KDEV, LLC
Geotechnical Engineering Evaluation

Valley View Subdivision
2219 NE 339th St
La Center, Washington

True North Project No. 22-0216-1
August 2022

August 8, 2022

KDEV, LLC
740 S 85th Ave
Ridgefield, WA 98642

Attn: Mr. Mason Wolfe

Subject: Geotechnical Engineering Evaluation
Valley View Subdivision
2219 NE 339th St
La Center, Washington 98629
True North Project # 22-0216-1

Dear Mr. Wolfe:

At your request, True North Geotechnical Services (True North) is providing you with this report summarizing our geotechnical services for the proposed new Valley View Subdivision residential development to be located at the above-mentioned address in La Center, Washington (site). The purpose of our services was to provide a geotechnical evaluation of the site as it pertains to the proposed new development.

We have endeavored to prepare this report in accordance with generally accepted geotechnical engineering practices at the time we prepared it, for the exclusive use of KDev, LLC, the owner, and their agents, for specific application to this project. Use or reliance upon this report by a third party is at their own risk. True North does not make any representation or warranty, express or implied, to such other parties as to the accuracy or completeness of this report or the suitability of its use by such other parties for any purpose whatever, known or unknown, to True North.

Based on the results of our study, development of the site with the proposed buildings and associated parking and utilities is feasible provided the recommendations in this report are included in the project design and implemented during construction. The chief geotechnical concerns of note associated with the project are ensuring foundations are bearing on dense, competent native soils.

The attached report includes a summary of our project understanding, geologic site reconnaissance, subsurface explorations, and our conclusions regarding the expected effect that the proposed lot development will have on the site.

PURPOSE AND SCOPE OF WORK

The purpose of our services was to provide a geotechnical evaluation of the site as it pertains to the proposed new development. This report includes a summary of our project understanding, geologic site reconnaissance, subsurface exploration, our conclusions regarding the effects of the proposed lot development on the site, and recommendations for design and construction.
The following describes our specific scope of work that was completed:

- **Geologic Map and Literature Review**: We reviewed published geologic and geologic hazard mapping for the site.
- **Test Pit Excavations:** We completed five (5) test pit excavations on the property. The test pit excavations extended to depths ranging from about 12 to 13 feet below the ground surface (bgs).
- **Laboratory Testing:** Samples collected from the borings were returned to our office for further examination including classification in general accordance with the Unified Soil Classification, Visual-Manual Procedure. Select samples were subjected to laboratory testing, including natural moisture content analysis, and fines content analysis.
- **Analysis:** Data collected during the literature research, subsurface explorations, and laboratory testing were used to develop site-specific geotechnical design parameters and construction recommendations.
- **Report Preparation:** This Geotechnical Engineering Evaluation summarizes the results of our explorations and analyses, including information relating to the following:
    - Exploration logs and site plan with exploration locations
    - Laboratory test results
    - Summary of interpreted surface and subsurface conditions
    - Shallow foundation design recommendations
        - Minimum embedment and allowable bearing pressure
        - Estimated settlement
        - Sliding coefficient and passive earth pressure
    - Subsurface drainage requirements
    - Earthwork recommendations
        - Temporary and permanent slope inclinations
        - Structural fill materials and preparation
        - Suitability of native and on-site soils for reuse as structural fill
        - Wet weather/conditions consideration
    - Foundation, slab and pavement subgrade preparation recommendations
    - Flexible and rigid pavement design recommendations
    - Utility trench excavation and backfill recommendations for associated utilities
    - Seismic design criteria and design considerations

PROJECT UNDERSTANDING

True North understands that you are planning to subdivide an existing Clark County Tax Parcel, no. 209062000. The site with respect to existing nearby features is shown in the attached Vicinity Map, Figure 1. The location of our explorations with respect to existing site conditions and the preliminary planned subdivision lots is shown on the attached Site Plan, Figure 2.

True North's understanding of the proposed development is based on a review of a "Preliminary Plat" for the project, prepared by Wolfe Project Management, LLC, dated April 13, 2022. We understand that the proposed project consists of the subdivision of the existing 8.6-acre lot into 34 new lots. The new lots will range in size from approximately to 0.17 to 0.22 acres and will each accommodate one single-family home. We understand that four existing public roadways, East Upland Avenue, East Vine Maple Avenue, East 9th Street, and East White Oak Avenue, are planned to be extended through the site to provide access to the lots. The plan proposes half street improvements on NE 24th Avenue and NE 339th Street, the Eastern and Northern site boundaries, respectively. In general, we understand that utilities are planned below the new roadways.

We anticipate the future homes at all lots will have relatively short driveways to the new private roadway and will be supported by conventional concrete spread footings. Based on our understanding of proposed development, we anticipate cuts and fills of less than 4 feet. The purpose of our explorations was to evaluate subsurface conditions and provide geotechnical recommendations for design and construction, including site preparation and support of the proposed new development.

SITE CONDITIONS

The site is located in the norther reaches of the Portland Basin, a structural basin filled with a thick sequence of sediment associated with basaltic lava flows and repeated glacial outburst flooding of the Columbia River and its tributaries. The last of these outburst flooding events, known as the Missoula Floods, occurred about 12,000 years ago. The flood deposits include layers of clay, silt, sand, and gravel. Some of the layers may include boulders up to 8 feet in diameter, often carried within large blocks of glacial ice.

In the immediate vicinity of the site the near surface soils are mapped as the sand and silt facies (QTc/Qa) of the ancestral Columbia River flood deposits. Soils consist of unconsolidated silt, sand, clay, and gravel from cobble to boulder size. The flood deposits are underlain at depth by basin-fill deposits that include the conglomerates and sandstone of the Tertiary-age Troutdale Formation (USGS SIM-3357).

