standard Method for Penetration Test and Split-Barrel Sampling of Soils*). Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater and other pertinent data are contained on the attached *Test Boring Logs*. The attached *Sketch* shows the test bore locations.

An Observation Well was installed at B1 to a depth of ≈20 ft. The well includes 2 inch diameter PVC pipe with requisite filter sand, bentonite seal, end plugs and road box. The well may be used to monitor seasonal and storm fluctuations.

SUBSURFACE CONDITIONS

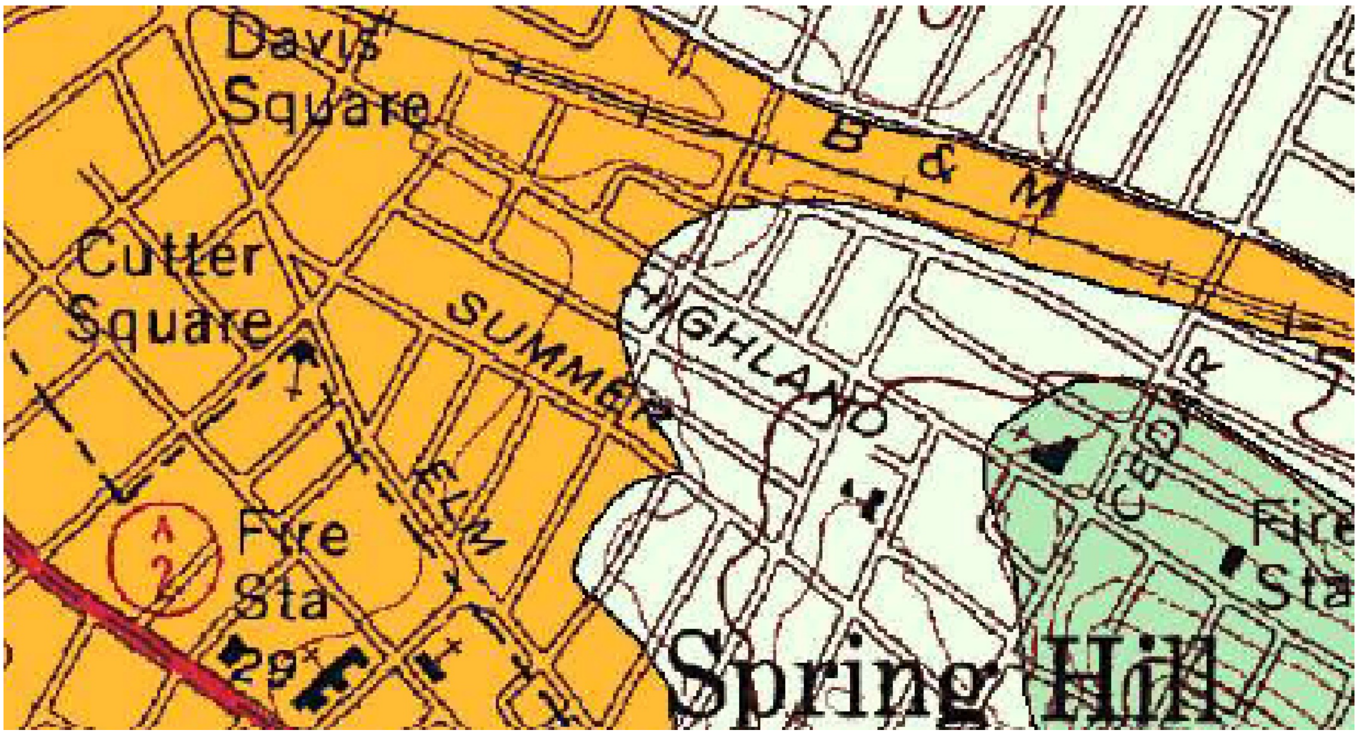
The subsurface conditions below (1) shallow Fill include (2) Stratified Sandy Outwash then (3) silty Clay. A *Subsurface Profile* depicting the subgrade conditions is attached.



Shallow Fill was encountered in all the test bores to depths of ≈5 ft. The Fill varies in composition but typically includes Sand, little gravel, little silt. Other fill should also be expected around the existing foundations and underground utilities.

A Granular Outwash was encountered to depths of about ≈18 ft below grade. The Outwash soils generally include Stratified Sand with deeper gravelly Sand. These soils are clean, granular, well-draining, stable and compact.

Below the Outwash is a Marine Clay (Boston Blue Clay) which was not penetrated to 57 ft below grade. The Clay is typically very soft.



