ADDENDUM NO. 1
to
REQUEST FOR PROPOSALS
by
CLATSOP CARE CENTER HEALTH DISTRICT
FOR CM/GC SERVICES
SKILLED NURSING FACILITY PROJECT

This Addendum No. 1 is dated November 24, 2026, and revises the Request for Proposals ("RFP") as follows. Terms used but not defined in this Addendum shall have the meanings given to them in the RFP.

1. *Section IV.B.1 of the RFP is hereby deleted and replaced with the following:*

   "1. Opening of Proposals. Proposals received in response to this RFP will be opened by the District at the time and date specified in the RFP Schedule, as modified by the District. Proposers who wish to be present at that time will be informed of the number and names of Proposers. No other information will be made available at that time."

2. *Enclosed as Attachment 1 to this Addendum is Exhibit C to the Contract.*

3. *AIA Document A201-2017 of the Contract is amended to include the following new provision as new Section 15.1.7:*

   "§ 15.1.7 Limited Waiver of Claims for Consequential Damages
   Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract, but only to the extent such consequential damages exceed the applicable limits of insurance required by this Contract. This mutual waiver applies only to Claims for the following items of consequential damages:

   .1 damages incurred by the Owner for rental expenses; losses of use, income, profit, financing, business, and reputation; and losses of management or employee productivity or of the services of such persons; and

   .2 damages incurred by the Contractor for principal office expenses, including compensation of personnel stationed there; losses of financing, business, and reputation; losses of profit on this Project or Contractor's other projects, including anticipated profit arising directly from the Work.

   This mutual waiver also applies to consequential damages, if any, arising out of or relating to either party's termination or suspension of the Contract in accordance with Section 14.

   Notwithstanding the foregoing, this mutual waiver shall not: (a) apply to or limit Contractor's indemnification duties or obligations under the Contract, including those set forth in Section 3.18.1; (b) limit or preclude Owner's recovery of liquidated damages for delay; (c) limit either party's liability for direct damages

or other damages that are not consequential damages; (d) apply to Claims by Owner against Subcontractors; (e) limit Contractor's liability for consequential damages arising out of or relating to Contractor's gross negligence or willful misconduct; or (f) limit Contractor's liability for fraud.

If Contractor successfully challenges the enforceability of any liquidated damages provision applicable to delay, the waiver of consequential damages in this Section 15.1.7 shall not apply to Owner's damages resulting from the delay that would otherwise have been subject to such liquidated damages provision, and Owner may recover its actual damages resulting from such delay, including consequential damages, to the extent otherwise recoverable under applicable law."

4. *Enclosed as Attachment 2 to this Addendum is the sign-in sheet from the non-mandatory pre-proposal conference.*

5. *Enclosed as Attachment 3 to this Addendum is the geotechnical report.*

6. *If the District elects to conduct interviews of one or more prospective proposers, the proposer(s) should be prepared to discuss the following topics, among others:*
    a. *The actual people assigned to Clatsop Care. Their experience, availability, responsibilities, and*
    b. *Preconstruction estimating and cost control. How the firm will establish credible estimated costs, identify history working together, savings, and avoid surprises.*
    c. *Deep soil mixing and site preparation. How it will coordinate geotechnical work, manage risks, and establish an achievable construction sequence.*
    d. *Working alongside an operating skilled nursing facility. Protecting residents and staff while minimizing operational disruptions.*
    e. *Collaboration and problem-solving. Examples of difficult decisions made with owners, architects, and consultants.*
    f. *Schedule management. How the firm intends to organize subcontractors, staffing, procurement, and construction activities.*
    g. *Relevant completed projects. Specific examples, including lessons learned, final costs, change orders, and schedule performance.*

7. *Following are questions received from prospective proposers and the District's responses.*

    a. Question: Could I please get an engineer's estimate or cost range for this project, if one is available?

        District Response: We do not have an engineer's estimate, but a preliminary estimate was prepared during the pre-bond measure work. The estimate for deep soil mixing and related earthwork is $8.5 million, and the estimate for building construction is $21.2 million.

b. Question: Can you explain the discrepancy between the illustrative slides included in Appendix A of the RFP and the 70% design development drawings regarding the commercial kitchen.

   District Response: With the new skilled nursing facility being attached to the existing assisted living facility, the plan is to share a commercial kitchen between the two facilities. The 70% DD drawings were made assuming the commercial kitchen in the existing facility would be used. A later decision was made to put the shared commercial kitchen in the new facility, and the illustrative slides reflect the updated floor plan.

c. Question: Can a copy of the soils report be provided?

   District Response: A copy of the geotechnical report is included with this Addendum.

d. Question: From the RFP, in the A201 index on page 8 (Appendix B Page 54 of 93) it lists Waiver of Consequential Damages 14.2.4, 15.1.7. Section 15.1.7 however is missing from the version of the A201 included in the contract example in the RFP. Is the owner willing to include the language from a standard A201 in section 15.1.7 that includes the mutual waiver of consequential damages?

   District Response: Owner has considered this request but is not willing to incorporate the standard AIA A201 Section 15.1.7 mutual waiver of consequential damages. In Owner's view, the standard waiver does not appropriately allocate the risk of consequential losses arising from matters for which Contractor is responsible under the Contract and could unreasonably shift the financial consequences of such matters to Owner.

   Owner has, however, included in this Addendum a revised Section 15.1.7 that provides a limited mutual waiver of consequential damages. This provision is intended as a reasonable compromise that balances the Owner's and Contractor's interests. Proposers should base their proposals on the Contract as revised.

   Proposers are reminded that Section I.J of the RFP sets forth the applicable protest process for objections to the terms and conditions of the RFP, including but not limited to the Contract.

e. Question: Do you plan to issue an addendum including the list of pre-proposal meeting attendees?

   District Response: A copy of the sign-in sheet from the non-mandatory pre-proposal conference is enclosed with this Addendum.

f. Question: Regarding the RFP specifications, are team resumes included from the (10) page proposal response?

District Response: Team resumes do not count toward the ten (10)-page limit.

-End of Addendum-

EXHIBIT C

INSURANCE REQUIREMENTS

1. Insurance Coverages. The Contractor and all Subcontractors shall procure and maintain at their respective expense during the Project and thereafter as required below the following insurance from one or more companies authorized to do business in the State of Oregon with a policyholder's rating of not less than A- VII in the most recent edition of *Best's Rating Guide*. Except as approved otherwise by the Owner in advance, such insurance shall protect against claims which arise out of or relate to all of the Contractor's and Subcontractors' services under the Agreement, whether performed by the Contractor or a Subcontractor or a person or entity for which either of them may be responsible.

1.1 Workers' Compensation Insurance, if required by law, with statutory limits.

1.2. Employer's Liability Insurance, if employees are employed for other than secretarial or bookkeeping services, with a limit of not less than $1,000,000 each accident, $1,000,000 disease each employee and $1,000,000 disease policy limit.

1.3. Commercial General Liability Insurance, applicable to all premises and operations, including Bodily Injury, Property Damage, Personal Injury, Contractual Liability, Independent Contractors, Products and Completed Operations, Broad Form Property Damage (including Completed Operations), and coverage for explosion, collapse and underground hazards, with limits of not less than $2,000,000 per occurrence, $4,000,000 aggregate applicable specifically to the Project, $2,000,000 personal and advertising injury and $4,000,000 Products and Completed Operations.

1.4. Business Automobile Liability Insurance, applicable to owned, non-owned and hired automobiles, with a limit of not less than $1,000,000 combined single limit each accident.

1.5. Professional Liability Insurance, applicable to all acts and omissions of Contractor and its consultants and any Subcontractor and its consultants performing a portion of the Work on a design-build basis, with limits of not less than $2,000,000 per claim and $4,000,000 aggregate.

1.6. Excess/Umbrella Liability Insurance, at least as broad as all liability policies described above, with limits of not less than $10,000,000 per occurrence and $10,000,000 aggregate. The Excess/Umbrella Liability policy shall follow form to, and be no more restrictive than, the underlying Employer's Liability, Commercial General Liability and Business Automobile Liability policies; shall provide additional insured status, primary and noncontributory coverage and waiver of subrogation to the same extent as those policies; and shall drop down to apply if any underlying aggregate limit is reduced or exhausted.

1.7. Contractor's Pollution Liability Insurance, covering bodily injury, property damage (including loss of use), cleanup costs and defense arising out of pollution conditions caused by or resulting from the Work, including sudden and gradual releases, mold and microbial matter, and transportation and non-owned disposal site exposures, with limits of not less than $2,000,000 per occurrence or claim and $2,000,000 aggregate. If written on a claims-made basis, the policy shall have a retroactive date no later than the date of commencement of the Work and shall be maintained, or an extended reporting period purchased, for not less than three (3) years after Final Completion. This requirement applies to the Contractor and to any Subcontractor performing earthwork, soil stabilization or soil cement mixing, dewatering, wetland work, or the handling, transport or disposal of hazardous materials.

1.8. Subcontractor Limits. In place of the limits stated in Paragraphs 1.3 through 1.6, each Subcontractor shall maintain limits of not less than: (a) Commercial General Liability, $1,000,000 per occurrence, $2,000,000 aggregate applicable specifically to the Project, $1,000,000 personal and advertising injury and $2,000,000 Products and Completed Operations; (b) Business Automobile Liability, $1,000,000 combined single limit each accident; (c) Excess/Umbrella Liability, $5,000,000 per occurrence and $5,000,000 aggregate; (d) Professional Liability, $2,000,000 per claim and $2,000,000 aggregate, if the Subcontractor performs any portion of the Work on a design-build basis; and (e) Contractor's Pollution Liability as stated in Paragraph 1.7, if the

Subcontractor performs work described in that Paragraph. Upon the Contractor's written request, the Owner may approve lower limits for a Subcontractor in writing. All other requirements of this Exhibit apply to each Subcontractor.

2. Deductibles. The Contractor and each Subcontractor shall pay all deductibles on all policies required by Paragraph 1.

3. Cross-Liability Coverages. The Commercial General Liability, Automobile Liability, Excess/Umbrella Liability and Contractor's Pollution Liability policies shall provide cross-liability coverages as would be achieved under the standard Insurance Services Office ("ISO") separation of insureds provision.

4. Additional Insureds. The Contractor's and Subcontractors' Commercial General Liability, Automobile Liability, Excess/Umbrella Liability and Contractor's Pollution Liability policies shall name the Owner and its officers, directors, agents, Board of Directors, and employees, and the successors in interest of the foregoing, as additional insureds, using ISO additional insureds endorsements CG 20 10 (ongoing operations) and CG 20 37 (completed operations), with primary and noncontributory status provided by CG 20 01, or substitutes providing equivalent coverages. Such coverages provided to the additional insureds shall (a) be primary and noncontributory with respect to any insurance or self-insurance retention of the additional insureds, including but not limited to any Excess Liability coverage maintained by the additional insureds, (b) provide the same types and extents of coverages as the coverages provided to the primary insured, and shall not be limited to the "vicarious liability" of the additional insureds, (c) waive all rights of subrogation against the additional insureds, (d) cover all additional insureds that are a partnership or joint venture, if any, as "Named Insureds" as expressly stated in endorsements and (e) be maintained for the same durations as the coverages provided to the primary insured, including but not limited to the continuation of the Products and Completed Operations coverage until ten (10) years after final payment to the Contractor on the Project, and shall not be limited to "ongoing operations". Notwithstanding the foregoing, this Paragraph shall not be construed to require the Contractor or any Subcontractor to provide insurance coverage of the additional insureds in a way or to an extent that results in a violation of ORS § 30.140.

5. Duration of Coverages. The insurance coverages required by Paragraph 1 shall be written on an occurrence basis, except the Professional Liability Insurance and, if permitted by Paragraph 1.7, the Contractor's Pollution Liability Insurance. The Professional Liability policy shall provide for a retroactive date of placement prior to or coinciding with the date of commencement under the Agreement. All other policies shall be in effect as of the date of commencement of the Contractor's services under the Agreement. All policies shall be maintained and remain in effect until Final Completion and thereafter whenever the Contractor or any Subcontractor is performing, assisting or advising the Owner regarding the correction of defective or nonconforming Work; provided that Products and Completed Operations coverage, including additional insured coverage for completed operations, shall be maintained until ten (10) years after final payment to the Contractor, and the Professional Liability policy shall be maintained, or an extended reporting period purchased, for not less than six (6) years after final payment to the Contractor. The Contractor shall notify the Owner of any claims against the Professional Liability policies, in which event the Owner shall have the right to require the Contractor or any Subcontractor at its expense to obtain additional Professional Liability Insurance in order to restore the required coverage available for the Project.

6. Proof of Insurance. The Contractor shall file with Owner, upon execution of the Agreement, certificates of insurance acceptable to the Owner, copies of the additional insured, primary and noncontributory, waiver of subrogation and per project aggregate endorsements, and the Insurance Compliance Checklist required by Paragraph 14, evidencing the insurance required by this Exhibit. Within fifteen (15) days after the Owner's request, the Contractor shall provide complete copies of any required policy, with all endorsements, exclusions and amendatory documents attached. If any of the required coverages are to renew during the period when such coverage is to remain in effect, or are required to remain in force after final payment to the Contractor on the Project, additional certificates evidencing continuation of such coverage shall be submitted upon renewal or with the Contractor's final invoice.