Surface Description

As discussed above, the site currently consists of one parcel comprising a total 8.64 acres, located off NE 339th Street in La Center, Washington. The parcel is currently occupied by a house, several detached storage buildings and barns, and a long gravel driveway connected to NE 339th Street. The existing garage/shop buildings will be demolished for the proposed new development.

The ground surface at the site is generally level across the site. The elevation at the site ranges from approximately 286 to 306 feet above mean sea level (AMSL). Photographs of some of our explorations are included in Figure 3.

Subsurface Conditions

We explored the subsurface conditions at the project site on June 14, 2022. The field explorations consisted of five test pit excavations, designated TP-1 through TP-5, extended to a maximum depth of about 13.0 feet below the existing ground surface (bgs). The approximate test pit locations are shown on Figure 2. The test pits were logged and representative soil samples collected by us, which were returned to our office for further testing and examination. Descriptions of field and laboratory procedures and the exploration logs are included in Attachment A. The following is a generalized description of the subsurface units encountered in our explorations.

Clayey SILT: Light brown/orange Clayey Silt (CL) with variable amounts of sand was encountered just below the ground surface in TP-1, TP-3, TP-4, and TP-5 extending to depths ranging from about 4.5 to 7.0 feet bgs. In general, the silt exhibited low to medium plasticity and the consistency was soft to medium stiff.. The moisture content of three samples tested from this layer ranged from 25 to 32 percent and the fines content from one sample was about 85 percent.

Sandy SILT/ Silty SAND: Light brown/orange Sandy Silt (ML/SM) and Silty Sand (SM) with dark concretions was encountered just below the Clayey Silt layer in TP-1, TP-3, TP-4 and TP-5, and just below the ground surface in TP-2, extending to depths ranging from about 7.0 to 12.5 feet. TP-5 was terminated in this layer. The sand was generally poorly-graded, appearing fine grained in some samples and coarse grained in others. The sand content generally increased with depth. The moisture content of nine samples from this layer ranged from 27 to 31 percent and the fines content from one sample was about 80 percent.

CLAY: Light brown/orange Clay (CL and CH) with varying amounts of sand and silt was encountered below the silty/sandy layer in TP-1, TP-2 TP-3 and TP-4extending to the termination depths of about 12 to 13 feet bgs in all, except for TP-3. In general, the sand was fine grained. Occasional sizeable dark concretions were observed in some of this layer. The moisture content of our samples from this layer ranged from 27 to 42 percent and the fines content from three sample was about 90 to 93 percent.

Groundwater

Groundwater was not encountered in any of our test pits at the time of our explorations. A review of publicly available well logs for nearby properties indicated groundwater is located at depths ranging from about 50 to 60 feet below the existing ground surface, although due to the fine-grained nature of the subsurface soil, layers of perched water may be present in localized areas seasonally.

USDA Soil Identification

According to the USDA Web Soil Survey, the near-surface soils at the site are generally identified as Gee silt loam, with small deposits of Hillsboro and Odne silt loam in the northeast corner of the site. These soils generally consist of loamy silt with varying amounts of coarse to fine sand and are assigned the hydrologic soil group "C" based on drainage and other properties, indicating the soils have a low to moderately high capacity to transmit water.

Geologic Hazards

The following provides a geologic hazard review for the subject site. The geologic hazard review as based on our site reconnaissance and explorations, as well as a review of publicly available published literature and maps.

Slope and Landslide Hazards:

Slopes between 5 and 15 percent can be observed within portions of the site. Relatively flat areas exist in the most of the center of the site. It is our understanding that the site will be graded to create relatively level lots, with cut and fill thickness of up to about 4 feet. Based on this understanding of the existing and planned topography, slope and landslide hazards are not considerd a concern at the property.

Seismic Hazards:

The following seismic hazards have been considered as part of our geologic hazards review for the project site:

Ground Motion Amplification: Based on a review of Clark County Maps Online, the site is designated as seismic Site Class "D". However, based on the limited depth of our exploration and recommendations below, it is our opinion that a Site Class "D" is more appropriate for use at the site. The seismic design parameters, in accordance with the 2018 IBC (with Washington State amendments), are summarized in Table 2.

Table 2. 2015 IBC Seismic Design Parameters

Location	Short Period	1-Second
Maximum Credible Earthquake Spectral Acceleration	S_s = 0.887 g	S_1 = 0.395 g
Site Class	D	
Site Coefficient	F_a = 1.145	F_v = 1.609
Adjusted Spectral Acceleration	S_{MS} = 1.016 g	S_{M1} = 0.636
Design Spectral Response Acceleration Parameters	S_{DS} = 0.677 g	S_{D1} = 0.424

g – acceleration due to gravity * see note below

Due to the Site Class "D" designation and the long period MCES (S_1) value exceeding 0.2 g, the structural engineer must apply the site-specific ground motion increases outlined in Section 11.4.8

of ASCE 7-16, including an increased of 50 percent to the seismic base shear coefficient, C_s. As an alternative to applying these conservative increases to the ground motions, a site-specific ground motion hazard analysis may be performed, however such an analysis was not included in the scope of this study.

Liquefaction: Due to the expected relatively deep groundwater below the site and the relative density and fines content of the soils encountered in our explorations, we consider the potential for liquefaction settlement within the site boundaries to be very low to negligible. Indeed, the site is mapped as having a “very low” liquefaction susceptibility based on the Liquefaction Susceptibility Map of Clark County.

CONCLUSIONS AND RECOMMENDATIONS

Geotechnical Design and Construction Considerations

Based on the results of our site reconnaissance, subsurface explorations, and geologic map review, it is our opinion that the planned single-family residential development of the site within the proposed new lots and the associated utilities, access roads and driveways are feasible provided the recommendations in this report are included in the project design and implemented during construction. The chief geotechnical concern of note associated with the project is ensuring foundations are bearing on competent dense native soils and maintaining proper moisture control of the fine grained site soils during site grading and filling operations. Our opinion is based on field observations and subsurface explorations completed by True North and review of the following documents and information sources: County soils and groundwater mapping, a published geologic map, and our understanding of the proposed development plans.