USGS SURFICIAL GEOLOGIC MAP - BOSTON, MASS - 2018

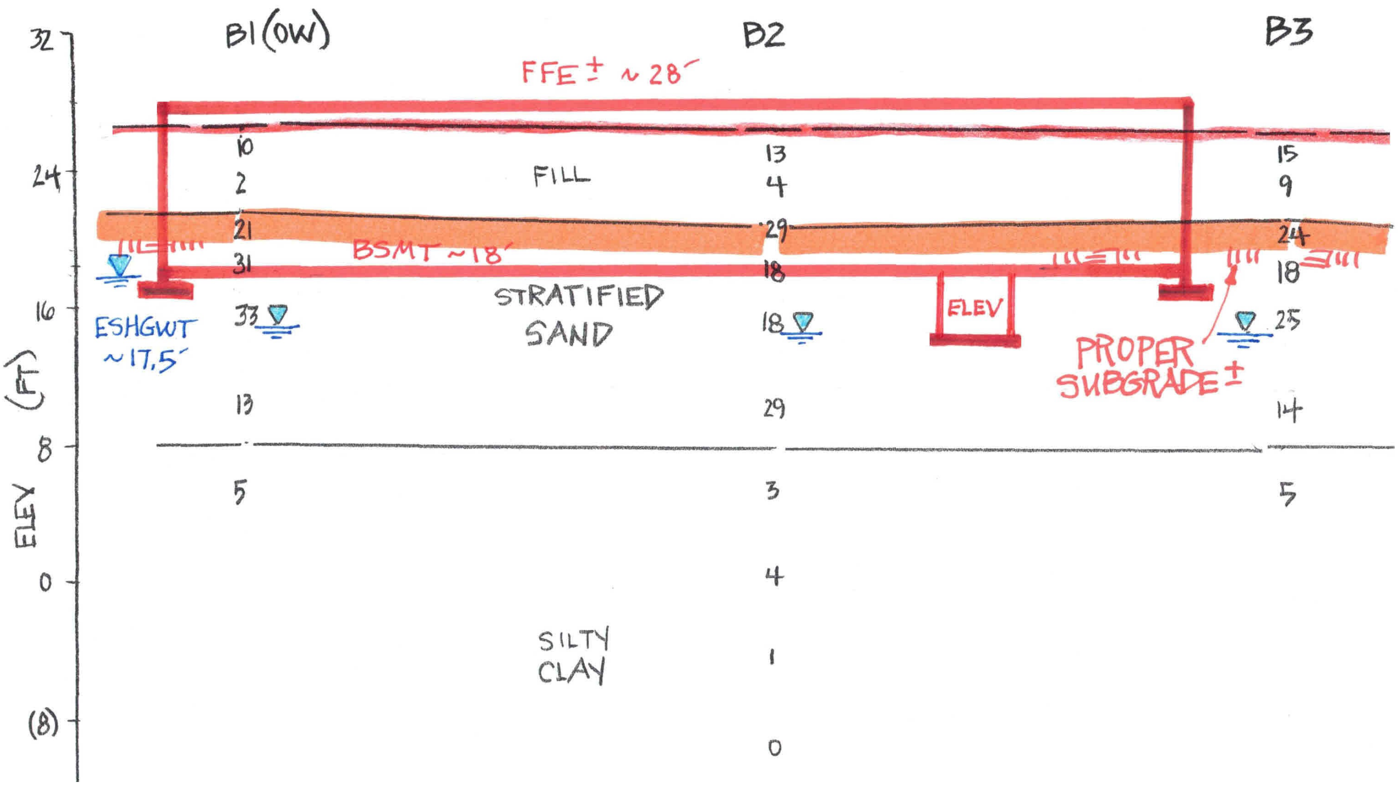
Coarse deposits consist of *gravel deposits*, *sand and gravel deposits*, and *sand deposits*, not differentiated in this report. *Gravel deposits* are composed of at least 50 percent gravel-size clasts; cobbles and boulders predominate; minor amounts of sand occur within gravel beds, and sand comprises a few separate layers. Gravel layers generally are poorly sorted, and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. *Sand and gravel deposits* occur as mixtures of gravel and sand within individual layers and as layers of sand alternating with layers of gravel. Sand and gravel layers generally range between 25 and 50 percent gravel particles and between 50 and 75 percent sand particles. Layers are well sorted to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. *Sand deposits* are composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay

The *USGS Surficial Geologic Map* identifies post glacial Stratified Outwash to include Coarse Deposits being located along the western base of Spring Hill (Glacial Drumlin). These conditions are consistent with this study.