7. Effect of No or Insufficient Insurance. The Contractor's or any Subcontractor's failure to comply with the requirements of this Exhibit shall constitute a material breach of the Agreement entitling the Owner to terminate the Agreement for cause. In the alternative, the Owner in its sole discretion may purchase the insurance required of, but not obtained or maintained, by the Contractor or a Subcontractor pursuant to this Exhibit and charge those costs

to the Contractor. The Owner's rights under this Paragraph shall be in addition to, and without waiver of, its other rights and remedies under the Agreement or applicable law.

8. Limitation of This Exhibit. Nothing in this Exhibit shall negate, abridge or reduce the Contractor's or any Subcontractor's responsibilities or liabilities under the Agreement or applicable law, the meaning and effect of the provisions of this Exhibit being limited to setting out the Contractor's and Subcontractor's express obligations with respect to insurance.

9. Builder's Risk Insurance. The Owner shall purchase and maintain builder's risk property insurance for the Project as provided in Section 11.2.2 of the General Conditions of the Contract (AIA Document A201, as modified for the Project) (the "General Conditions"), and the cost of such insurance shall not be included in the Guaranteed Maximum Price. The Contractor's responsibility for losses within the deductibles and self-insured retentions of that insurance is stated in Section 11.2.2.1.1 of the General Conditions. The Contractor shall promptly provide the Owner and the Owner's insurer the information needed to place and maintain the coverage, including construction values, schedule, and changes in the Work, and shall comply with the reasonable loss-control and site security requirements of the Owner's insurer.

10. Prohibited Restrictive Endorsements. The Commercial General Liability and Excess/Umbrella Liability policies of the Contractor and each Subcontractor shall not contain any of the following endorsements, exclusions or limitations, or any substantially similar provision, unless approved by the Owner in writing in advance:

(a) any exclusion or limitation of coverage for bodily injury to an employee of any contractor, subcontractor, staffing or labor provider, or to a temporary worker, broader than the standard Employer's Liability exclusion in ISO form CG 00 01 (an "action-over" or contractor-employee exclusion);

(b) any exclusion of property damage to "your work" arising out of work performed by a subcontractor, including ISO forms CG 22 94 and CG 22 95;

(c) any subsidence, earth movement, soil condition or underground work exclusion;

(d) any residential, habitational, multi-family, assisted living, nursing home or health care facility exclusion;

(e) any exclusion of prior or existing work, or of progressive, continuous or deterioration-type injury or damage, that would limit coverage for the products-completed operations hazard;

(f) any modification of the definition of "insured contract" that removes or restricts coverage for tort liability of others assumed under the Agreement, including indemnity for injury to employees of the Contractor, a Subcontractor or a staffing provider, to the extent such indemnity is permitted by ORS § 30.140;

(g) any designated project or other provision that caps, rather than applies separately, the general aggregate limit for the Project;

(h) any exclusion for claims by one insured against another that applies to the additional insureds;

(i) any contractors professional liability exclusion, including ISO form CG 22 79, unless the Contractor or Subcontractor maintains the Professional Liability Insurance required by this Exhibit; and

(j) any Exterior Insulation and Finish System exclusion, including ISO form CG 21 86, if such systems are part of that party's Work.

11. Per Project Aggregate. The general aggregate limit of each Commercial General Liability policy shall apply separately to the Project, using ISO form CG 25 03 (Designated Construction Project(s) General Aggregate Limit) or an equivalent approved by the Owner. An endorsement that caps the aggregate available to designated projects shall not satisfy this requirement.

12. Blanket Endorsements; Subcontracts. Blanket additional insured and blanket waiver of subrogation endorsements that apply "when required by written contract" are acceptable only if the written contract is executed before the Contractor or Subcontractor begins Work. The Contractor shall ensure that every subcontract, at every tier, is executed before that Subcontractor begins Work and expressly requires the insurance, additional insured status, primary and noncontributory coverage and waivers of subrogation required by this Exhibit in favor of the Owner and the other additional insureds.

13. Staffing and Labor Providers. If the Contractor or any Subcontractor uses temporary workers or a staffing or labor provider on the Project, the Contractor shall ensure that (a) the provider maintains workers' compensation and employer's liability insurance for those workers; (b) the Commercial General Liability coverage that applies to those workers' activities on the Project is not limited to "staffing services" and is not subject to an exclusion described in Paragraph 10(a); and (c) the provider names the Owner and the Contractor as additional insureds as required by this Exhibit. Workers furnished by a staffing or labor provider are persons or entities for which the Contractor may be responsible under Paragraph 1.

14. Insurance Compliance Checklist. With the certificates required by Paragraph 6, the Contractor shall deliver an Insurance Compliance Checklist in the form attached as Exhibit C-1, completed and signed by the Contractor's insurance agent or broker based on the policy forms and endorsements as issued. The Contractor shall obtain a completed checklist from each Subcontractor before that Subcontractor begins Work and shall provide copies to the Owner on request. Any "Yes" answer in Section A or "No" answer in Section B shall be identified and explained and is subject to the Owner's written approval. The Owner's acceptance of a checklist or certificate shall not waive any requirement of this Exhibit.

15. Surplus Lines Insurers. The insurance required by this Exhibit may also be provided by an insurer that is not authorized to do business in the State of Oregon, if the insurer is an eligible surplus lines insurer under Oregon law, the policy is placed through an Oregon-licensed surplus lines licensee, and the insurer meets the rating requirement of Paragraph 1.

16. Contractor's Property. Tools, equipment, machinery, vehicles, temporary structures and other property of the Contractor and Subcontractors that are not to become part of the permanent Work are not covered by the Owner's builder's risk insurance and are at the sole risk of their owners. Any property insurance the Contractor or a Subcontractor maintains on such property shall include a waiver of subrogation in favor of the Owner and the other additional insureds, and the Contractor and each Subcontractor waive all rights against the Owner and the other additional insureds for loss of or damage to such property.

EXHIBIT C-1

INSURANCE COMPLIANCE CHECKLIST

Project: Clatsop Care Center Health District Skilled Nursing Facility
Insured: _____
Role: Contractor / Subcontractor (scope of Work: _____)
Carriers and policy numbers (General Liability / Umbrella / Pollution / Professional):
_____

Section A. Restrictive endorsements on the General Liability and Umbrella policies. "Yes" means the exclusion or limitation is on the policy.

Question	Yes / No	Governing form or explanation
A1. Exclusion for bodily injury to employees of contractors, subcontractors, staffing providers or temporary workers (action-over), broader than CG 00 01?		
A2. Damage to your work performed by subcontractors exclusion (CG 22 94, CG 22 95 or equivalent)?		
A3. Subsidence, earth movement or underground work exclusion?		
A4. Residential, habitational, multi-family, assisted living, nursing home or health care facility exclusion?		
A5. Prior work, progressive or continuous injury exclusion affecting completed operations?		
A6. Modification of "insured contract" that restricts contractual liability coverage?		
A7. Designated project aggregate cap?		
A8. Insured versus insured or cross-suits exclusion that applies to additional insureds?		
A9. Contractors professional liability exclusion (CG 22 79)?		
A10. EIFS exclusion (CG 21 86), if EIFS is in scope?		
A11. Coverage limited to a described class of operations or to "staffing services" only?		

Section B. Required coverage features. "Yes" means the policy provides it.

Question	Yes / No	Governing form or explanation
B1. Additional insured, ongoing operations (CG 20 10 or equivalent)?		
B2. Additional insured, completed operations (CG 20 37 or equivalent), maintained for the period required by Exhibit C?		
B3. Primary and noncontributory (CG 20 01 or equivalent)?		
B4. Waiver of subrogation on General Liability, Auto, Workers' Compensation and Umbrella (CG 24 04 or equivalent)?		
B5. Per project aggregate (CG 25 03 or equivalent)?		
B6. Contractual liability for the Agreement's indemnity with no restrictive endorsements?		
B7. Umbrella follows form and extends additional insured, primary and noncontributory, and waiver of subrogation?		
B8. Contractor's Pollution Liability as required by Paragraph 1.7, including transportation and non-owned disposal sites (if applicable)?		
B9. Owner and other additional insureds named on schedule, or blanket endorsement applies under a contract signed before Work began?		

Each “Yes” answer in Section A and each “No” answer in Section B must be explained, with the governing form identified, and is subject to the Owner’s written approval under Exhibit C, Paragraph 14.

I certify that the answers above are based on the policy forms and endorsements as issued.

Agent / Broker: _____ Agency: _____
Phone: _____ Signature: _____ Date: _____

Clatsop Care Center Health District
Pre-Proposal Conference-CMGC
November 19, 2026

General Contractor Company	Company Representative
Walsh Construction	Brian Ames and Jennifer Cornilles
LB const. Inc	Troy farwell troy@lbconst.us
Deacon Construction	Nick Bonar
Kaufman Commercial	Zach Gwyn
SKANSKA	TYLER FREEMAN
Big River Construction	Phil Gaffney pgaffney@bigrivercompanies.com
Skanska	Ryan Gay ryan.gay@skanska.com
SKANSKA	KELLY AUST Kelly.aust@skanska.com
Gerding Builders	RYAN MCALISTER RYANM@GERDINGBUILDERS.COM
Kemik Construction	Dexter Parry dp@kemik.com
Triplett Wellman	Todd Rutledge nick@triplettwellman.com
ANDERSEN CONSTRUCTION	BEN MILES bmiles@andersen-const.com

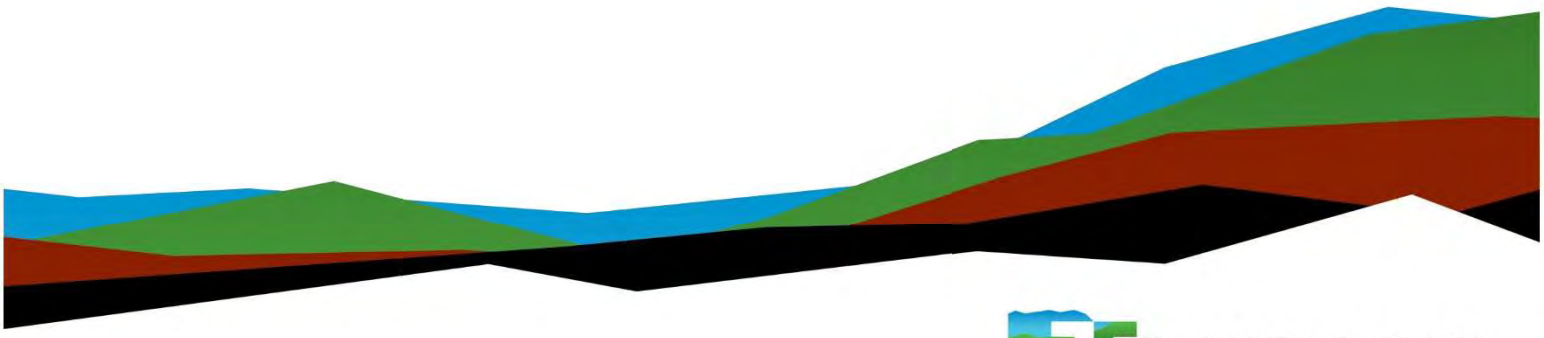
Clatsop Care Center Geotechnical Engineering Report

Astoria, Oregon

November 6, 2025 | Terracon Project No. 82245014

Prepared for:

Clatsop Care Center Health District
646 16th Street
Astoria, Oregon 97103



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November 6, 2025

Clatsop Care Center Health District
646 16th Street
Astoria, Oregon 97103

Attn: Mr. Mark Remley
P: 503-325-0313
E: Mremley@aidanhealthservices.com

Re: Geotechnical Engineering Report
Clatsop Care Center
947 Olney Avenue
Astoria, Oregon
Terracon Project No. 82245014

Dear Mr. Remley:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P82245014 dated March 25, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon



Expires 6/30/2027

Jordan Real, E.I.T.
Senior Geotechnical Staff Engineer

Kristopher T. Hauck, P.E.
Senior Principal

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Note: **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Report Summary