Site Preparation

After any surface and near surface water sources have been controlled, the construction areas should be cleared and stripped of organic matter, and other deleterious materials. Silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads should be used as required to reduce sediment transport during construction to acceptable levels.

Where present, existing topsoil and other disturbed surface materials should be stripped and removed from proposed development locations and for a five-foot-margin around such areas. Based on our explorations, the depth of stripping may range from 3 to 6 inches, although greater stripping depths may be required if loose or soft materials are encountered, or where mature trees and their associated roots are removed. Deleterious materials encountered during site preparation should be removed from the subgrade soils and hauled off site for disposal. Stripped material should be transported off site for disposal or stockpiled for use in landscaped areas. If stripping operations occur during wet weather, a generally greater stripping depth might be required in order to remove disturbed moisture sensitive soils; therefore, stripping is best performed during a period of dry weather.

Subgrade Verification

Following site preparation, including removal of all topsoil/till zone and compaction of the exposed subgrade and prior to placing aggregate base for the foundations, building pad, or pavement section, the exposed subgrade should be evaluated. The subgrades should be evaluated by qualified True North personnel using a steel foundation probe. Unsuitable areas identified during the field evaluation should be re-compacted to or be excavated to firm ground and replaced with structural fill.

Wet/Freezing-Weather/Wet-Soil Conditions

Due to the presence of fine-grained silt in the near-surface materials at the site, construction equipment may have difficulty operating on the near-surface soils when the moisture content of the surface soil is more than a few percentage points above the optimum moisture required for compaction. Soils that have been disturbed during site preparation activities, or unsuitable areas identified during proofrolling or probing, should be removed and replaced with compacted structural fill.

Site earthwork and subgrade preparation should not be completed during freezing conditions.

Protection of the subgrade is the responsibility of the contractor. Construction of granular haul roads may help reduce further damage to the pavement and disturbance of site soils. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic. The actual thickness of haul roads and staging areas should be based on the contractors' approach to site development, and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. A geotextile fabric should be used to separate the subgrade from the imported granular material in areas of repeated construction traffic.

Excavations

Where required, temporary soil cuts associated with site excavations or regrading activities should be adequately sloped back to prevent sloughing and collapse, unless a shoring box or other suitable excavation side wall bracing is provided. It is the responsibility of the contractor to ensure that excavations are properly sloped or braced for worker safety protection, in accordance with OSHA safety guidelines.

Structural Fill

Structural fill includes any fill materials placed under footings, pavements, or driveways and backfill over the embedded mat foundation. Typical materials used for structural fill include: clean, well-graded sand and gravel; clean sand; crushed rock; controlled-density fill (CDF); lean-mix concrete; and various soil mixtures of silt, sand, and gravel. Use of the on-site soils as structural fill may be feasible, provided they are properly moisture conditioned prior to placement and compaction. Due to their fine-grained nature, mass grading at the site should be limited to dry weather.

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well graded between coarse and fine particle sizes. The fill should contain no organic matter or other deleterious materials, have a maximum particle size of one inch, and have less than 5 percent passing the U.S. No. 200 Sieve. In deep excavations, or where subgrade soils require stabilization, the particle size may be increased to four inches. The percentage of fines can be increased to 12 percent of the material passing the U.S. No. 200 Sieve if placed during dry weather and provided the fill material is moisture-conditioned, as necessary, for proper compaction. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exist, the initial lift thickness may be increased to 24 inches and should be compacted by rolling with a smooth-drum, nonvibratory roller.

Foundations

Continuous-wall and isolated-spread footings should be at least 12 and 24 inches wide, respectively. For frost protection, the footings should be founded at least 12 inches below the lowest adjacent grades or deeper if required by local building code. The footings should be founded below an imaginary line project at a 1H:1V slope from the base of any adjacent, parallel utility trenches.

Footings should bear on the near-surface silt or gravelly clay or structural fill placed in accordance with our recommendations. Footings should be sized for an allowable bearing capacity of 1,500 psf. We estimate post construction settlements will be less than one inch for our recommended allowable bearing capacity. We estimate that the differential settlement will be approximately half of the total settlement. Our recommended bearing capacity is based on limiting settlements and includes a minimum factor of safety of 3 against ultimate bearing failure.

Lateral loads acting on the foundations can be resisted by passive earth pressures on the sides of the foundation and by friction along the soil-rock-concrete interface at the base of the foundation. We recommend using an allowable passive earth pressure of 250 pounds per cubic foot (pcf) for foundations confined by the near-surface silty sand or structural fill placed in accordance with our recommendations. We recommend an allowable coefficient of friction of 0.35 for foundations. In order to develop these capacities, concrete must be poured neat in excavations, the adjacent grade must be level, and the static ground water level must remain below the base of the footing throughout the year. The passive pressure within the upper foot of embedment should be neglected. These allowable lateral resistance values include a factor of safety of 1.5.

Slab-on-grade Floors

Satisfactory subgrade support for lightly-loaded building floor slabs can be obtained on the undisturbed native soil or on engineered structural fill. A subgrade modulus of 125 pounds per cubic inch may be used to design floor slabs.

A minimum 6-inch-thick layer of drain rock should be placed and compacted over the prepared subgrade to assist as a capillary break and blanket drain. The drain rock may include a capping layer of clean ¾ inch minus crushed rock that contains no more than 5% fines. The drain rock and capping rock should be placed in one lift and compacted until well-keyed, about 90% of the maximum dry density as determined by ASTM D698.