Groundwater was encountered about ≈11½ ft below grade upon completion of the test bores. Wet and saturated soils were encountered at these depths. It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, utilities and other factors differing from the time of the measurements. This study was completed at a time of seasonally low groundwater (dry summer). We recommend an Estimated Seasonal High Groundwater Table (ESHGWT) at elevation 17½ ft for design.

FOUNDATION SUBGRADE RECOMMENDATIONS

The subgrade conditions are favorable for supporting the proposed building on a conventional spread footing foundation with a concrete floor slab. The undocumented Fill soils, are **not** considered suitable for foundation support given questionable strength and compressibility characteristics. As such, these soils as well as intersecting utilities, abandoned foundations and other questionable materials shall be fully removed from the building pad including the perimeter *Footing Zone of Influence* (*FZOI*) to expose the Outwash soils. The *FZOI* is defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay (up to a ≈3 ft lateral distance from the edge of foundation). The attached *Profile* illustrates "Proper Subgrade" in relation to the proposed construction. Fill and other questionable matter are expected to be penetrated with the basement foundation. Structural Fill (Table 1) should be used below the foundation as necessary. A 1 inch minus crushed stone may be used in wet conditions.



CONCEPTUAL BASEMENT FOUNDATION

The parent subgrade soils (Stratified Sand) should be exposed in the foundation areas prior to casting the footings or placing structural fill. The parent subgrade soils shall be proof-rolled with vibratory densification and exhibit stable and compact conditions. The purpose of the proof-rolling is to densify the site soils and identify potential loose or unstable areas which should be removed as necessary. Proof-rolling should involve at least 4-5 passes with a vibratory compactor (minimum 850 pound static weight) operating at peak energy. During the proof rolling, the subgrade should be observed by an Engineer to identify areas exhibiting weaving or instability. It will be necessary to remove weakened or unstable soils and replace with a Structural Fill. Proper groundwater control and storm water management are also necessary to maintain site stability. The groundwater (or puddled storm water) should be continuously maintained at least one foot below construction grade. Proper groundwater control and storm water management are necessary to maintain site stability. Wet conditions are generally more problematic if construction occurs during the wetter winter or spring season. The drier summer months are typically more favorable for groundwater control.

The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions will be rendered unsuitable for structural support. The Contractor shall ultimately be responsible for the means and methods of temporary groundwater control, subgrade protection and site stability during construction. An Engineer from KMM should be scheduled to review the foundation subgrade conditions and preparation during construction.

FOUNDATION DESIGN RECOMMENDATIONS

The footings are expected to gain bearing support atop the Stratified Sand. Footings may be designed using a net allowable bearing capacity of 4 ksf (FS=3). The allowable bearing capacity may be increased a third (⅓) when considering transient loads such as wind or seismic. The bearing capacity is contingent upon the perimeter strip footings and isolated column footings being no less than 2 ft and 3 ft in width respectively. For footings less than 3 ft in lateral dimension, the net allowable bearing capacity should be reduced to one-third and multiplied by the least lateral footing dimension in feet. Foundation settlement should be less than 1 inch with differential settlement less than ½ inch. The settlement should be elastic and occur during construction. Exterior footings shall be provided with at least 4 ft of frost protection. Proper frost protection should be necessary during winter construction.

Recommendations for the lateral earth pressure against the unbalanced walls and drainage control are outlined on Table 2. Proper drainage behind the unbalanced foundation walls (ie: basement) will also be necessary as summarized on Table 2.

The subsurface conditions were reviewed with respect to seismic criteria set forth in the ***Massachusetts State Building Code***. Based on the relative density of the soils and the depth to groundwater, the site is not susceptible to liquefaction in the event of an earthquake. Based on interpretation of the *Building Code*, the *Site Classification* is "D" (Stable Soil Profile).

It is recommended that a minimum 6-inch base of *Gravel Base Fill* (Table 1) be placed below the concrete floor slab for moisture and frost control. The gravel base shall be increased to no less than 12 inches for exterior concrete slabs exposed to frost as well a paved areas. Structural fill necessary within and below the foundation should also conform to the attached *Specifications* (Table 1). The Granular Outwash soils are suitable for re-use backfill around the foundation.

FOUNDATION DRAINAGE

Due to the proposed basement level, a foundation drainage system will be required to permanently control the high groundwater as required by the *MSBC*. The purpose of the drainage system is to prevent uplift (buoyant) and lateral hydrostatic forces against the foundation walls and protect the basement level from groundwater intrusion. The basement floor slab is expected to be impacted by seasonal fluctuations. We recommend an ESHGWT at elevation 17½ ft for design. Consideration should be given to elevating the basement slab to mitigate groundwater impact. We recommend an under slab drainage system for a basement below elevation 18 ft.