Topic [1]	Overview Statement [2]
Project Description	The project includes the development of an approximate 28,000 square foot structure, asphalt and concrete parking lot, drive lanes, and loading docks on the 15.85-acre parcel.
Geotechnical Characterization	Subsurface conditions encountered in the planned building area consisted of: ■ Existing fill to depths of about 1 to 3 feet at the northeast portion of the site, ■ Topsoil to depths of about 2.5 to 4 inches, over ■ Very loose liquefiable sand and very soft to soft tidal flat deposits (lean to fat clays, silts, and sands) to depths of about 90 feet, over ■ Weathered siltstone, mudstone, and sandstone resulting from the weathering of marine sedimentary rock, ■ Groundwater was observed as shallow as 3 feet below the ground surface (bgs) during our explorations.
Geologic Hazards	Based on our site-specific analyses, we estimate that the saturated native materials have a high risk of liquefaction. We expect total liquefaction-related vertical settlements could be up to 17 inches. Lateral spread is expected at the site due to the sloping nature of the ground surface and the nearby slope-face down to the waterline. We estimated lateral spread movement could be over 15 feet and includes potential flow failures through the project site.
Ground Improvement	Due to the anticipated structural loads, liquefaction and lateral spread risks, soft underlying soils, and limited settlement tolerance of the planned structures, the structures should be supported on ground-improved soils consisting of deep soil mixing that penetrates the liquefiable and/or soft native materials to be founded in the underlying very stiff fat clay (weathered mudstone).
Earthwork	■ Near-surface soils expected to be encountered in excavations are fine-grained and non-plastic. These soils are sensitive to moisture variation and prone to disturbance from tire construction equipment, especially during wet weather

Topic [1]	Overview Statement [2]
	■ Fine-grained soils will not likely be reusable as structural fill without cement modification and/or significant drying during the summer months. ■ In order to construct ground improvements, a granular working pad to support ground improvement equipment should be planned and constructed.
Shallow Foundations	Shallow foundations can be used to support the structure following liquefaction mitigation of the site using deep soil mixing ground improvements.
Pavements	Paved drive lanes and parking areas will be constructed to serve the proposed building. With cement-treated subgrades prepared as noted in **Earthwork**, we recommend the following pavement sections: Asphaltic Concrete (HMAC) Section Assumed Loading: ■ 3 inches HMAC over 4 inches of crushed aggregate base course Portland Cement Concrete (PCC) Section Assumed Loading: ■ 6 inches PCC over 6 inches of crushed aggregate base coursecourse
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and geotechnical engineering services for the proposed care home facility to be located at 947 Olney Avenue in Astoria, Oregon. The purpose of these services was to provide information and geotechnical engineering recommendations related to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site class per ASCE 7-22
- Liquefaction and lateral spread potential
- Site preparation and earthwork
- Dewatering considerations
- Foundation design and construction
- Floor slab design and construction
- Lateral earth pressure
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of six borings to depths of 6 to 91½ feet below existing ground surface (bgs), laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and exploration locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the exploration logs and/or as separate graphs in the **Exploration and Laboratory Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	An email with a proposed site layout was provided by Lenity Architecture on February 9, 2024. The site layout included a parcel map and an approximate size of the new facility. A building footprint and location file was also provided.
Project Description	The proposed project will include a skilled nursing facility, associated pavements, and possible stormwater pond.
Proposed Structure	The new structure will have a footprint of approximately 28,000 square feet. The number of floors has not been finalized by the design team. Based on conversations with Lenity Architecture, we anticipate the new building may be generally 1 story, with an elevator to provide access to the existing building to the west.
Building Construction	We understand the building will be wood-framed walls and above grade floors with strip and column footings. We expect the building will contain a slab-on-grade main floor.
Finished Floor Elevation	Not provided; boring depths have assumed that finished floor is not more than 3 feet below existing grade on this generally level to gently sloping site.
Maximum Loads	Anticipated structural loads were provided by Lenity: ▪ Columns: 45 kips ▪ Walls: 2.5 kips per linear foot (klf)
Grading/Slopes	Proposed finished grade elevation for the building pad is expected to be within about 2 feet of the existing ground surface.
Below-Grade Structures	No basement levels planned. We anticipate retaining walls associated with loading docks will be up to 4 feet in height.
Free-Standing Retaining Walls	With the exception of the loading docks, retaining walls are not expected to be constructed as part of site development to achieve final grades.
Pavements	A preferred pavement surfacing has not been identified to us as part of the preliminary information. Asphalt surfacing is common in the area for projects of this nature and is the assumed preference. We assume that the traffic classification will consist of: ▪ Class I: Parking stalls for autos and pickup trucks ▪ Class II: Traffic consisting of home delivery trucks, trash pickup The pavement design period is 20 years.
Building Code	2025 Oregon Structural Specialty Code (OSSC)

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 947 Olney Avenue in Astoria, Oregon. The approximate center of the 15.85-acre site is located at the following coordinates: ■ Latitude: 46.1726° N ■ Longitude: 123.8329° W See **Site Location**.
Existing Improvements	The northwest corner of the site is occupied by the existing Clatsop Retirement Village. The structure is three stories in height. Two single-story storage buildings are located on the eastern portion of the site in the area of the proposed development.
Current Ground Cover	The central portion of the site is heavily vegetated with brush and trees, with an existing building, a gravel parking lot, and a grassed area at the east portion of the site
Existing Topography	The site generally descends gently to the southeast and south, with total vertical relief of about 20 feet. The southern approximate two-thirds of the parcel is occupied by Youngs River. Beyond the vegetation line at the west edge of the site, the site grade gradually steepens into the Youngs River, with a dredge channel at the center of the river for navigational purposes.

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

Geotechnical Characterization

Geology

Based on available geologic mapping[1] of the area, the site is underlain by Quaternary flood plain alluvium. The mapping shows beach sand deposits (bs) mapped at the site and the sand deposits are interbedded with terrace alluvium (tsc), which consists of elastic silt, fat clay, and peat. We have interpreted beach sand deposits to be consistent with GeoModel Layer 2 below and the terrace alluvium to be consistent with the GeoModel Layer 3.

The tidal flat and terrace alluvium deposits are underlain by Oligocene and Miocene sedimentary rocks (Toms). The sedimentary rocks (interpreted to be consistent with GeoModel Layer 4) consist of thinly-bedded to massive, medium to dark gray, tuffaceous siltstone and claystone with localized shale, sandstone, and conglomerate. Thickness of the sedimentary rocks is over 5,000 feet.

Groundwater

We observed our explorations while drilling and after completion for the presence and level of groundwater. The water levels observed in the explorations are provided on the exploration logs in **Exploration and Laboratory Results**, and are summarized below.

Exploration Number	Approximate Ground Surface Elevation (feet) [1]	Approximate Depth to Groundwater while Drilling (feet)
B-1	12	5
B-2	12½	5½
B-3	11	5
B-4	12½	3
B-5	11	6
IT-1	11	3

[1] Schlicker, H.G., Deacon, R.J., Beaulieu, J.D., and Olcott, G.W., 1972, **Environmental geology of the coastal region of Tillamook and Clatsop Counties**: Oregon Department of Geology and Mineral Industries, Bulletin 74, scale 1:62,500.

Exploration Number	Approximate Ground Surface Elevation (feet) [1]	Approximate Depth to Groundwater while Drilling (feet)

1. Based on elevations obtained from Google Earth and depth to the observed groundwater during explorations. Note the assumed ground surface elevation is presented on the exploration logs.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the explorations were performed. We also expect the groundwater conditions at the site to be tidally influenced. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the exploration logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GeoModel

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration and Laboratory Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each exploration location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Topsoil and Fill Materials**	TOPSOIL; POORLY GRADED GRAVEL FILL: fine to coarse grained, angular, nonplastic to low plasticity, brown and gray, medium dense, variable clay and silt content
2	**Alluvium**	GRAVEL, SAND, and SILT mixtures (GP, SP, SM, ML): brown to gray, very loose to loose/soft, fine to coarse grained angular to subangular gravel, fine to coarse grained sand, nonplastic silt
3	**Fine Grained Alluvium**	LEAN to FAT CLAY (CL,CH), SILT to ELASTIC SILT (ML, MH), ORGANIC SILT (OH): nonplastic to high plasticity,

Model Layer	Layer Name	General Description
		gray to orangish brown, very soft to very stiff, variable fine to medium grained sand content, variable organic content
4	**Mudstone**	MUDSTONE: decomposed to high-plasticity clay, gray to brown, stiff to very stiff

Geologic Hazards

Seismic Hazards

Seismic hazards resulting from earthquake motions can include slope stability, liquefaction, and surface rupture due to faulting or lateral spreading. Liquefaction is the phenomenon wherein soil strength is dramatically reduced when subjected to vibration or shaking.

We reviewed the Statewide Geohazards Viewer (HazVu) published by the Oregon Department of Geology and Mineral Industries (DOGAMI) and available online[2]. The viewer categorizes the expected earthquake shaking from light, moderate, strong, very strong, severe and violent; and the landslide susceptibility from low, moderate, high, and very high.

- Earthquake Liquefaction Hazard: High
- Expected Earthquake Shaking: Severe
- Landslide Susceptibility (due to earthquake): Low to Moderate

Nearby Faults

The United States Geological Survey (USGS) maintains the Quaternary Fault and Fold Database containing descriptions and locations of recently active faults within the United States. The three closest faults to the project site include the Cascadia Fold and Fault Belt (No.784), Unnamed Offshore Faults (No.785), and the Willapa Ba fault zone

[2] Statewide Geohazards Viewer (HazVu) published by the Oregon Department of Geology and Mineral Industries (DOGAMI) **https://gis.dogami.oregon.gov/hazvu/,** accessed July 2023

(No.592). Published information pertaining to each fault or fault zone is provided in the following table:

Fault Name	Cascadia fold and fault belt	unnamed offshore faults	Willapa Bay fault zone
USGS Fault Number	784	785	592
USGS Fault Class	A	A	A
Distance and Direction of Fault from the Site	10 mi W	11 mi WSW	17 mi NNW
Length of Fault	302.5 miles	175 miles	23.1 miles
Strike (degrees)	N30°W	N11°W	N22°W
Sense of Movement	Thrust	Left lateral	Thrust
Dip Direction	W	Unspecified	Unspecified
Slip-rate Category	Between 1.0 and 5.0 mm/yr	Between 1.0 and 5.0 mm/yr	Between 0.2 and 1.0 mm/yr
Most recent prehistoric deformation	Undifferentiated Quaternary (<1.6 Ma)	Latest Quaternary (<15 ka)	Middle and late Quaternary (<750 ka)

Based on our review of the available fault information, the depth to bedrock, and the site's proximity to the nearest known faults, it is our opinion that the risk of surface rupture due to ground faulting is low.

Seismic Considerations

Site Class

Seismic design requirements for structures are based on Seismic Design Category. Site Class is required to determine the Seismic Design Category for a structure. The 2025 OSSC references ASCE 7-22 for determination of Site Class and seismic design parameters. ASCE 7-22 Site Classes are based on shear wave velocities within the upper 100 feet of the subsurface materials at the site. Borings were advanced as part of our field exploration and SPT N-values (blow counts) were collected. For determination of the Site Class, Terracon used published SPT/shear wave velocity correlations[3] to

[3] Wair, B.R., and Dejong, J.T., 2012, Guidelines for Estimation of Shear Wave Velocity Profiles, Pacific Earthquake Engineering Research Center, PEER Report 2012/08

determine the average shear wave velocity and corresponding Site Class in accordance with ASCE 7-22 Section 20.3.

As discussed below, the site soils have a high risk of liquefaction. ASCE 7-22 Section 20.2.1 indicates the presence of liquefiable soils underlying the site necessitates a **Site Class of F**.

Seismic Design Parameters

The following seismic design parameters may be used for design of the proposed structures:

Description	ASCE 7-22
2025 Oregon Structural Specialty Code (2025 OSSC) Site Class	**F** [1]
Site Latitude	46.1727° N
Site Longitude	123.8338° W
S_S Mapped Spectral Acceleration for Short (0.2 second) Period [2]	1.63g
S_1 Mapped Spectral Acceleration for 1 Second Period [2]	0.69g

1. See above for site class discussion.
2. Seismic parameter values determined from the ASCE 7 online tool (https://asce7hazardtool.online/).

Based on our experience with structures similar to the proposed development, we anticipate that the fundamental period of the structure will be less than 0.5 seconds. For structures with fundamental periods of vibration equal to or less than 0.5 second, Section 20.2.1(1) of ASCE 7-22 allows spectral accelerations may be determined in accordance with Section 11.4. Provided the structure fundamental period is 0.5 second or less, the following code-prescribed seismic parameters may be used for design in accordance with ASCE 7-22:

Code	S_{DS} [1]	S_{D1} [1]
ASCE 7-22	1.5	1.34g

1. Seismic parameter values determined from the ASCE 7 online tool (https://asce7hazardtool.online/).

Liquefaction

Liquefaction is the phenomenon where saturated soils develop high pore-water pressures during seismic shaking and lose their strength characteristics. This phenomenon generally occurs in areas of high seismicity, where groundwater is shallow and loose granular soils or relatively low- to non-plastic fine-grained soils are present. Very soft silts and loose sands were encountered in the explorations interbedded with high plasticity (non-liquefiable) soils to depths of about 55 to 90 feet bgs. Groundwater was observed as shallow as 3 feet in the explorations during our field exploration.