A vapor retarder manufactured for use beneath floor slabs should be installed according to the manufacturer's recommendations. Careful attention should be made during construction to prevent perforating the retarder, and to seal edges and utility penetrations. We recommend following ACI 302.1, Chapter 3 with regard to installing a vapor retarder.

Pavement Design

The following pavement design recommendations are based on our experience with similar facilities and subgrade conditions.

For automobile parking areas, we recommend a pavement section consisting of 3 inches of asphaltic concrete (AC) over 8 inches of crushed rock base (CRB) or 5 inches of Portland Cement concrete (PCC) over 5 inches of crushed rock base (CRB). For truck traffic areas, the pavement section should consist of 4 inches of AC over 12 inches of CRB or 6 inches of PCC over 8 inches of CRB. These recommended pavement sections are based on the assumption that the subgrade consists of firm structural fill or compacted native subgrade and that the pavement will be constructed during the dry summer months. Proofrolling should be used to evaluate pavement subgrade. Any soft areas disclosed by proofrolling will likely need to be reworked. Some contingency should be provided for the repair of any soft areas. If pavement construction is scheduled for the wet season, it will be necessary to increase the above-recommended base course sections. AC and CRB materials should conform to WSDOT specifications. All CRB should be compacted to at least 95 percent of the modified proctor ASTM D-1557 laboratory test standard.

Permanent, properly installed drainage is also an essential aspect of pavement design and construction. All paved areas should have positive drainage to prevent ponding of surface water and saturation of the base course. This is particularly important in cut sections or at low points within the paved areas, such as around stormwater catch basins.

Drainage

The Contractor should be made responsible for temporary drainage of surface water and groundwater as necessary during construction to prevent standing water and/or erosion at the site.

As a matter of good construction practice, we recommend that perimeter drains be installed for all buildings. Perimeter drains should consist of perforated drainpipe embedded in a zone of free draining fill that is wrapped in a non-woven geotextile filter. The pipe should be connected to a tightline drainpipe leading to storm drain facilities. Foundation and crawl space drainage should be sloped to drain to a sump or low point drain outlet. Water should not be allowed to pond within crawl spaces. Roof drains should be connected to a tightline drainpipe leading to storm drain outlet facilities.

Water should not be allowed to “pond” or collect anywhere on the site. The ground surface around structures should be sloped to drain away from building foundations for a distance of at least 5 feet. Surface water should be directed away from all buildings into drainage swales or other approved drainage areas. “Trapped” planting areas should not be created next to any buildings without providing means for drainage.

Soil Erosion

Site-specific erosion control measures should be implemented to address the maintenance of slopes or exposed areas. This may include silt fence, bio-filter bags, straw wattles, or other suitable methods. During construction, all exposed areas should be well compacted and protected from erosion. Temporary slopes or expose areas may be covered with straw, crushed aggregate, or rip in localized areas to minimize erosion.

Finished slopes should be vegetated as soon as possible with erosion-resistant native grasses and plants. Once established, slope vegetation should be properly maintained. Concentrated water should be prevented from flowing over slope faces.

CONSTRUCTION OBSERVATIONS

Satisfactory earthwork performance depends on the quality of construction. Sufficient monitoring of the contractor’s activities is a key part ensuring that work is completed in accordance with the construction drawings and specifications. We recommend that True North observe that the subsurface conditions observed during our site investigation are consistent with those encountered during construction, and that foundation subgrades are suitable for placement of structural fill, rebar, or concrete for the new structures.

Clark County may require a final letter of geotechnical compliance before they will finalize a permit. If such a letter is required, a representative from True North MUST observe foundation subgrades PRIOR to concrete being poured for the foundation. If True North does not perform this observation, we cannot provide a final letter of geotechnical compliance, and a permit will not be eligible for final sign-off. It is the owner's responsibility to ensure that True North be notified in a timely manner (i.e., at least 48 hours prior to the required site observation) of the need for our services on site during construction.

LIMITATIONS

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed Valley View subdivision. The opinions and recommendations contained within this report are not intended to be, nor should they be, construed as a warranty of subsurface conditions, but are forwarded to assist in the planning and design process.

We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist in other locations. If subsurface conditions vary from those encountered in our site exploration, True North should be alerted to the change in conditions so that we may provide additional geotechnical recommendations, if necessary. The future performance and integrity of the improvements will depend largely on proper initial site preparation, drainage, and construction procedures. Observation by experienced geotechnical personnel should be considered an integral part of the construction process.

The conclusions and recommendations contained in this report are based on our understanding of the currently proposed project, as derived from written and verbal information supplied to us by you. When the design has been finalized, we recommend that we review the design and specifications to see that our recommendations have been interpreted and implemented as intended. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

CLOSING

I appreciate the opportunity to be of service to you. If you have any questions, or if I can be of further assistance to you, please contact me at (360) 984-6584.