A perimeter foundation drain should be located at least ≈2 inches above the bottom of footing elevation and six inches outward from the edge of footing. The drains may be placed inside or outside the foundation. The drains should not encroach within the *Footing Zone of Influence* defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay. Furthermore, the invert elevation of the drain should be at least 10 inches below the underside of the adjacent floor slab. The drains should consist of minimum 4 inch diameter, perforated PVC-SDR35 drain pipe encased within 12 inches of ¾-inch stone and wrapped with a filter fabric such as Mirafi 140N or equal. To provide drainage along the basement wall, a 20 inch vertical lift of *Structural Fill* (Table 1) should be placed directly behind the foundation wall to within ≈18 inches of finish grade. The Clean Outwash may be used for this purpose. The ground surface immediately adjacent to the foundation should be sloped away from the building to allow for positive drainage. It is also recommended that the surficial materials adjacent to the building be relatively impermeable to reduce the volume of precipitation infiltrating into the subsurface. Such impermeable materials include cement concrete, bituminous concrete or a vegetated silty topsoil.

The underslab drainage system shall include a minimum 12 inch base of one inch crushed stone atop a geotextile filter fabric such as Mirafi 140N or equal. The filter fabric should be over-lapped a minimum one foot at intersecting seams. Furthermore, minimum 4 inch perforated PVC- SDR35 pipe should be embedded in the stone base at maximum ≈35 ft intervals with an invert at least 10 inches below the underside of the slab. The interior drains should also be placed adjacent to the perimeter foundation. The interior drains should not be located lower than the foundation footings.

The foundation drains will need to discharge into the storm drain system not subject to surcharge or to a sump with pump. The sump pump shall be equipped with back-up power and alarm. <u>The Site Engineer should review the discharge of the foundation drains in this regard</u>. It is recommended that a backflow preventer be installed at the outlet of the drains to reduce the impact of surcharges. The drains should be provided with permanent clean-outs at convenient locations to facilitate access to all sections of the system. Clean-outs should be located at bends and no greater than 175 ft on-center. Roof gutters and other storm collection should not be discharged to the foundation drains.

Recharge systems, infiltrators and/or dry wells shall be kept away from the basement level to prevent hydrostatic surcharge. This should also be reviewed by the Site Engineer. Our experience with these urban projects is that the Site Engineer is required to discharge (infiltrate) storm water and roof gutters on the site. This is usually in conflict with the need to remove water away from the below grade basement areas. Nonetheless, this should be reviewed and designed accordingly. We have not seen *Drainage Plans* for the project.

The basement foundation should be waterproofed or, at a minimum, damproofed to protect against moisture damage. The basement floor should be damproofed with minimum ten-mil StegoWrap™ or equal with joints lapped 10 inches below the floor slab. Damproofing of below grade foundation walls should include the application of a bituminous or other approved material from the top of footing to above ground level. Water-proofing should be specified by others.

Below slab foundations (such as elevator pits) should be fitted with continuous waterstops in all construction joints and should be waterproofed as well as structurally designed (buoyant load) to protect against groundwater intrusion. Groundwater relief or drainage is typically not feasible for the depressed elevator pit. An equivalent fluid weight of 90 pcf should be used for the design of the elevator pit as the groundwater will not be controlled in this depressed area. This increased lateral pressure shall be used in areas where dry wells or infiltrators are necessary near the foundation.

PROTECTION OF EXISTING FOUNDATIONS

It is recommended that where the building is in proximity to existing buildings that the footings be constructed at similar grade to mitigate the overlapping of stresses. The *Existing Footing Zone of Influence* of the existing foundation should not be encroached or disturbed without review by a Professional Engineer. The *Existing Footing Zone of Influence* is defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1.5H:1V splay. Per the *Building Code*, an imaginary line drawn between the lower edges of adjoining footings shall not have a steeper slope than 25° (2H:1V) with the horizontal unless the material supporting the higher footing is braced or otherwise retained. There is no present information regarding the adjacent building(s). This study did not include verification of the existing foundation via test pits. KMM can provide additional technical assistance if the existing foundation needs to be shored or underpinned.