We performed a site-specific liquefaction analysis using the methods based on empirical methods originally developed by Seed and Idriss and subsequently modified by others. The latest recommended procedures were presented by Idriss and Boulanger (2014). The peak ground acceleration and moment magnitude used in the analysis were based on the PGA as required by the 2025 OSSC and factored for the site class coefficient (PGA_M). The risk for liquefaction of the non-plastic to low plasticity site soils encountered between the top of the groundwater surface and the mudstone underlying the site at depth is high and we estimate liquefaction-induced total settlements of approximately 17 inches could be experienced at the site. We anticipate up to 2/3 of the total settlement (or 11¼ inches) could be experienced as differential settlement. Based on Table 12.13-3 Differential Settlement Threshold of ASCE 7-22, a Site Risk Category of II, wood framed single story structure, and assumed length between footings of approximately 50 feet the code defines a differential settlement threshold of 9 inches. Therefore, we have included liquefaction remediation strategies in our recommendations below.

Liquefaction Lateral Movement

In addition to vertical settlement, horizontal deflections are commonly observed in areas subjected to seismic events. Horizontal deflections or lateral spreading occurs in areas adjacent to broad river valleys and free vertical faces. Generally, the magnitude of lateral spread is based on the horizontal distance between the structure and the free face or water source, the height of the vertical face or slope of the area, and the presence of liquefiable soils beneath the structure. However, without a detailed topographic survey of the project area, detailed lateral spread analyses are not feasible. Therefore, we have completed an analysis using elevation data obtained from Google Earth software. Upon identifying the presence of liquefiable soils underlying the site and the distance to a free-face along Youngs River south of the site, we estimate lateral deflections of 18 feet (flow failure) may occur during the design (subduction) earthquake. Our analysis considered the linear regression technique determined by Youd et al. (2002), which is an empirical method developed from 6 earthquakes from the western United States, 2 earthquakes from Japan, as well as case-histories for 448 horizontal displacement vectors and 270 nearby boring logs. Therefore, due to the lateral spread hazard at the site, liquefaction and lateral spread risk reduction measures

need to be implemented to reduce the risk of lateral spread to less than 18 inches for a Site Risk Category of II.

Geotechnical Overview

The primary geotechnical consideration at this site is the potential for liquefaction and resulting lateral spread to occur from a design level earthquake. As presented in the **Liquefaction** section, our liquefaction analyses estimate 17 inches of settlement may occur from such an earthquake. In addition, lateral spread risks at the site are estimated to be 18 feet (flow failure) during a design level event. According to ASCE 7-22, the potential vertical settlements resulting from liquefaction and lateral spread movements would exceed code derived maximum thresholds for the proposed structure(s). Therefore, some level of mitigation or reduction needs to be incorporated in the design and construction of the project.

Due to the seismic risks, we recommend ground improvement be used to reinforce the site soils and reduce the settlements and lateral deformations within the building pad. Based on the subsurface conditions, our analyses, and experience with different ground improvement technologies, we recommend that the building foundation systems be planned to be improved with deep soil mixing as presented in the **Ground Improvement** section of this report. Based on our liquefaction analyses and coordination with ground improvement design contractor(s), we anticipate the depth of ground improvement could be on the order of 90 feet below existing site grades. The depth of the ground improvement elements will be a function of the settlement and lateral spread tolerances of the proposed structures while maintaining life-safety.

The near surface silt and clay soils are sensitive to changes in moisture content. The natural moisture content of these materials ranged from 15% to 53%, indicating moist to wet conditions in the upper 15 units of the ground surface. This will likely result in difficulty achieving minimum compaction density during fill placement. Due to their moisture sensitivity and low strength, fat clay and elastic silt soils are not recommended for re-use as structural fill, unless amended with cement. Therefore, we recommend subgrade stabilization consisting of either removal and replacement with non-expansive granular fill or subgrade improvement using cement amendment.

Due to groundwater levels encountered as shallow as 3 feet bgs during our subsurface exploration, groundwater will affect design and construction. The contractor should be prepared to control groundwater seepage in the excavations. Construction activity should be monitored and curtailed if the construction activity is causing subgrade disturbance. See the **Dewatering** section for further information. Geotechnical recommendations presented in this report assume the site will be developed at or above existing site grades. Additional recommendations will be required if the building pad is cut below existing site grades due to the groundwater conditions.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration and Laboratory Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations as well as the Attached "*Important Information about This Geotechnical-Engineering Report*" found in the **Supporting Information** section.

Earthwork

Earthwork is anticipated to include clearing and grubbing, ground improvements, excavations, and structural fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Subgrade Preparation – Building Pad

Subgrade preparation within the building pad will consist of the preparation of a working surface for the ground improvement contractor. See the **Ground Improvement** section for discussion.

Subgrade Preparation – Pavements

Following site stripping, pavement subgrades should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the observation of the Geotechnical Engineer or representative. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by chemical subgrade stabilization. Excessively wet or dry material should either be removed or moisture conditioned and recompacted. Depending on the time of year construction occurs, chemical stabilization of the entire parking lot subgrade may be appropriate.

We understand that due to the shallow groundwater, the preparation of the existing native subgrade soils will be difficult. As an alternative provided in the Subgrade Stabilization section below, the subgrade soils could be cement-amended, similar to the working pad preparation defined by ground improvement contractors for the ground improvement equipment.

Existing Fill

Explorations B-2 and B-5 encountered previously placed fill to depths ranging from about 1 to 3 feet. We have no records to indicate the degree of control, and consequently, the fill is considered unreliable for support of the building and/or pavements. Support of floor slabs and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, inherent risk exists for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

Subgrade Stabilization

As described in the Report Summary and Geotechnical Overview, we expect subgrades to need stabilization in order to provide a suitable working surface. Therefore, some overexcavation and replacement with granular fill or subgrade stabilization should be expected, especially during wet periods of the year. For this site, improvement of pavement subgrades with Portland cement could be considered for the subgrade preparation in lieu of removal and replacement with granular fill. Cement amendment of soils should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions.

For planning purposes, we estimate that pavement subgrades would need to be amended with an approximate 7 to 9 percent cement by dry weight in order to provide a stabilized subgrade for both wet weather and pavement support. We recommend a cement-amendment design be prepared prior to construction phase to refine this estimate for construction specifications.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas.

Reuse of On-Site Soil: Excavated on-site soil is not suitable for reuse as Structural Fill and should not be placed beneath settlement sensitive structures and within foundation bearing zones. Portions of the on-site soil have an elevated fines content and will be

sensitive to moisture conditions (particularly during seasonally wet periods) and may not be suitable for reuse when above optimum moisture content.

Fill Materials: Structural fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Fill Type [1]	Specifications	Acceptable Location for Placement (for Structural Fill)
Common Fill	Oregon Department of Transportation Standard Specifications for Construction (ODOT SSC) Section 00330.13 Selected General Backfill (Maximum PI = 10% and LL = 40%)	All locations outside of building pad and beneath pavement structures. Dry weather only acceptable
Select Fill	ODOT SSC Section 00330.14 Selected Granular Backfill [2]	All locations across the site. Wet and dry weather acceptable.
Crushed Aggregate Base Course (CABC)	ODOT SSC Section 02630.10 Dense Graded Aggregate (2"-0 to ¾"-0) [2]	All locations across the site. Wet and dry weather acceptable.
Trench Backfill	ODOT SSC Section 00405.14 for Trench Backfill with additional stipulations [4]	Acceptable materials include Common and Select Fill listed above.
Subgrade Stabilization	ODOT SSC Section 00330.14 for Selected Granular Backfill above groundwater seepage and OSSC Section 00330.16 for Stone Embankment Material with additional stipulations [4]	Greater than 12 inches below finished floor or pavement subgrade. Wet and dry weather aceptable.
Bedding & Haunching	ODOT SSC Section 00405.13, Pipe Zone Material	Thickness above and below pipe recommended by Electrical Engineer

1. Controlled, compacted fill should consist of approved materials that are free (free = less than 3% by weight) of organic matter and debris (i.e. wood sticks greater than ½ inch in diameter). A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Material should have a maximum aggregate size of 2 inches, and a minimum laboratory CBR of 20% for granular soils, and no more than 8% passing the No. 200

Fill Type [1]	Specifications	Acceptable Location for Placement (for Structural Fill)

sieve by weight determined by ASTM D6913. Fines should have a Plasticity Index (PI) of less than 20% per ASTM D4318. Reclaimed glass will not be accepted.

3. The contractor shall select the appropriate material for use based on the current and forecasted weather conditions at the time of construction.
4. Maximum aggregate size shall be limited to 3 inches and less than 5% passing the No. 200 sieve.

Fill Placement and Compaction Requirements

Structural should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1,2]	95% of max. above and below foundations and within 2 feet of finished pavement subgrade 92% of max. when more than 2 feet below finished pavement subgrade
Water Content Range [1]	-2% to +2% of optimum

1. Maximum density and optimum water content as determined by the modified Proctor test (ASTM D1557).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D4253 and D4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

Dewatering

Groundwater was encountered as shallow as 3 feet below the existing ground surface (bgs). Groundwater should be expected within excavations penetrating the ground surface. Where possible, utilities and site grading should be conducted above the groundwater table to limit overexcavation and dewatering concerns during construction.

Where utilities or structural elements are beneath the groundwater table, the contractor should be prepared to control these areas of localized groundwater seepage in the excavations. Construction activity should be monitored and curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to aid in limiting subgrade disturbance

We anticipate that dewatering for site preparations as well as subgrade preparations will be necessary for utility trenches and/or perched water within the fill soils (depending on the season) for the foundation excavations. We provide the following recommendations for incorporation into the project specifications with respect to dewatering:

- The contractor should be made responsible for designing, permitting, and constructing dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides.
- The dewatering system should be of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow work to be installed in a dry condition (i.e. no standing water) that maintains stability of the subgrade soils.
- The contractor should be responsible for obtaining discharge permits and designing settling basins, as necessary by permit, for the pumped water and performing water quality testing that may be required by regulatory agencies including but not limited to Oregon Department of Environmental Quality. All data and other submittals required by regulatory agencies shall be submitted to the owner and Civil Engineer.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of structural fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The recommendations included in this report, including any options or alternatives, are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied on judgement and opinion to do so. Terracon can finalize the recommendations only after observing actual subsurface conditions exposed during construction. Therefore, earthwork efforts should be observed by the Geotechnical Engineer or their representative. Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and existing fill soils), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 100 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Ground Improvement

The structure and floor slabs should be supported on ground improvements to reduce the static and liquefaction risk onsite. Ground improvement methods should be designed by licensed contractors who can provide further information regarding support options. Final ground improvement design should incorporate loads from fills if the grading plan indicates the site will be raised for drainage and groundwater control.

Deep Soil Mixing

Based on our discussions with ground improvement contractors, we recommend deep soil mixing (DSM) be planned to improve site soils. Deep soil mixing is an in-place improvement technique that involves mixing site soils with cement or other binding agents to a prescribed depth based on the design tolerances of the structure and development. The resulting soil-cement column of improved soils have higher strength and lower compressibility characteristics, and soils are rendered non-liquefiable within the improvement zone. Other ground improvement technologies may be feasible and could be explored more in detail once the design criteria and layout of the structures is refined during the design phase.

Design-Build Contractors

We recommend that design build proposals for ground improvement be based on soil conditions noted on the explorations, and the settlement and lateral deformation tolerances established by the project structural engineer depending on the final building structural tolerances. We recommend that a qualified design-build contractor be contacted regarding ground improvement design and installation for this project to provide relative costs. The contractor will require the subsurface information presented in this report to formulate a scope and budget for the improvements.

Subject to review by the project structural engineer, we recommend that the design-build contractor's design be based on the following minimum criteria:

- The required depth of ground improvement will be determined by the design contractor to meet the performance criteria established by the owner's design team. As part of the design-build process, the ground improvement contractor may recommend additional subsurface investigations if they determine that further data is necessary to refine the liquefaction assessment or optimize the ground improvement design.
- Total Static Settlement of all footings shall be less than 1 inch when considering the structural loads for both the improved and un-improved depths of the ground improvement.

- Static differential settlements of footing should also be less than ½ of the total settlement over 50 feet (or column spacing).
- Achieve an allowable bearing capacity of at least 3 ksf. Higher capacities may be achievable by the ground improvement design should the structural engineer desire higher capacities for their design.
- Depending on the structural engineer and owner coordination, reduce maximum liquefaction related settlements to less than 8 inches total (or other value determined by structural engineering tolerance) and 4 inches differential over 40 feet.
- Depending on the structural engineer and owner coordination, reduce maximum lateral deformations to less than 18 inches (or other value determined by structural engineering tolerance). It's important to note that the structure also needs to be designed to tolerate the 18-inches of lateral displacement and protect life safety.
- The ground improvement design shall provide a post-installation verification testing program that includes design assumption verification (cores of the DSM with strength testing) and demonstration of subsurface improvements. The submittal shall include the Tip resistance (for CPTs), N-value (for borings), or other proposed improvement criteria for the methodology required for acceptance.