Respectfully Submitted,

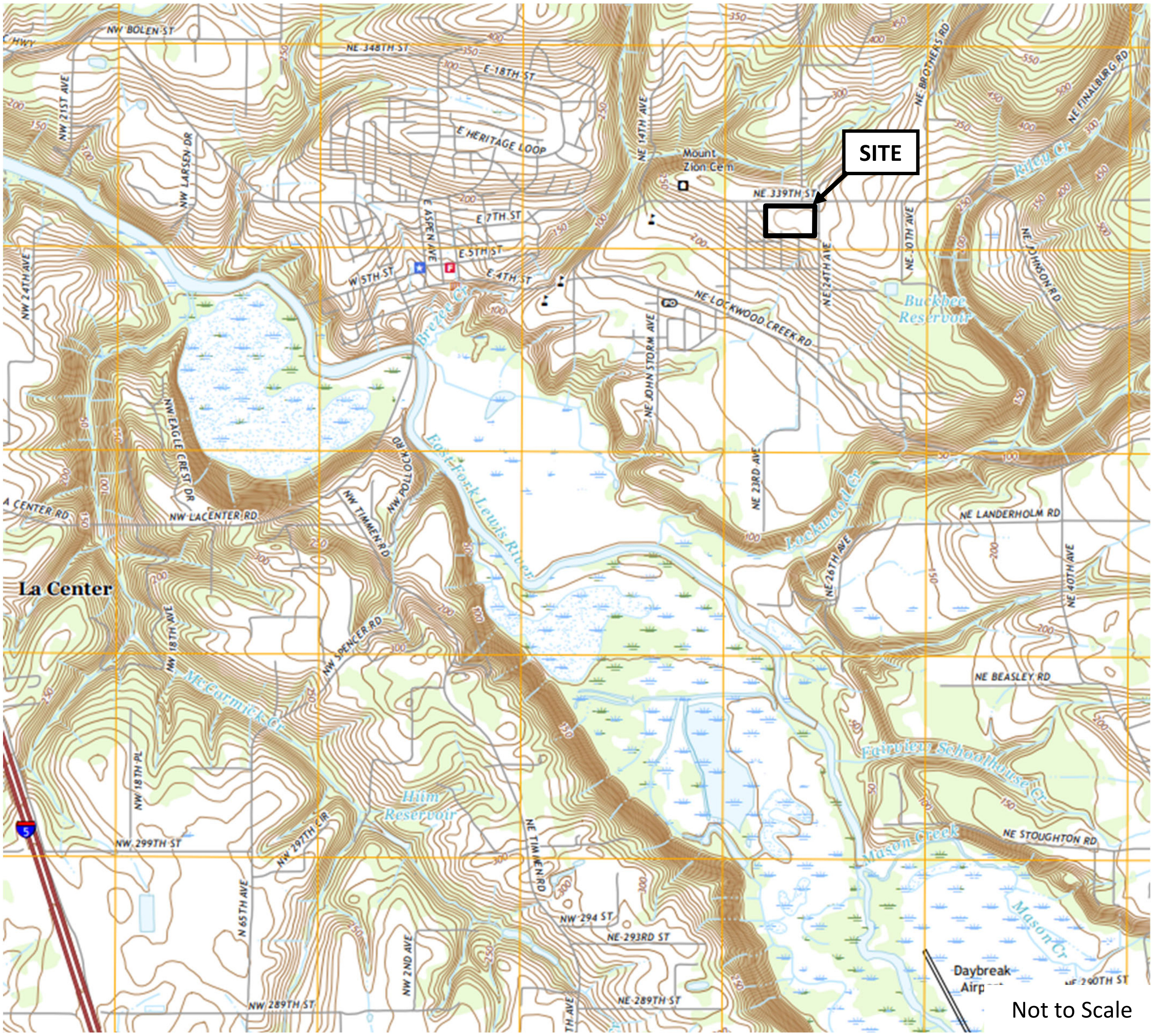
TIMOTHY JAMES NORTH
STATE OF WASHINGTON
48620
REGISTERED PROFESSIONAL ENGINEER

Exp: 01/20/23

Timothy J. North, P.E.
Geotechnical Engineer

Attachment:	Figure 1 – Vicinity Map
	Figure 2 – Site & Exploration Plan
	Figure 3 – Typical Cut and Fill Slope Detail
	Appendix A – Field Exploration and Laboratory Testing Procedures
	Test Pit Logs TP-1 through TP-5

FIGURES



Not to Scale

Source: “Topographic Map of the Ridgefield Quadrangles, 7.5 minute series” 2020, United States Geological Survey, accessed June 16, 2022.

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Valley View Subdivision
La Center, WA

Project # 22-0216-1

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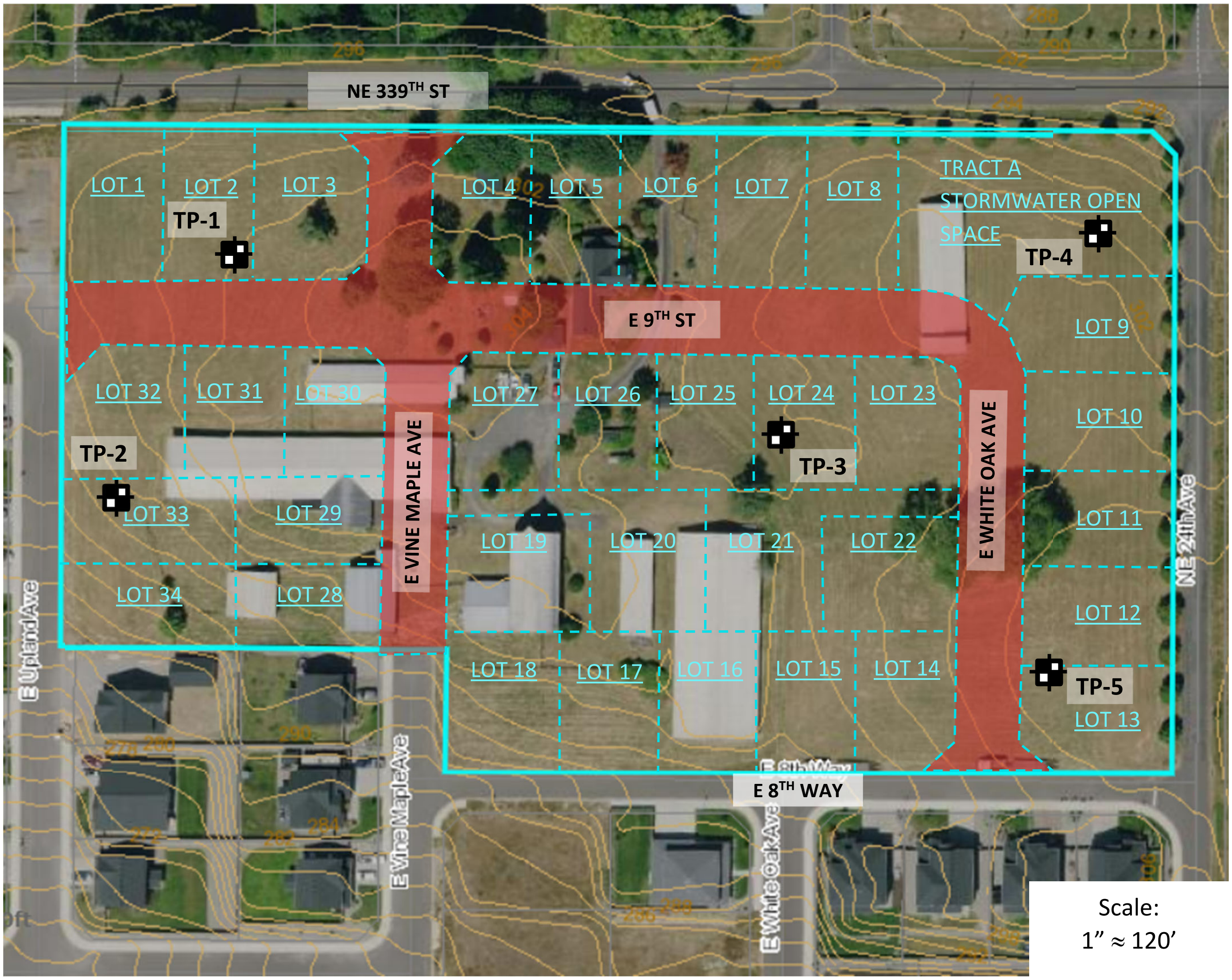
August 2022