CONSTRUCTION CONCERNS

The contractor should be required to maintain a stable-dewatered subgrade for the building foundation and other concerned areas during construction. Subgrade disturbance may be influenced by excavation methods, moisture, precipitation, groundwater control and construction activities. The stratified outwash soils are generally not considered vulnerable to disturbance when exposed to wet conditions and construction activities given their good drainage. Steady groundwater seepage, however, will likely disturb these soils if not properly managed during construction. The contractor should take precautions to reduce subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, minimizing the extent of exposed subgrade if inclement weather is forecast, backfilling footings as soon as practicable and maintaining an effective dewatering program. Soils exhibiting weaving or instability should be over-excavated to a competent bearing subgrade then replaced with a free draining structural fill or crushed stone. The moisture concerns are typically more problematic if construction takes place during the winter to spring season or other periods of inclement weather. A protective base of ¾-inch minus crushed stone may be placed at least ≈6 inches below and laterally beyond the footing limits for protection during construction. The stone base is to protect the site soils, facilitate necessary dewatering and provide a dry/stable base upon which to progress foundation construction. The protective base should be considered elective and dependent upon the site conditions. The stone base should be considered necessary if wet conditions are present at footing grade. The protective stone base shall be tamped with a plate compactor and exhibit stable conditions.

The groundwater and puddled storm water will need to be temporarily controlled to complete work in dry conditions and protect the competency of the sensitive subgrade. Wet conditions should be continuously maintained at least one foot below construction grade. Groundwater or puddled storm water is expected to be controlled with conventional sumps and pumps. The temporary sumps should be filtered with stone and fabric and extend at least ≈24 inches below construction grade. Adequate dewatering and storm water management are necessary for maintaining the competency of the site soils. The discharge of the collected water should be reviewed by others.

The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions will be rendered unsuitable for structural support. The Contractor shall ultimately be responsible for the means and methods of temporary groundwater control, subgrade protection and site stability during construction. An Engineer from KMM should be scheduled to review the foundation subgrade conditions and preparation during construction.

LATERAL SUPPORT OF EXCAVATION

Deep excavations (≈8-12 ft) are expected for the foundation construction and possibly for utility installation around the property. Excavations should be sloped and/or laterally supported in accordance with the *Occupational and Health Administration (OSHA)* regulations (29 CFR Part 1926) and the *Commonwealth of Massachusetts Department of Labor and Industries Division of Industrial Safety (DLIDIS) - Rules and Regulations for the Prevention of Accidents in Construction Operations* (454 CMR 10.00), Part 14. Should excavations be sloped, the minimum slope based on soil type (Fill/Granular Outwash) is 1.5H:1V provided the groundwater is properly lowered below the bottom of the excavation. The foregoing slope requirement does not consider surcharge loads (stockpiled soils, equipment, roadways, materials) which may be situated at the crest of the slope and vibration loads (soil compaction, sheet piling). It should be noted that these slope requirements are minimums required by OSHA/DLIDIS regulations. The contractor should be ultimately responsible for design, maintenance and stability of the temporary slopes and/or shoring associated with construction activities.

Laterally supported earth systems should be designed by a qualified Professional Engineer retained by the contractor per OSHA Regulations. Cantilevered soldier piles with lagging are expected to be feasible for depths of ≈8-10 ft.

CONSTRUCTION MONITORING

It is recommended that a qualified engineer or representative be retained to review earthwork activities such as the preparation of the foundation bearing subgrade and the placement/compaction of Structural Fill. It is recommended that KMM be retained to provide construction monitoring services. This is to observe compliance with the design concepts presented herein.

We trust the contents of this memorandum report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

Somerville199ElmSt.wpd

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by KMM Geotechnical Consultants, LLC.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Picker Construction in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by KMM Geotechnical Consultants, LLC. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to preliminary geotechnical design considerations only.

TABLE 1

Proposed Building
199 Elm Street
Somerville, MA

Recommended Soil Gradation & Compaction Specifications

Gravel Base Fill
(Select Crushed Gravel Fill)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3 inch	100
3/4 inch	60-90
No. 4	20-70
No. 200	2-8

NOTE: For minimum 8-inch base below Concrete Floor Slab-on-Grade (heated)
For minimum 12-inch base for concrete slabs or pavements exposed to frost
A ¾-inch crushed stone may be used in lieu of gravel
Shall have less than 12% fines (No. 200 sieve) based on the Sand fraction

Structural Fill
(Gravelly SAND, trace Silt)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 inch	100
3/4 inch	50-100
No. 4	20-80
No. 200	0-10

Structural Fill placed beneath the foundation should include the *Footing Zone of Influence* which is defined as that area extending laterally one foot from the edge of the footing then outward and downward at a 1H:1V splay. Structural Fill should be placed in loose lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors. Structural Fill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Test (ASTM-D1557). Structural Fill should be compacted within ±3% of optimum moisture content. The adequacy of the compaction efforts should be verified by field density testing which is also a requirement of the *Massachusetts State Building Code*.