Ground Improvement Working Pad

We recommend that a granular working surface be placed within the building pad over the subgrade after stripping for support of the equipment necessary to install the Aggregate Pier improvements. The thickness of the working mat will need to be determined by the design-build contractor because a stable working mat will be dependent on the equipment necessary for installation. After installation of the ground improvements is complete, the granular working mat fill should be stripped of loose and disturbed soils and compacted and tested in accordance with the requirements of this report. Following preparation of the prepared subgrade, the surface should be evaluated to detect soft, yielding soils which should be removed to a stable subgrade. The granular working mat materials could then be left in-place as subgrade for the building and slab base.

Geotechnical Review

Design of a soil improvement system requires a thorough understanding of site subsurface conditions. Furthermore, soil improvement design is somewhat approximate and often involves an evaluation of project risks and benefits relative to the extent of the improvement. Terracon should be retained to review the plans, and specifications once they have been prepared by the ground improvement contractor.

Because deep soil cement mixing (DSM) is considered a specialty type construction, it is our opinion that special inspection during the construction should be performed by personnel experienced in the construction methods. Therefore, we recommend that Terracon be retained to provide geotechnical special inspection services during the ground improvement process.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in the **Earthwork** section, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	3,000 psf (foundations bearing on improved soils) – though it is possible to obtain higher bearing capacities based on the ground improvement design.
Required Bearing Stratum [3]	Ground Improved Soils (deep soil mixing)
Minimum Foundation Dimensions	Columns: 6 feet Continuous: 2 feet
Ultimate Passive Resistance [4] **(equivalent fluid pressures)**	300 pcf (granular backfill)
Ultimate Sliding Resistance [5]	0.5 ultimate coefficient of friction - granular material
Minimum Embedment below Finished Grade [6]	12 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch static and 8 inches seismic post improvement
Estimated Differential Settlement [2, 7]	About 1/2 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure. These values can be increased by 1/3 for short-term wind and seismic loading condition cases.

Item	Description

2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Final bearing capacity to be determined by ground improvement design-build firm.
4. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in the **Earthwork** section.
5. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure.
6. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
7. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
8. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Footing Drains

A perforated rigid plastic drain line installed at the base of footings along the perimeter of the structures. The invert of a drain line around a building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage. The drain line should be surrounded by clean, free-draining granular material meeting the specifications for Select Fill as defined in the **Fill Material Types** section. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted native material to reduce infiltration of surface water into the drain system.

Foundation Construction Considerations

As noted in the **Earthwork** section, the footing excavations should be evaluated under the observation of the Geotechnical Engineer in order to consider our recommendations final. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing

soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Floor Slabs

Design parameters for floor slabs assume the requirements in the **Ground Improvement** section have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Existing fill materials and materials described as possible fill were observed at the site to depths of 1 to 3 feet below existing grade. As previously described, any existing fill present beneath floor slabs should be completely removed.

Floor Slab Design Parameters

Floor Slab Design Parameters

Item	Description
Floor Slab Support[1]	A minimum of 6 inches of CABC compacted over 12 inches of Select Fill compacted to at least 95% of the maximum dry density determined by ASTM D1557 over Ground Improvements.
Estimated Modulus of Subgrade Reaction [2]	175 pounds per square inch per inch (psi/in) for point loads

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in Earthwork, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for about 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

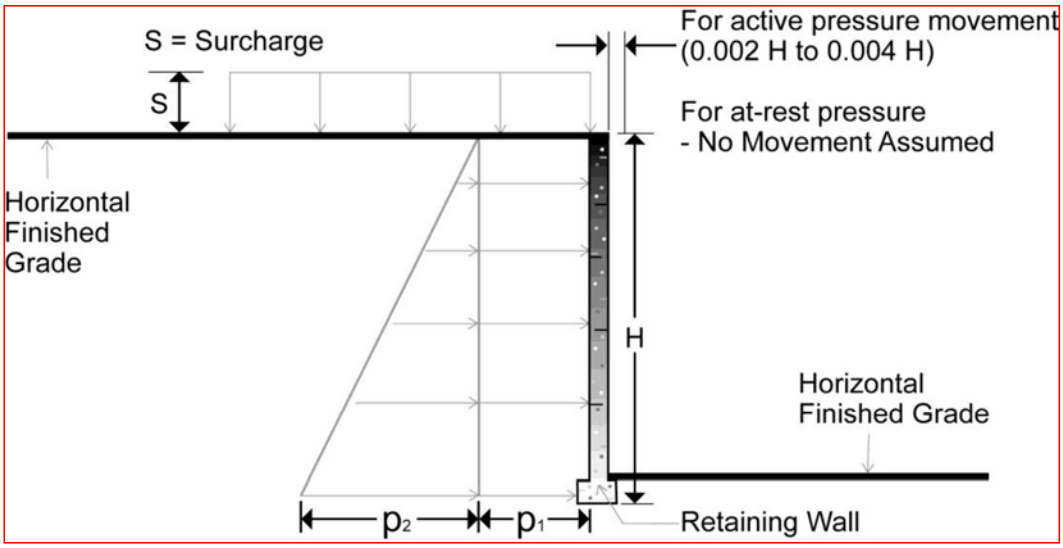
The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Lateral Earth Pressures

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of

construction, and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]		
			Unsaturated [5]	Submerged [5]	Seismic Surcharge
Active (Ka)	Granular – (0.33)	(0.33)S	(42)H	(83)H	(7.1)H
At-Rest (Ko)	Granular – (0.50)	(0.50)S	(63)H	(94)H	(11.9)H
Passive (Kp)	Granular – (3.00)	(3.00)S	(375)H	(250)H	--

1. For active earth pressure, the wall must rotate about the base, with top lateral movements of 0.002 H to 0.004 H, where H is the wall height. For passive earth pressure, the wall must move horizontally to mobilize resistance. Fat clay or other expansive soils should not be used as backfill behind the wall.
2. Uniform, horizontal backfill, with a maximum unit weight of 125 pcf for granular soils.

Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]		
			Unsaturated [5]	Submerged [5]	Seismic Surcharge

3. Uniform surcharge, where S is the surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. To achieve "Unsaturated" conditions, follow the guidelines in the **Subsurface Drainage for Below-Grade Walls** section. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.
6. Seismic surcharges should be added to all other loading conditions. Seismic Surcharge pressures determined utilizing Mononobe-Okabe Method.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active case.

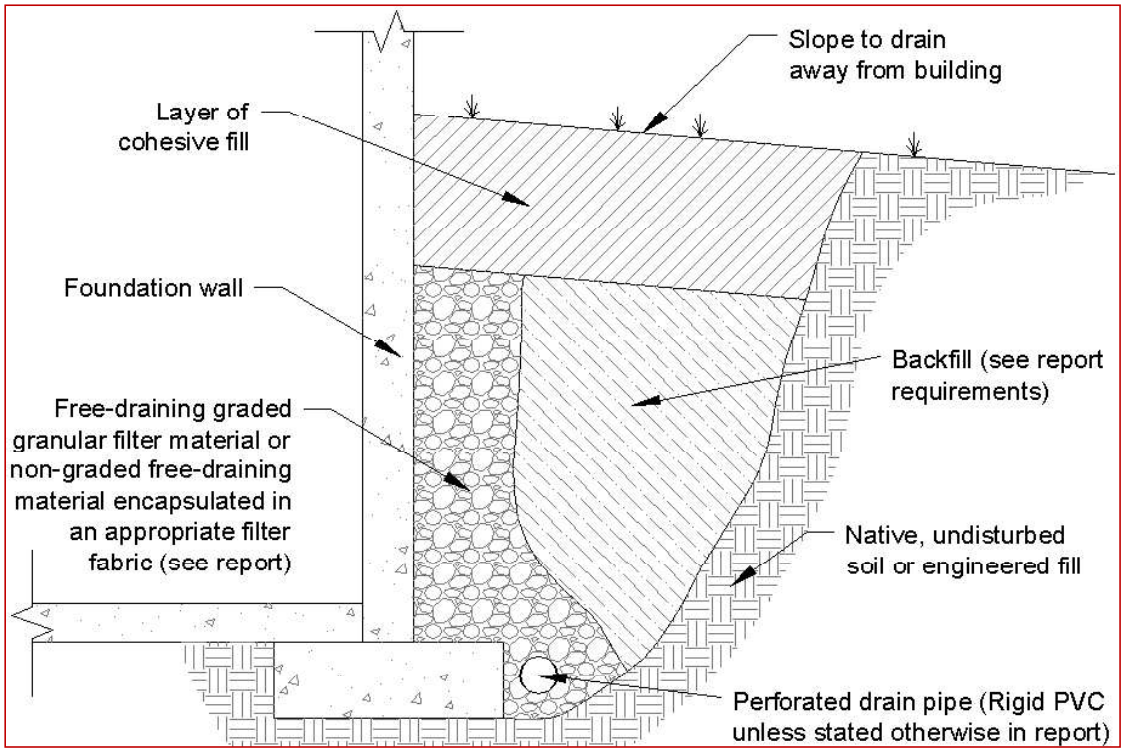
Footings, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure.

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop a proposal for evaluation and design of such wall systems upon request.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should be a minimum of 12 inches in thickness and extend to within 2 feet of final grade, where

it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a prefabricated drainage structure may be used. A prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in the **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Site Preparation** section.

Pavement Design Parameters

A California Bearing Ratio (CBR) of 2 was used for the subgrade consisting of compacted site soils for the asphaltic concrete (AC) pavement designs. A modulus of subgrade reaction of 100 pci was used for the Portland cement concrete (PCC) pavement designs supported on the compacted subgrade soils. The value was empirically derived based upon our experience with the sandy subgrade soils and our expectation of the quality of the subgrade as prescribed by conditions outlined in the **Earthwork** section. A modulus of rupture of 580 psi was used in design for the concrete (based on correlations with a minimum 28-day compressive strength of 4,000 psi).

We understand the design pavement thicknesses should consider the following ESAL values:

- Asphaltic Concrete – Post-construction Owner Use: Pavements experiencing up to 38,200 ESALs
- Portland Cement Concrete - Pavements exposed to heavy commercial vehicle (HCV) related traffic: Pavement experiencing up to 34,400 ESALs (concrete)

This traffic information and the design period of 20 years for owner use traffic were used to design the pavement sections.

Pavement Section Thicknesses

As a minimum, we suggest the following pavement section be considered:

Minimum Recommended Pavement Sections				
Subgrade Stabilization Method	**Pavement Type**	**Thickness (inches)**		
		Pavement	**Crush Aggregate Base[5]**	**Cement Treated Subgrades**
Soil Cement	Asphaltic Concrete[1,2,3]	3	4	12
	Portland Cement Concrete[1,4]	6	6	12

1. See Error! Reference source not found. for more specifics regarding traffic classifications.
2. All asphaltic concrete pavement materials should meet the specifications of Section 00745 of the current Oregon DOT Standard Specifications for Construction (ODOT SSC). Additionally, we recommend asphaltic concrete be

Minimum Recommended Pavement Sections				
Subgrade Stabilization Method	**Pavement Type**	**Thickness (inches)**		
		Pavement	**Crush Aggregate Base[5]**	**Cement Treated Subgrades**

compacted to a minimum of 92 percent of the Rice (theoretical maximum) density.

3. A minimum 1.5-inch surface course should be used on AC pavements.
4. All plain concrete pavement materials should meet the specifications of Section 00756 of the current ODOT SSC. Additionally, we recommend all plain concrete have a minimum compressive strength of 4,000 psi after 28 days of curing.
5. See CABC requirements in Fill Material Types section.

The above sections represent minimum thicknesses for the anticipated traffic and, as such, periodic maintenance should be anticipated. Pavements subjected to higher traffic volumes and heavy trucks, concentrated turn areas, and start/stop maneuvers require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. If at any time larger traffic volume is expected, Terracon should be contacted to review the pavement recommendations.

The computation of applicable ESAL's and pavement thicknesses does not consider axle configurations or loading not approved by DOT regulations, or off-road construction equipment. Areas for repeated maneuvering of heavy vehicles is also not considered for pavement thickness design, which is primarily for one-direction and channelized roadway traffic. Consideration could be given to additional steel reinforcement or joint load-transfer dowel bars (at control/contraction joints and at expansion/construction joints) for areas anticipated to receive more complex traffic patterns or at intersections.

Although not required for structural support, a minimum 4-inch-thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of

pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Portland cement concrete pavements should be Jointed Plain Concrete Pavement (JPCP) which does not use distributed reinforcing steel (i.e., throughout the slab) but must have proper design and detailing of longitudinal and transverse control joints with tie bars and joint dowels. The PCC recommendations presented above require dowel reinforcement in longitudinal and transverse contraction joints as shown in ACI 330.2R-17[4].