Figure 1 – Vicinity Map



TP-1 ⌖ Approximate Test Pit Locations, excavated June 14, 2022

Source: Aerial & Topo – Clark County MapsOnline, accessed June 16, 2022.

Subdivision Layout – “ Preliminary Plat & Preliminary Utility Plan”, by Wolfe Project Management, LLC, dated April 13, 2022.

TRUE NORTH ◆ GEOTECHNICAL ◆	KDEV, LLC Valley View Subdivision La Center, WA	Project # 22-02106-1
202 E Evergreen Blvd, Suite B Vancouver, WA 98660 360-984-6584	August 2022	Figure 2 – Site and Exploration Plan

Photo 1. Excavation at TP-3; colorful silty clay observed in every test pit at varying depths.

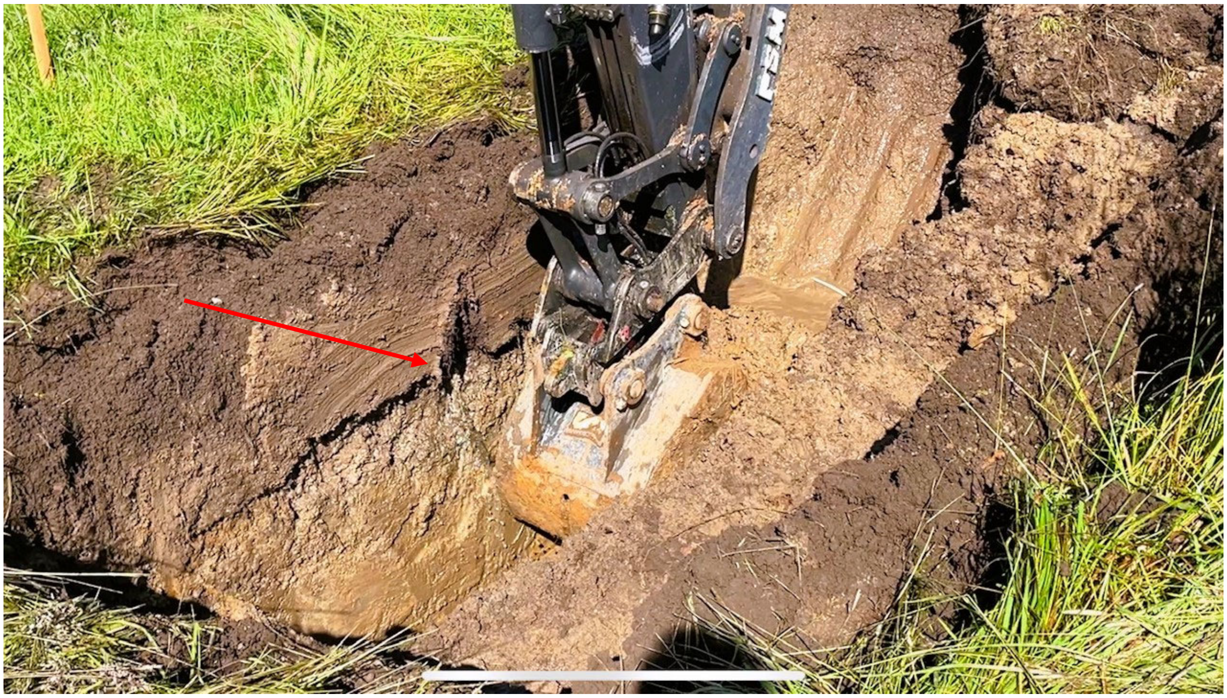


Photo 2. Excavation at TP-5, arrow pointing toward damaged clay drainage pipe; no groundwater observed.

TRUE NORTH ◆ GEOTECHNICAL ◆	KDEV, LLC Valley View Subdivision La Center, WA	Project # 22-0216-1
202 E Evergreen Blvd, Suite B Vancouver, WA 98660 360-984-6584	August 2022	Figure 3 (Sheet 1 of 1) – Site Photographs

APPENDIX A

Field Exploration Procedures
Laboratory Testing Procedures
Test Pit Logs

FIELD EXPLORATION PROCEDURES

General

We explored subsurface conditions at the site by excavating five test pits, designated TP-1 through TP-5, to depths ranging from about 12.0 to 13.0 feet bgs. The test pit explorations were excavated on June 14, 2022 with a Hitachi ZX tracked mini-excavator, owned and operated by Dan Tapani Excavating of Battle Ground, Washington. Upon completion, the test pits were backfilled with excavated soils.