TABLE 2

Proposed Building
199 Elm Street
Somerville, MA

Recommended Lateral Earth Pressures & Drainage for Unbalanced Walls

Lateral earth pressures for the structural design and stability analysis of unbalanced foundation walls (basement walls, retaining walls, elevator pit, etc) are provided herein. The following table outlines the recommended lateral earth pressure coefficients and equivalent fluid weights:

WALL CONDITION	LATERAL TRANSLATION (Δ/H)	EARTH PRESSURE COEFFICIENT (K)	EQUIVALENT FLUID WEIGHT (γ_{EFW})
restrained	0	K_o	60 pcf
no restraint	0.002	K_a	35 pcf
no restraint	0.02	K_p (FS=3)	125 pcf
seismic	n/a	K_{eq}	see note

where: Δ = movement at top of wall by tilting or lateral translation
H = height of wall

The above lateral earth pressures are based upon:

1. Rankine earth pressure theory;
2. Retaining wall backfilled with Structural Fill (Table 1)
3. Unit weight of backfill less than 125 pcf
4. No hydrostatic pressures
5. No surcharge loading;
6. A level backfill in front and behind of wall;
7. Seismic loads distributed as an inverse triangle over the height of wall (*MSBC*);
8. Dynamic/compaction stresses accounted for with seismic pressures;
9. Soil backfill densified with plate compactors within 3 ft lateral distance of wall;
10. Top 2 ft should not be considered for passive resistance.

The lateral load due to seismic pressure shall be in accordance with *Section 9.5.2.9* of the *MSBC*. *Equation 9.5.2.9* shall be used to estimate the seismic force (F_w). The unit weight of the backfill used in this equation is 125 pcf (Structural Fill). There are no soils subject to liquefaction below and/or behind the wall.

The lateral resistance of retaining walls should also accommodate surcharge loads. Uniformly distributed loads should be superimposed along the face of the wall at a magnitude equal to the surcharge pressure multiplied by the appropriate earth pressure coefficient. Surcharge loads should be considered where they are located within a horizontal distance equivalent to 1.0 times the height of the wall. Anticipated point or line loads situated behind the wall should be evaluated in accordance with linear elastic theory.

For frost and drainage concerns, it is recommended that *Structural Fill* (Table 1) be placed directly behind the unbalanced walls. The ground surface immediately adjacent to the unbalanced foundation should be sloped away from the building to allow for positive drainage. It is also recommended that the surficial materials adjacent to the building be relatively impermeable to reduce the volume of precipitation infiltrating into the subgrade. Such impermeable materials include Portland cement concrete, bituminous concrete, or a vegetated silty topsoil. The purpose of the low permeable soils or barriers is to mitigate storm water flow towards the embedded foundation.

Unbalanced foundation walls (basement level) should be provided with adequate footing drains per the *MSBC*. The drains should be located along the periphery of the footprint. The perimeter foundation drain should be located at least ≈2 inches above the bottom of footing elevation and six inches outward from the edge of footing. The drains should not encroach within the *Footing Zone of Influence* defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay. The invert elevation of the drain should be at least 10 inches below the underside of the adjacent floor slab. The drains should consist of minimum 4 inch diameter, perforated PVC-SDR 35 drain pipe encased within 12 inches of ¾-inch stone and wrapped with a filter fabric such as Mirafi 140N or equal. The drains shall discharge to an interior sump pit for pump ejection away from the building. Back-up power and alarm shall be provided in the event of a failure. <u>The Site Engineer should review the discharge of the drains</u>. The drains should be provided with permanent clean-outs at convenient locations to facilitate access to all sections of the system. Roof gutters and other storm collection should not be discharged to the foundation drains. Recharge systems, infiltrators and/or dry wells shall be kept away from the basement level to prevent hydrostatic surcharge<u>. This should also be reviewed by the Site Engineer.</u> Our experience with these urban projects is that the Site Engineer is required to discharge (infiltrate) storm water and roof gutters on the site. This is usually in conflict with the need to remove water away from the below grade basement areas. Nonetheless, this should be reviewed and designed accordingly. We have not seen *Drainage Plans* for the project.

The basement floor slab is expected to be impacted by seasonal fluctuations. We recommend an ESHGWT at elevation 17½ ft for design. Consideration should be given to elevating the basement slab to mitigate groundwater impact. We recommend an under slab drainage system for a basement below elevation 18 ft.

If the unbalanced foundation walls can not be drained to alleviate hydrostatic forces, then the lateral earth pressure equivalent fluid weight should be increased to 90 pcf. Such earth pressures should be used for elevator pits, if necessary. This increased lateral load should also be used if infiltrators or dry wells are located adjacent and above BOF grade.