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

[4] Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities, American Concrete Institute, ACI 330.2R-17.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and

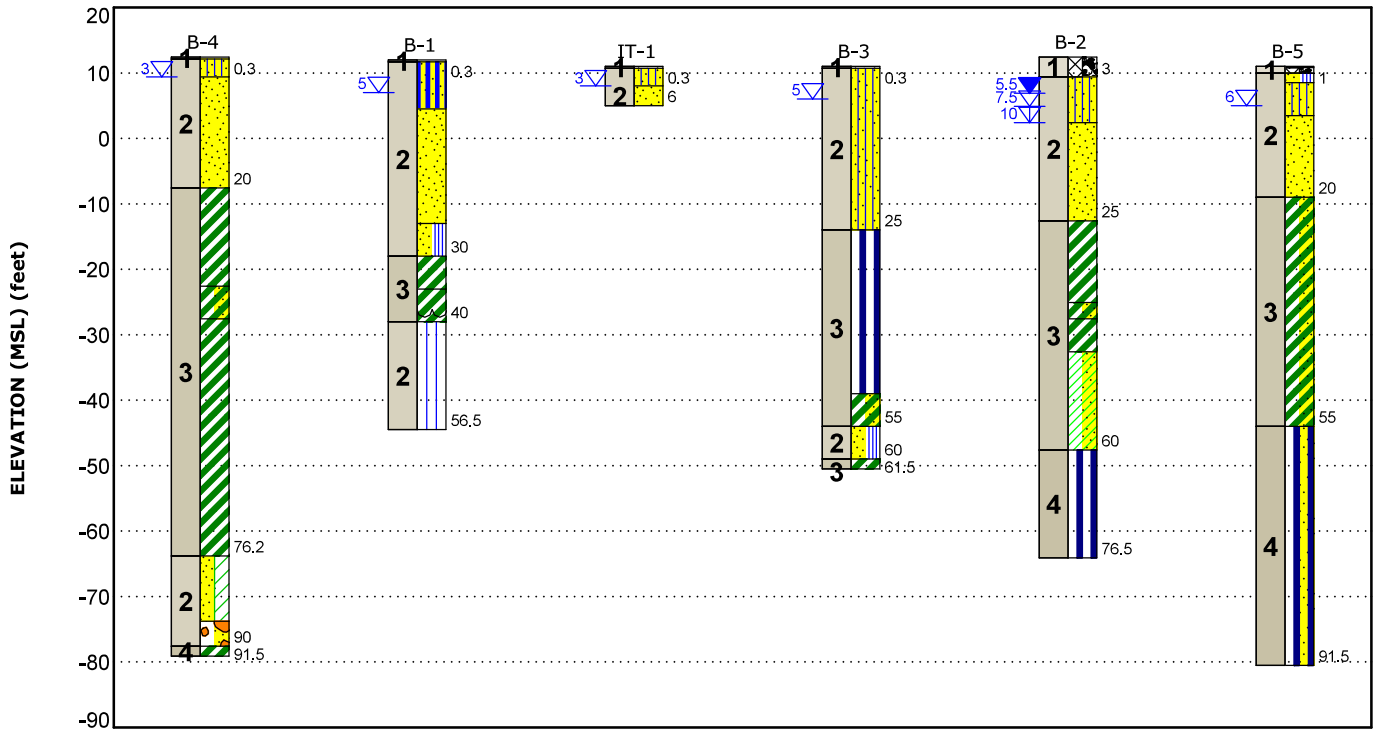
recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Topsoil and Fill Materials**	TOPSOIL; POORLY GRADED GRAVEL FILL: fine to coarse grained, angular, nonplastic to low plasticity, brown and gray, medium dense, variable clay and silt content
2	**Alluvium**	GRAVEL, SAND, and SILT mixtures (GP, SP, SM, ML): brown to gray, very loose to loose/soft, fine to coarse grained angular to subangular gravel, fine to coarse grained sand, nonplastic silt
3	**Fine Grained Alluvium**	LEAN to FAT CLAY (CL,CH), SILT to ELASTIC SILT (ML, MH), ORGANIC SILT (OH): nonplastic to high plasticity, gray to orangish brown, very soft to very stiff, variable fine to medium grained sand content, variable organic content
4	**Mudstone**	MUDSTONE: decomposed to high-plasticity clay, gray to brown, stiff to very stiff

Legend

- Topsoil
- Poorly-graded Sand
- Fat Clay
- Silt
- Silty Sand
- Lean Clay with Sand
- Poorly-graded Sand with Clay
- Elastic Silt with Sand
- Sandy Silt
- Poorly-graded Sand with Silt
- Organic Elastic Silt
- Fill
- Fat Clay with Sand
- Elastic Silt
- Poorly-graded Gravel with Sand

First Water Observation
Second Water Observation
Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Exploration Number	Exploration Type	Approximate Exploration Depth (feet)	Location	
			Latitude	Longitude
B-1	Drilled Boring	56.5	46.1729°N	121.8330°W
B-2	Drilled Boring	76.5	46.1729°N	121.8324°W
B-3	Drilled Boring	61.5	46.1727°N	121.8327°W
B-4	Drilled Boring	91.5	46.1725°N	121.8330°W
B-5	Drilled Boring	91.5	46.1726°N	121.8323°W
IT-1	Drilled Boring	6	46.1723°N	121.8328°W

Exploration Layout and Elevations: Terracon personnel provided the exploration layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth. If elevations and a more precise exploration layout are desired, we recommend explorations be surveyed.

Drilled Borings: We advanced the borings with a track-mounted rotary drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

Exploration Logging: All explorations were supervised and logged by a field engineer who recorded field test data, classified soils, and collected the samples from the explorations. Our exploration team prepared field exploration logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final exploration logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

Property Disturbance: We backfilled borings according to local jurisdiction requirements after completion of each exploration. Pavements were patched with cold-mix asphalt and/or ready mixed concrete, as appropriate. Our services did not include repair of the site beyond backfilling our boreholes and cold patching existing pavements. Excess auger cuttings were dispersed in the general vicinity of each borehole. Since backfill material often settles below the surface after a period, we recommend boreholes be checked periodically and additional backfill added, if necessary.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Atterberg Limits
- Consolidation

Laboratory test results are presented on the exploration logs and/or as separate graphs in the **Exploration and Laboratory Results** section. The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the **Unified Soil Classification System**.

Photography Log



Photo 1
Tags: Boring B-5 completed and backfilled with cuttings and bentonite, facing north



Photo 2
Tags: Boring B-4 completed and backfilled with cuttings and bentonite, facing north



Photo 3
Tags: Boring IT-1 completed and backfilled with cuttings, facing west



Photo 4
Tags: Boring B-1 completed and backfilled with cuttings and bentonite, facing north



Photo 5
Tags: Boring B-4 before drilling, with drill rig set up, facing north

Site Location and Exploration Plans

Contents:

Site Location
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

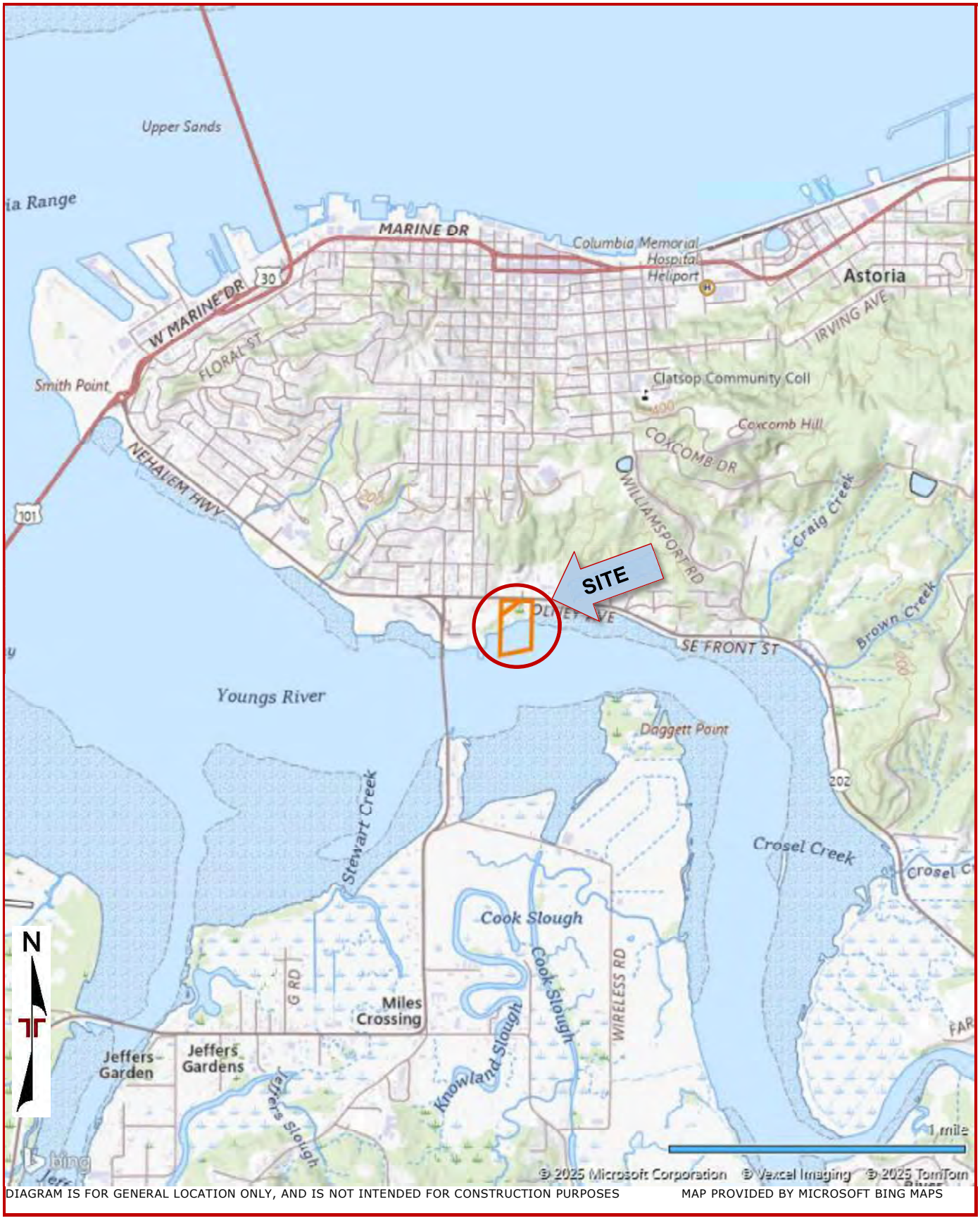


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICRO SOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-5 and IT-1) (14 pages)
Atterberg Limits
Consolidation (2 pages)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8330°

Depth (Ft.) Elevation: 12 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3 / 11.7 **TOPSOIL**, dark brown, moist, soft, grass and rootlets						
		SANDY SILT (ML), fine grained, brown and gray, moist, soft			0-1-1 N=2	40.4		
					1-1-1 N=2	37.9		57.5
			▽		0-0-0 N=0	42.6		
		7.5 / 4.5			0-1-1 N=2	45.9		
2		**POORLY GRADED SAND (SP)**, fine grained, gray, wet, very loose			1-0-1 N=1	46.1		
		loose			0-4-2 N=6	44.4		
		medium grained, very loose			0-0-1 N=1	38.8		
		25.0 / -13						
		POORLY GRADED SAND WITH SILT (SP-SM), medium grained, gray, wet, very loose			0-0-0 N=0	47.0		
		30.0 / -18						
3		**FAT CLAY (CH)**, high plasticity, gray, wet, very soft			0-0-0 N=0	47.3		
		35.0 / -23						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-7.5 Ft - 3.25" Hollow Stem Auger
7.5-56.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8330°

Depth (Ft.) Elevation: 12 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
3		**ORGANIC SILT (OH)**, high plasticity, gray, wet, very soft, organic material/wood debris			0-0-0 N=0	100.7	68-45-23 60-43-17	
		40.0 -28						
2		**SILT (ML)**, gray, wet, very soft, trace fine to medium grained sand			0-1-0 N=1	55.6		
					0-1-1 N=2	59.5		91.9
					0-1-0 N=1	47.3		
		soft, organic material			0-2-1 N=3	96.1		
		56.5 -44.5						
		Boring Terminated at 56.5 Feet						

40 45 50 55

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-7.5 Ft - 3.25" Hollow Stem Auger
7.5-56.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8324°

Depth (Ft.) | Elevation: 12.41 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FILL - POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**, fine to coarse grained, angular, low plasticity, brown and gray, moist			10-9-7 N=16			
		3.0 / 9.41						
2		**SILTY SAND (SM)**, fine grained, gray, wet, very loose			2-2-2 N=4	15.7		
					0-2-0 N=2	53.7		
					3-1-1 N=2	32.5		
		10.0 / 2.41						
		POORLY GRADED SAND (SP), fine grained, gray, wet, loose			0-3-2 N=5	31.6		
		very loose			0-1-1 N=2	38.8		
					1-1-0 N=1			
		25.0 / -12.59						
3		**FAT CLAY (CH)**, high plasticity, gray, wet, very soft			0-0-0 N=0	55.2		
					0-0-0 N=0			