Soil Sampling

A True North representative observed subsurface explorations to record the soil, rock, and groundwater conditions encountered, and to obtain soil samples. Disturbed soil sample were obtained from the sidewalls of the excavation, the excavator bucket, and the hand auger bit at selected depths throughout the explorations. Soil samples were sealed to retain moisture and returned to our laboratory for additional examination and testing.

Field Classification

Soil samples were initially classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors, and other distinguishing characteristics of the soil samples were noted. The terminology used is described in the key and glossary that follow.

Summary Exploration Logs

Results from the test pits are shown in the summary exploration logs. The left-hand portion of a log provides our interpretation of the soil encountered, sample depths, and groundwater information. The right-hand portion of a log shows the results of field and laboratory testing. Soil descriptions and interfaces between soil types shown in summary logs are interpretive, and actual transitions may be gradual.

LABORATORY TESTING PROCEDURES

Soil samples obtained during field explorations are examined in a laboratory, and representative samples may be selected for further testing. The testing program included visual-manual classification and natural moisture content testing.

Visual Manual Classification

Soil samples are classified in general accordance with guidelines presented in ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The physical characteristics of the samples are noted and the field classifications are modified, where necessary, in accordance with ASTM terminology, though certain terminology that incorporates current local engineering practice may be used. The term which best described the major portion of the sample is used to describe the soil type.

Natural Moisture Content

Natural moisture content is determined in general accordance with guidelines presented in ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

Fines Content

Fines content testing is performed in general accordance with guidelines presented in ASTM D1140, *Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No.200) Sieve in Soils by Washing*. The fines content is the fraction of soil that passes the U.S. Standard Number 200 Sieve. This sieve differentiates fines (silt and clay) from sand and gravel. Soil material that remains on the Number 200 sieve is sand. Material that passes the sieve is fines. The test is used to refine soil type.

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TABLE A1
Key to Test Pit and Boring Terminology and Symbols

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTION
			GRAPH	LETTER	
Coarse Grained Soils More Than 50% Material Retained on No. 200 Sieve	Gravel and Gravelly Soils More Than 50% Coarse Fraction Retained on No. 4 Sieve	Clean Gravels (Little or No Fines)	○	GW	Well-graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			⬡	GP	Poorly-graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		Gravels with Fines (Significant Percentage of FInes)	▥	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			▨	GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand and Sandy Soils More Than 50% Coarse Fraction Passing No. 4 Sieve	Clean Sands (Little or No Fines)	░	SW	Well-graded Sands, Gravelly Sands, Little or No Fines
			░	SP	Poorly-graded Sands, Gravelly Sands, Little or No Fines
		Sands with Fines (Significant Percentage of FInes)	▥	SM	Silty Sands, Sand-Silt Mixtures
			▨	SC	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils More Than 50% Material Passing No. 200 Sieve	Silts and Clays	Liquid Limit Less than 50 percent	▥	ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands, Clayey Silts
			▨	CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays
			▤	OL	Organic Silts and Organic Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit Greater than 50 percent	▥	MH	Inorganic Silts Micaceous or Diatomaceous Fine Sand or Silty Soils
			▨	CH	Inorganic Clays of High Plasticity, Fat Clays
			▨	OH	Organic Clays of Medium to High Plasticity, Organic Silts
			+	PT	Peat, Humus, Swamp Soils
Topsoil			░		Humus and Duff Layer
Fill			▩		Highly Variable Constituents

Relative Density of Coarse-Grained Soils	
Relative Density	**N - Blows per Foot**
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50+

Consistency of Fine-Grained Soils	
Relative Density	**N - Blows per Foot**
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 -8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	30 - 50
Very Hard	50+

Key to Sampler Type Symbols

G	☒	◫	▥	◨
Grab	SPT	Shelby Tube	Dames & Moore	Rock Core

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TEST PIT LOG TP-1

Project Name: KDEV - Valley View Estates

Project Location: 2219 NE 339th St, La Center WA 98629

Project No.: 22-0216-1

Operator: Dan Tapani Excavating

Equipment: Mini excavator w 2' bucket

Date Started: 06/14/22

Logged By: EP

Checked By: TJN

Date Completed: 06/14/22

Depth (feet)	Sample Type	Sample No.	Graphic Log	USCS Symbol	Soil Description	Water Content, %	Field Testing	Notes and Lab Data
					Loose to medium stiff, dark brown TOPSOIL with trace sand; medium plasticity; fine sand; moist.			
1					Medium stiff, light brown and orange Clayey SILT with trace sand; medium plasticity; fine sand; moist.			
2							PP= 0.5 PP= 1.0	
3	G	S-1		ML/ CL		30	PP= 2.5	
4							PP= 3.0	
5					Medium stiff to stiff, orange Sandy SILT; low to medium plasticity; trace dark concretions; moist.			
6	G	S-2			increasing plasticity, stiffness, and sand content with depth	27		
7				ML/ SM				
8	G	S-3				29		
9								
10	G	S-4			Medium stiff, orange/red and gray CLAY with silt and sand; low plasticity; fine sand; minor cementation; moist.	29		Fines content = 84%
11				CL				
12								
13					Excavation terminated at 13.0 feet bgs. Groundwater not encountered. Backfilled with excavated soils.			
14								
15								

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TEST PIT LOG TP-2

Project Name	KDEV - Valley View Estates		
Project Location	2219 NE 339th St, La Center WA 98629	Project No.	22-0216-1
Operator	Dan Tapani Excavating	Equipment	Mini excavator w 2' bucket
Date Started	06/14/22		
Logged By	EP	Checked By	TJN
Date Completed	06/14/22		