<u>Recommended Friction Factor (f)</u>

$f = \tan(\delta)$, where δ is the interface friction angle

- Concrete against the following soils

Structural Fill (Table 1)	0.50
Glacial Soils	0.50

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

199 Elm Street
Somerville, MA

B-1

25-08037

Ground Elevation: 26 ft+/-
Date Started: 09/11/25
Date Finished: 09/11/25
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
9/11/25	11'6"		Upon Completion
9/15/25	11.9 ft		Well Reading

Depth Ft.		Sample No.	Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
							ASPHALT
						2"	______
1		1	10"	0'2"-2'2"	20-5-5-9		Tan, f-m Sand, little gravel, dry (FILL)
		2	3"	2'2"-4'2"	4-1-1-1		Dark Brown, Sand, little gravel, little silt, dry (FILL)
						5'	______
5		3	20"	5'0"-7'0"	7-7-14-19		Tan, mottled, Fine Sand, dry
		4	19"	7'0"-9'0"	9-14-17-14		Brown, f-m Sand, dry
10		5	17"	10'0"-12'0"	14-15-19-14		Brown, f-m Sand, wet (STRATIFIED SAND) Brown, f-c Sand, wet
15		6	20"	15'0"-17'0"	6-6-7-12		f-c Sand, little gravel, wet
						18'	______
20		7	24"	20'0"-22'0"	2-2-3-5		Grey, silty Clay (MARINE CLAY)
							______
							EOB @ 22' BGS Set Well @ 20'
25							GWT @ 11'6" upon completion
30							
35							

Notes: GeoProbe 6712

			CASING	SAMPLE	CORE TYPE
Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace 0 to 10%				
10 -30 M Dense, 30 -50 Dense, 50+ V Dense.	Little 10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff	Some 20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And 35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

199 Elm Street
Somerville, MA

B-2

25-08037

Ground Elevation: 26 ft+/-
Date Started: 09/11/25
Date Finished: 09/11/25
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING AT	STABILIZATION
9/11/25	11'6"		

Depth Ft.		Sample No.	Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
							ASPHALT
						2"	________________________________
1		1	12"	0'2"-2'2"	12-7-6-6		Black, silty Sand, little gravel, dry (FILL)
		2	3"	2'2"-4'2"	4-3-1-3		Tan-Black, Sand, dry (FILL)
							________________________________
5		3	6"	5'0"-5'6"	4	5'	Topsoil
						5'6"	________________________________
		3A	10"	5'6-7'0"	14-15-14		Tan, Fine Sand, dry
		4	20"	7'0"-9'0"	8-8-10-10		Tan, Fine Sand, little silt, dry
10		5	20"	10'0"-12'0"	12-7-11-14		Rust, f-c Sand, trace silt, wet
							(STRATIFIED SAND)
15		6	19"	15'0"-17'0"	14-14-15-11		f-c Sand w/ Gravel, wet
						18'	________________________________
20		7	24"	20'0"-22'0"	1-2-1-2		Grey, silty Clay, wet
25		8	23"	25'0"-27'0"	1-2-2-3		Grey, silty Clay, wet
							(MARINE CLAY)
30		9	20"	30'0"-32'0"	WH/12"-1-2		Grey, silty Clay, wet
35		10	24"	35'0"-37'0"	WH/24"		Grey, silty Clay, wet

Notes: Geoprobe 6712

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

199 Elm Street
Somerville, MA

B-2

25-08037

Ground Elevation: 26 ft+/-
Date Started: 09/11/25
Date Finished: 09/11/25
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION

Depth Ft.		Sample No.	Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
40		11	24"	40'0"-42'0"	WH/24"		Grey, silty Clay, wet
45							
							Soft Clay
50							
55							
							________________________________
60							EOB @ 57' BGS ** Still soft Push rod to 57' GWT @ 11'6" upon completion
65							
70							
75							

Notes: GeoProbe 6712

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

199 Elm Street
Somerville, MA

B-3

25-08037

Ground Elevation: 25 ft+/-
Date Started: 09/11/25
Date Finished: 09/11/25
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
9/11/25	11'6"		