5 10 15 20 25 30 35

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
- While drilling
- At completion of drilling
- After drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger
10-76.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8324°

Depth (Ft.) | Elevation: 12.41 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
		FAT CLAY (CH), high plasticity, gray, wet, very soft *(continued)*				56.1		
		37.5 -25.09				54.5 56.1		
		FAT CLAY WITH SAND (CH), high plasticity, gray, wet, very soft, fine to medium grained sand						
		40.0 -27.59						
		FAT CLAY (CH), high plasticity, gray, wet, very soft			0-0-0 N=0	60.4		
		45.0 -32.59						
3		**LEAN CLAY WITH SAND (CL)**, medium plasticity, gray, wet, very soft, wood debris, fine to medium grained sand			0-0-0 N=0	53.4		
		medium stiff			0-2-3 N=5	44.1	39-23-16 41-23-18	
					2-3-4 N=7			
		60.0 -47.59						
4		**ELASTIC SILT (MH)**, high plasticity, yellowish brown and orangish brown, wet, stiff			6-6-6 N=12			
					4-6-5 N=11	47.1		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
- While drilling
- At completion of drilling
- After drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger
10-76.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 46.1729° Longitude: -123.8324° Depth (Ft.) Elevation: 12.41 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
4		**ELASTIC SILT (MH)**, high plasticity, yellowish brown and orangish brown, wet, stiff *(continued)* greenish gray				7-7-5 N=12	54.2		
		gray, very stiff	75			7-8-9 N=17	37.8	82-39-43	
		76.5 -64.09 ***Boring Terminated at 76.5 Feet***							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
While drilling
At completion of drilling
After drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger
10-76.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 46.1727° Longitude: -123.8327°

Depth (Ft.) Elevation: 11 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3 **TOPSOIL**, brown, moist, grass and rootlets 10.7						
2		**SILTY SAND (SM)**, fine grained, brown and gray, moist, very loose			2-6-4 N=10	20.1		
					1-1-0 N=1	24.5		
		wet	▽		1-0-1 N=1	34.6		
		gray, loose			0-2-3 N=5	32.3		
		very loose			0-2-1 N=3	29.6		
					1-0-0 N=0	41.6		12.5
					1-0-0 N=0	42.4		
3		25.0 -14 **ELASTIC SILT (MH)**, medium plasticity, gray, wet, very soft			0-0-0 N=0	53.4		
					0-0-0 N=0	60.3		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-7.5 Ft - 3.25" Hollow Stem Auger
7.5-61.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 46.1727° Longitude: -123.8327°

Depth (Ft.) Elevation: 11 (Ft.)

Model Layer	Graphic Log		Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
3		**ELASTIC SILT (MH)**, medium plasticity, gray, wet, very soft *(continued)*				0-0-0 N=0	57.6		
			40			0-0-0 N=0	57.8	49-33-16	
			45			0-0-0 N=0	55.1		
		50.0 -39							
		FAT CLAY WITH SAND (CH), high plasticity, gray, wet, very soft, fine to medium grained sand	50			0-0-0 N=0	64.8		
		55.0 -44							
2		**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, gray, wet, very loose	55			1-1-2 N=3	39.0		
		60.0 -49							
3		**FAT CLAY (CH)**, high plasticity, gray, wet, very soft	60			0-0-0 N=0	58.6		
		61.5 -50.5							
		Boring Terminated at 61.5 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-7.5 Ft - 3.25" Hollow Stem Auger
7.5-61.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 46.1725° Longitude: -123.8330°

Depth (Ft.) | Elevation: 12.41 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3 **TOPSOIL**, brown, moist, grass and rootlets (12.11)						
2		**SILTY SAND (SM)**, fine grained, gray, moist, very loose			1-0-1 N=1	45.6		
		3.0 (9.41) **POORLY GRADED SAND (SP)**, fine grained, gray, wet, loose	▽		2-2-3 N=5	40.3		
					2-5-3 N=8	36.7		
					0-0-4 N=4			
					5-5-2 N=7	35.1		
		very loose			0-0-0 N=0			
		20.0 (-7.59)						
3		**FAT CLAY (CH)**, high plasticity, gray, wet, very soft			0-0-0 N=0	65.9		
					0-0-0 N=0	58.3		
		35.0 (-22.59)						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-5 Ft - 3.25" Hollow Stem Auger
5-91.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 46.1725° Longitude: -123.8330°

Depth (Ft.) Elevation: 12.41 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
3		0			0-0-0 N=0	54.5		
		40.0 -27.59						
		40			0-0-0 N=0	57.1		
		45			0-0-0 N=0	57.3		
		50			0-1-0 N=1	63.2		
		55			0-0-1 N=1	63.7		
						44.6		
		60			0-0-0 N=0	63.3		92.9
		65						
		70						

FAT CLAY WITH SAND (CH), high plasticity, gray, wet, very soft, fine to medium grained sand

FAT CLAY (CH), high plasticity, gray, wet, very soft

trace fine to medium grained sand

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-5 Ft - 3.25" Hollow Stem Auger
5-91.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 46.1725° Longitude: -123.8330°

Depth (Ft.) | Elevation: 12.41 (Ft.)

Model Layer	Graphic Log		Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
3		**FAT CLAY (CH)**, high plasticity, gray, wet, very soft *(continued)*							
					X	0-0-2 N=2	54.5		
			75						
					X	0-0-4 N=4	56.6		
		76.2 -63.79							
2		**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, wet, loose, low plasticity fines							
		medium dense	80						
					X	4-6-5 N=11	65.9		
			85						
					X	5-20-23 N=43	34.3		
							14.8		
		86.2 -73.79							
		POORLY GRADED GRAVEL WITH SAND (GP), fine to coarse grained, angular to subangular, gray and brown, wet, dense							
		90.0 -77.59	90						
4		**FAT CLAY (CH)**, high plasticity, gray, wet, very stiff							
					X	9-12-15 N=27	32.8	81-35-46	
		91.5 -79.09							
		Boring Terminated at 91.5 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-5 Ft - 3.25" Hollow Stem Auger
5-91.5 Ft - Mud/Rotary Wash

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8323°

Depth (Ft.) Elevation: 10.99 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Description	Elevation (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.2	**FILL - TOPSOIL**, low plasticity, brown, moist, rootlets	10.79							
		1.0	**FILL - POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, fine to coarse grained, gray and brown, moist, medium dense	9.99				8-6-7 N=13	5.3		
									19.9		
		2.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, gray, moist, medium dense	8.49				2-1-1 N=2	40.7		
			SILTY SAND (SM), fine grained, gray, moist, very loose		5			0-0-0 N=0	40.2		
			wet								
		7.5		3.49				2-6-6 N=12	36.5		
2			**POORLY GRADED SAND (SP)**, fine grained, gray, wet, medium dense		10			5-2-0 N=2	35.1		
			very loose								
					15			0-1-1 N=2	37.6		
		20.0		-9.01							
3			**FAT CLAY WITH SAND (CH)**, high plasticity, gray, wet, very soft, fine to medium grained sand		20			0-0-0 N=0	62.7		
					25			0-0-0 N=0	44.2		
					30			0-0-0 N=0	43.1		
					35						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8323°

Depth (Ft.) Elevation: 10.99 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
3		**FAT CLAY WITH SAND (CH)**, high plasticity, gray, wet, very soft, fine to medium grained sand *(continued)*						
					0-0-0 N=0	44.3		
		40						
					0-0-0 N=0	52.3		
		45						
					0-0-0 N=0	58.8		
		50						
					0-0-0 N=0	84.9		
		55.0 -44.01						
4		**ELASTIC SILT WITH SAND (MH)**, high plasticity, gray, wet, very soft, fine to medium grained sand, wood debris						
		55			2-0-1 N=1	49.4	80-42-38 80-35-45	
		gray and orangish brown, wet, medium stiff, fine grained sand						
		60			3-3-4 N=7	54.4		
		stiff						
		65			1-4-6 N=10	30.8		
		70						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 46.1729° Longitude: -123.8323°

Depth (Ft.) Elevation: 10.99 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
4		**ELASTIC SILT WITH SAND (MH)**, high plasticity, gray, wet, very soft, fine to medium grained sand, wood debris *(continued)*						
					4-5-5 N=10	43.4		
		75			4-5-5 N=10	43.0		73.7
		medium stiff 80			2-2-5 N=7	38.4	91-41-50	
		stiff 85			4-7-8 N=15	31.8		
		very stiff 90			11-13-15 N=28	34.0		
		91.5 -80.51						
		Boring Terminated at 91.5 Feet						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring extended beyond the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Notes

Advancement Method
0-10 Ft - 3.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Boring Log No. IT-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 46.1723° Longitude: -123.8328° Depth (Ft.) / Elevation: 11 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1		0.3 **TOPSOIL**, brown, moist, grass and rootlets 10.7							
2		**SILTY SAND (SM)**, fine grained, gray, moist, very loose 3.0 8		▽					
		POORLY GRADED SAND (SP), fine grained, gray, wet, loose 6.0 5	5				31.3		
		Boring Terminated at 6 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevation determined from Google Earth Pro