Depth (feet)	Sample Type	Sample No.	Graphic Log	USCS Symbol	Soil Description	Water Content, %	Field Testing	Notes and Lab Data
			⁘		Loose to medium stiff, dark brown TOPSOIL with trace sand; moist.			
1 2 3 4 5	G G	S-1 S-2	⁙	ML/ SM	Soft to medium stiff, light brown Sandy SILT; low plasticity; fine sand; moist. increasing stiffness and orange color with depth	28 28	PP= 1.0 PP= 1.0 PP= 1.5 PP= 4.0	
6 7 8	G	S-3	⁙	ML/ SM	Medium stiff, orange and light brown Sandy SILT; low to medium plasticity; dark concretions; moist.	27		Fines content = 86%
9 10			⁙	SM	Medium dense, red/orange Silty SAND; low plasticity; fine sand; gray concretions; moist.			
11	G	S-4	▨	CL/ ML	Stiff, yellow/orange Silty CLAY with trace sand; medium plasticity; fine sand; colorful concretions; moist.	30		Fines content = 92%
12 13 14 15					Excavation terminated at 12.0 feet bgs. Groundwater not encountered. Backfilled with excavated soils.			

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TEST PIT LOG TP-3

Project Name	KDEV - Valley View Estates
Project Location	2219 NE 339th St, La Center WA 98629
Project No.	22-0216-1
Operator	Dan Tapani Excavating
Equipment	Mini excavator w 2' bucket
Date Started	06/14/22
Logged By	EP
Checked By	TJN
Date Completed	06/14/22

Depth (feet)	Sample Type	Sample No.	Graphic Log	USCS Symbol	Soil Description	Water Content, %	Field Testing	Notes and Lab Data
					Loose, dark brown TOPSOIL with trace sand; moist.			
1				ML/ CL	Soft to medium stiff, light brown/gray Clayey SILT; medium plasticity; moist.		PP= 0.5	
2							PP= 0.5	
3	G	S-1				25	PP= 0.75	Fines content = 85%
4							PP= 1.0	
5	G	S-2		ML/ SM	Medium stiff, orange and light brown Sandy SILT; low to med plasticity; coarse sand; dark concretions; moist.	23		
6								
7								
8	G	S-3		CH	Stiff, gray CLAY with trace red/orange silt and sand; high plasticity; fine sand; moist. increasing sand content with depth	27		Fines content = 90%
9								
10								
11								
12				ML/ SM	Medium stiff, light brown Sandy SILT; med plasticity; fine sand; moist.			
13	G	S-4				38		Fines content = 70%
					Excavation terminated at 13.0 feet bgs. Groundwater not encountered. Backfilled with excavated soils.			
14								
15								

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TEST PIT LOG TP-4

Project Name KDEV - Valley View Estates		Project No. 22-0216-1
Project Location 2219 NE 339th St, La Center WA 98629		
Operator Dan Tapani Excavating	Equipment Mini excavator w 2' bucket	Date Started 06/14/22
Logged By EP	Checked By TJN	Date Completed 06/14/22

Depth (feet)	Sample Type	Sample No.	Graphic Log	USCS Symbol	Soil Description	Water Content, %	Field Testing	Notes and Lab Data
			░		Loose, dark brown TOPSOIL with trace sand; moist.			
1 2	G	S-1	▥	ML/ CL	Soft, dark brown Clayey SILT; medium plasticity; moist.	32	PP= 1.0 PP= 1.0	
3 4	G	S-2	▥	ML/ CL	Soft, light brown Clayey SILT with trace sand; low plasticity; coarse sand; moist.	31	PP= 1.5 PP= 2.0	Fines content = 91%
5 6			▒	SM	Medium dense, light brown Silty SAND; medium plasticity; fine sand; dark concretions; moist.			
7 8	G	S-3	▨	CL	Stiff, light brown/orange Sandy CLAY; medium plasticity; fine sand; moist.	33		
9 10 11 12	G	S-4	▨	CH	Stiff, brown/orange/gray CLAY with trace sand; high plasticity; fine sand; dark gray concretions; moist. increasing clay content with depth	42		Fines content = 93%
13 14 15					Excavation terminated at 13.0 feet bgs. Groundwater not encountered. Backfilled with excavated soils.			

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TEST PIT LOG TP-5

Project Name KDEV - Valley View Estates		
Project Location 2219 NE 339th St, La Center WA 98629		Project No. 22-0216-1
Operator Dan Tapani Excavating	Equipment Mini excavator w 2' bucket	Date Started 06/14/22
Logged By EP	Checked By TJN	Date Completed 06/14/22

Depth (feet)	Sample Type	Sample No.	Graphic Log	USCS Symbol	Soil Description	Water Content, %	Field Testing	Notes and Lab Data
					Loose, dark brown TOPSOIL with trace sand; moist.			
1				ML/ CL	Soft to stiff, light brown/orange Clayey SILT with trace sand; coarse sand; low to medium plasticity; moist.		PP= 1.5	
2	G	S-1			increasing plasticity and stiffness with depth	30	PP= 2.0	Fines content = 90%
3							PP= 3.0	
4							PP= 3.5	
5								
6								
7	G	S-2				25		
				ML/ SM	Very stiff, light brown/orange Sandy SILT; medium plasticity; fine sand; dark concretions; moist.			
8	G	S-3				28		
9								
10				SM	Stiff, orange Sandy SILT with gray clay; medium plasticity; fine sand; dark concretions; moist.			
11	G	S-4				29		Fines content = 81%
12								
13					Excavation terminated at 12.5 feet bgs. Groundwater not encountered. Backfilled with excavated soils.			
14								
15								