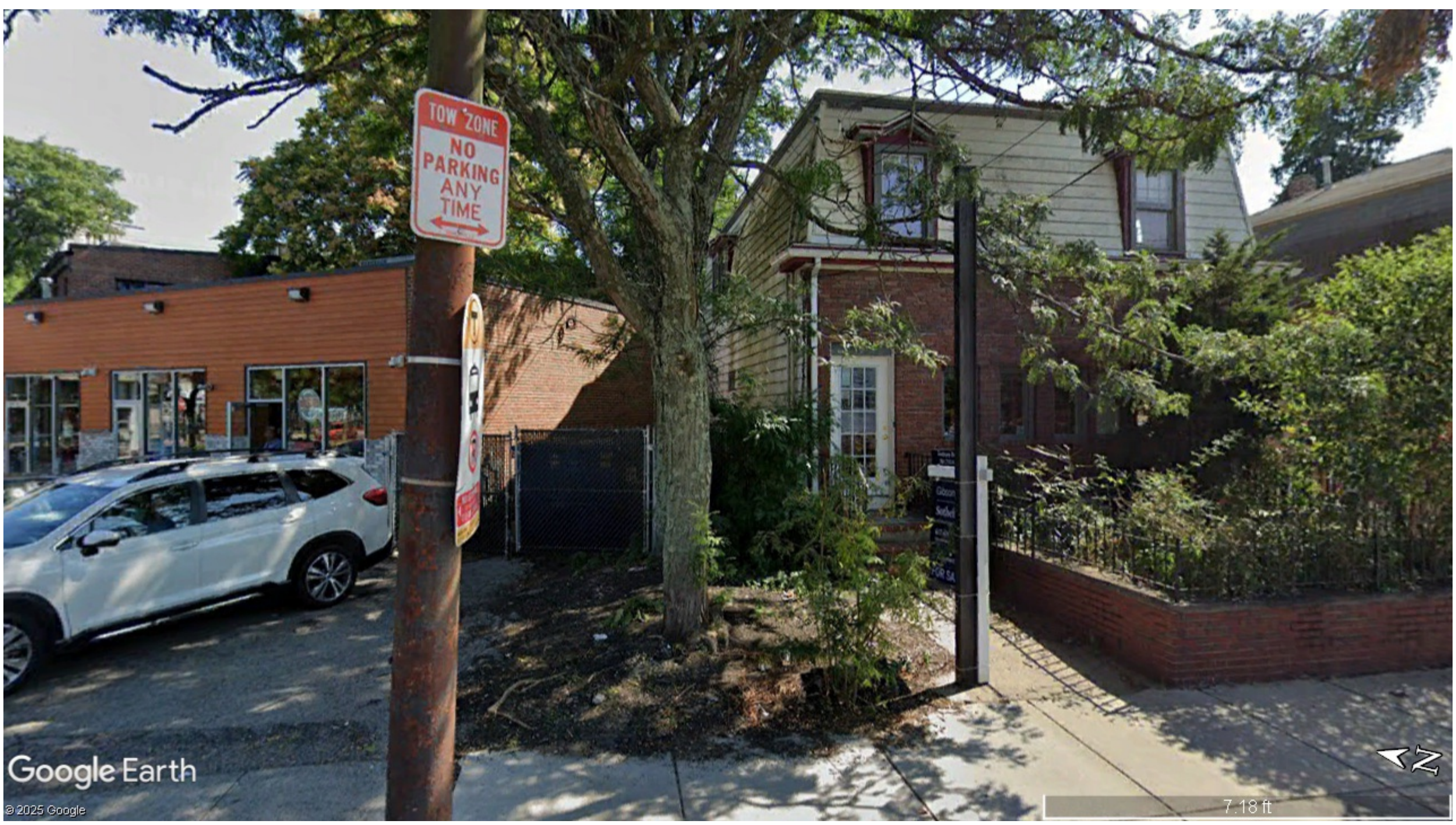
Depth Ft.		Sample No.	Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
							ASPHALT
						3"	
1		1	6"	0'2"-2'2"	15-7-8-7		Black, Sand, little silt (FILL)
		2	3"	2'2"-4'2"	5-5-4-6		Black Sand, little gravel, trace ash, cinders, dry (FILL)
						5'	
5		3	21"	5'0"-7'0"	12-12-12-16		Brown, Fine Sand, dry
		4	18"	7'0"-9'0"	10-9-9-10		Tan, mottled, f-c Sand, trace silt, dry
10		5	15"	10'0"-12'0"	15-15-10-9		f-c Sand, wet (STRATIFIED SAND)
15		6	16"	15'0"-17'0"	5-7-7-12		f-c Sand, little gravel, wet
						18'	
20		7	22"	20'0"-22'0"	2-2-3-3		Grey, silty Clay, wet (MARINE CLAY)
							EOB @ 22' BGS GWT @ 11'6" upon completion
25							
30							
35							

Notes: GeoProbe 6712

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	


TOW ZONE
NO
PARKING
ANY
TIME
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7.18 ft