Boring terminated at the planned depth

Water Level Observations
▽ While drilling

Drill Rig
Geoprobe 3126 GT

Hammer Type
Automatic

Driller
Greg Jarrett

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and Bentonite

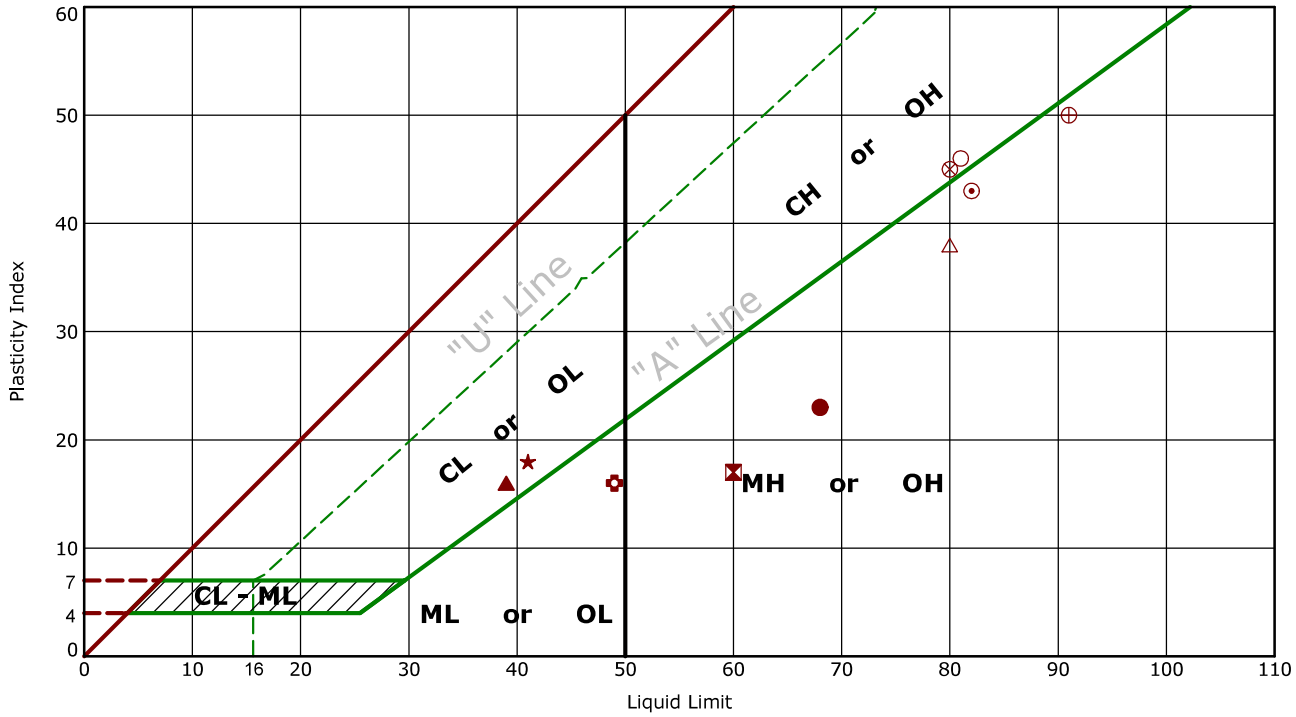
Logged by
YY

Boring Started
09-02-2025

Boring Completed
09-02-2025

Atterberg Limit Results

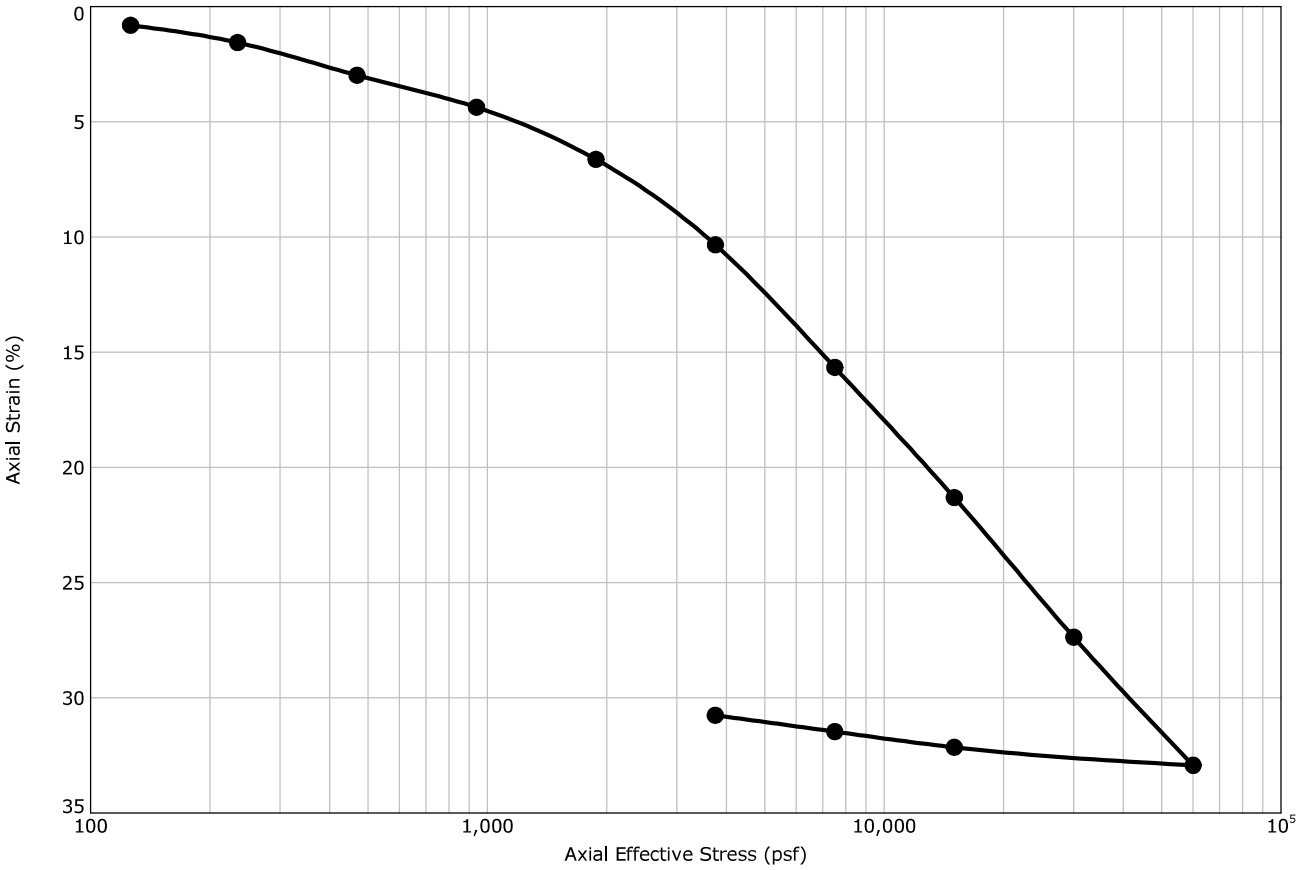
ASTM D4318

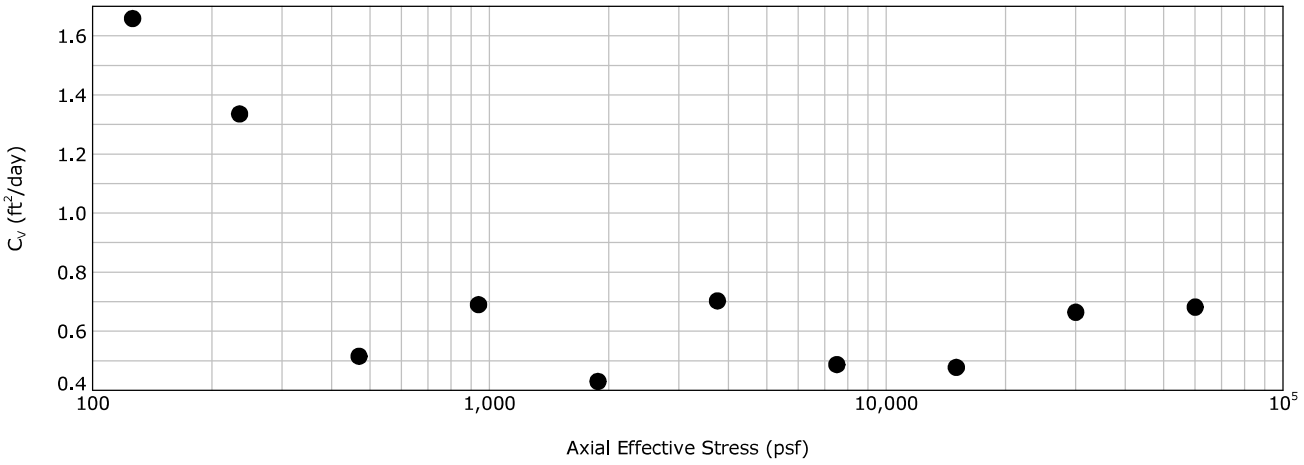


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	35 - 35.8	68	45	23		MH	Elastic Silt
⊠	B-1	35.8 - 36.5	60	43	17			oven dried sample of B-1 at 35'-35.8'
▲	B-2	50 - 50.8	39	23	16		CL	Lean Clay
★	B-2	50.8 - 51.5	41	23	18			oven dried sample of B-2 at 50'-50.8'
⊙	B-2	75 - 76.5	82	39	43		MH	Elastic Silt
✿	B-3	40 - 41.5	49	33	16		ML	Silt
○	B-4	90 - 91.5	81	35	46		CH	Fat Clay
△	B-5	55 - 55.8	80	42	38		MH	Elastic Silt
⊗	B-5	55.8 - 56.5	80	35	45			oven dried sample of B-5 at 55'-55.8'
⊕	B-5	80 - 81.5	91	41	50		MH	Elastic Silt

One-Dimensional Consolidation Test

D2435





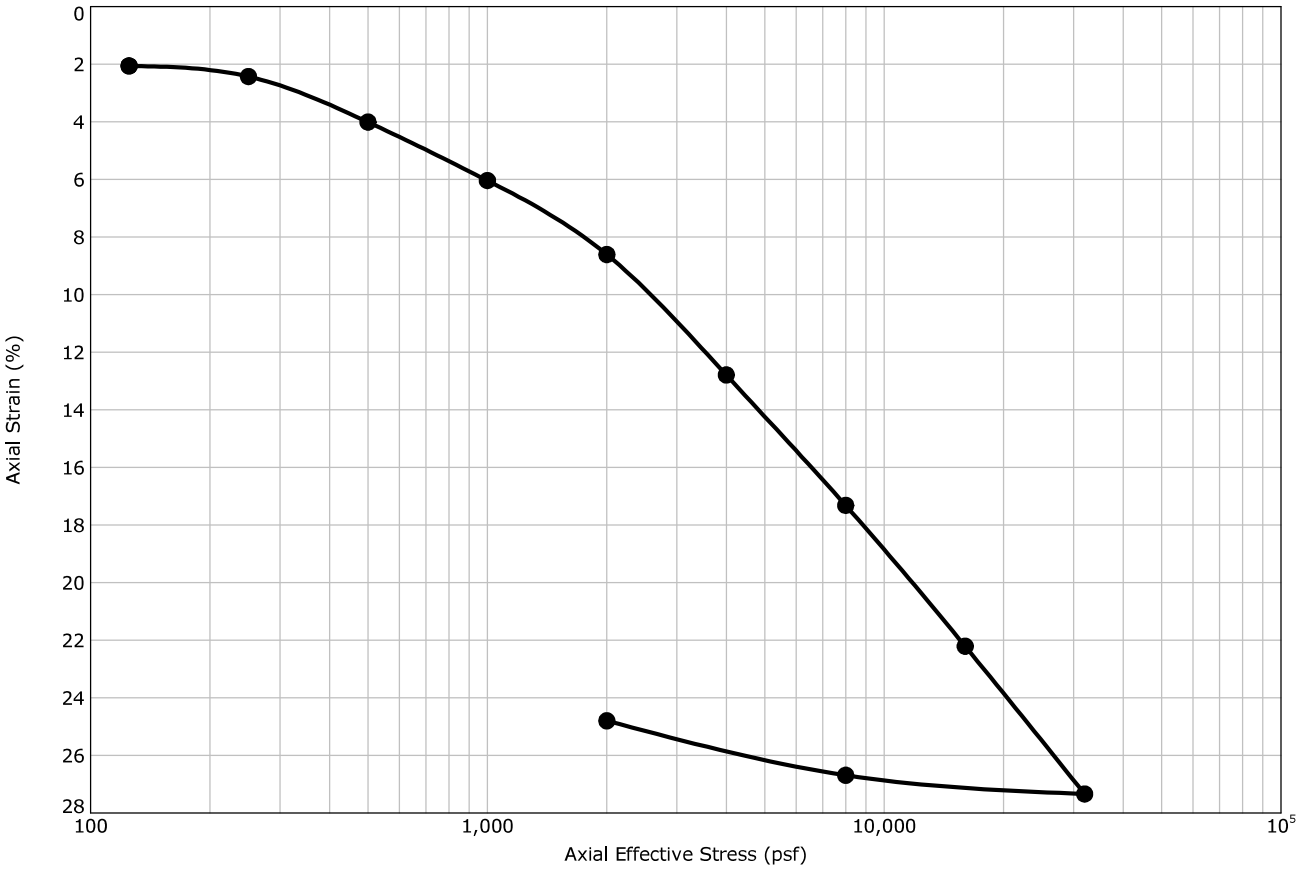
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
B-2	35.01 - 36.25	s-10a	Fat Clay	CH	

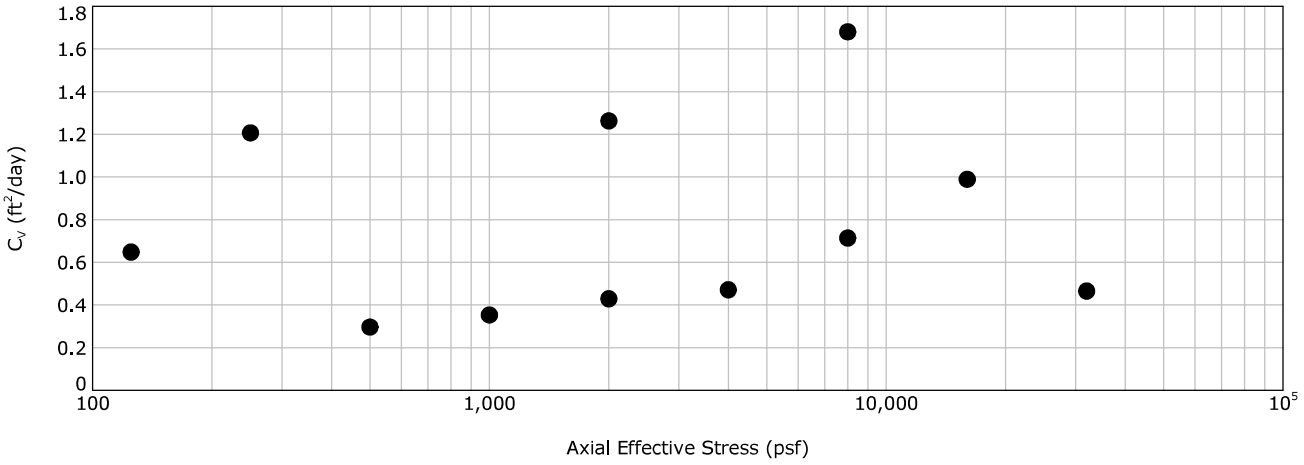
Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
95.9	56.1	65.8			2.75	1680	2,069	18.470	1.780	

Notes: innundated at seating load (125 psf); overburdern = effective vertical stress at the sample depth; preconsolidation pressure calculated using the Casagrande Method; Cc = the slope of the e–log of effective vertical stress line beyond Pc'; Cr the slope of the e–log of effective vertical stress line before Pc'; Specific Gravity (SG) is assumed to be 2.75

One-Dimensional Consolidation Test

ASTM D2435





Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
B-2	36.25 - 37.5	S-10b	Fat Clay	CH	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
99.8	56.1	67.4			2.75	1680	1,528	17.041	2.109	

Notes: This test was run on a sample adjacent to the sample of B-2 at 35' to 37.5' at the same depth; sample innundated at seating load (125 psf); innundated at seating load (125 psf); overburdern = effective vertical stress at the sample depth; preconsolidation pressure calculated using the Casagrande Method; Cc = the slope of the e–log of effective vertical stress line beyond Pc'; Cr the slope of the e–log of effective vertical stress line before Pc'; Specific Gravity (SG) is assumed to be 2.75

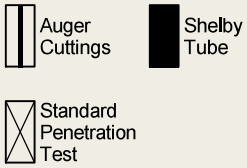
Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
	 Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	5 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	9 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	16 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

