GN Northern, Inc.

Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

GEOTECHNICAL SITE INVESTIGATION REPORT

ATLAS AGRO PACIFIC GREEN FERTILIZER PLANT
NW CORNER OF HORN RAPIDS ROAD & STEVENS DRIVE
RICHLAND, WASHINGTON, USA

GNN PROJECT NO. 223-1672

NOVEMBER 2023

Prepared for

TECNICAS REUNIDAS
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Prepared by

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November 7, 2023

Técnicas Reunidas
Construction Division/Subcontracting Department
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Attn: David Jiménez Sancho, Subcontract Engineer

Subject: Geotechnical Site Investigation Report (Rev 2)
Atlas Agro Pacific Green Fertilizer Plant
NW Corner of Horn Rapids Road & Stevens Drive
Richland, Washington, USA

GNN Project No. 223-1672

Dear Mr. Sancho,

As requested, GN Northern (GNN) has completed a geotechnical site investigation report for the referenced 141-acre site that Atlas Agro intends to develop the Pacific Green Fertilizer Plant in north Richland, Washington.

Based on the findings of our geotechnical site investigation, we conclude that subject site is suitable for the planned development provided that the geotechnical recommendations presented in this report, and any subsequent design-level geotechnical investigation report(s) are followed during the design and construction phases of the project.

This report describes the results of our investigation, summarizes our findings and presents our recommendations concerning earthwork and the design and construction of foundations and infrastructure for the proposed project. ***It is important that Técnicas Reunidas retain GNN to provide geotechnical engineering consultation during the design development phases to ensure implementation of the geotechnical recommendations.***

If you have any questions regarding this report, please contact us at 509-734-9320.

Respectfully submitted,
GN Northern, Inc.

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1.0 PURPOSE AND SCOPE OF SERVICES

This *Geotechnical Site Investigation Report* has been prepared for the proposed Atlas Agro Pacific Green Fertilizer Ammonia Fertilizer Plant planned on an approximately 141-acre site located at the northwest corner of Horn Rapids Road and Stevens Drive in Richland, Washington; the site location is shown on the *Vicinity Map* (Figure 1, Appendix I). Our investigation was conducted to collect information regarding subsurface conditions and present recommendations for suitability of the subsurface materials to support the planned site development, and geotechnical soil design parameters and considerations for the proposed design and construction.

GN Northern, Inc. has prepared this report for use by Atlas Agro Holding Ag, Técnicas Reunidas and their consultants in the planning and front end engineering design services of the proposed development.

Our study was conducted in general accordance with the scope of work defined in the Technical Requisition I and II, Updated Technical Specification (10560-000-CIV-SP-0002_Geotechnical Work Specifications-GNN Revisions 7-6-2023), GNN Geotech Exploration Map 1 of 2 with boring depth table and Geotech Exploration Map 2 of 2 dated 6/24/2023, and a Letter Agreement for Geotechnical Study dated July 10, 2023, along with our understanding of the proposed project based on communications with Técnicas Reunidas's team. Notice to proceed was provided on July 11, 2023 via email and in the form of a signed **Purchase Order Number 1056023700** dated July 10, 2023.

The field exploration, consisting of thirty-nine (39) exploratory borings, three (3) downhole seismic tests in boreholes, four (4) temporary piezometer in boreholes for groundwater measurements, twelve (12) test-pits, seven (7) in-situ infiltration tests, twelve (12) static cone penetration tests (CPTs), fourteen (14) seismic refraction and refraction microtremor soundings, five (5) electrical resistivity tests, and collection of soil samples for two (2) thermal resistivity tests, were completed from July 26th through September 29, 2023. Field exploration and test locations are shown on the *Site Exploration Maps* (Figure 2, and 2A in **Appendix I).** Detailed boring and test-pit logs are presented in Appendix IV, and results of our laboratory testing are presented in Appendix VII.

This report has been prepared to summarize the data obtained during this study and to present our recommendations based on the proposed construction and the subsurface conditions encountered at the site. Results of the field exploration and laboratory testing were analyzed to develop recommendations for site development, earthwork, foundations and slabs, pavements, utilities etc. Design parameters and a discussion of the geotechnical engineering considerations related to construction are included in this report.

2.0 PROPOSED CONSTRUCTION

We understand that Atlas Agro intends to construct a fertilizer production plant on land purchased from the Port of Benton, a 141-acre vacant site which is a portion of the parcel identified by Benton County Assessor as Parcel No. 110081000001004, located northwest of the intersection of Stevens Road and Horn Rapids Road in north Richland, Benton County, Washington. The site will be developed into a zero-carbon fertilizer plant meeting strategic national objectives to reduce CO_2 emissions by means of developing a green ammonia production facility utilizing a "a closed-loop system that produces green hydrogen from electrolysis of water and uses the Haber-Bosch synthesis process to make calcium ammonium nitrate." The design elements will include installation of electrolyzes, a new ammonia synthesis, a new nitric acid and ammonium nitrate solution plant.

Preliminary information regarding site layout and buildings and structures are shown on the Soil Investigation Layout Attachment A_10560-000-CIV-SP-0002_REV_B, and the Loads and Settlements Layout Plan Drawing # 10560-000-CIV-SP-0002_REV_A, dated June 23, 2023 prepared by Técnicas Reunidas. Construction will include process plants and related auxiliary units and pre-engineered metal storage buildings with slab-on-grade, above-ground bolted steel tanks, low pipe racks, and various structures. We understand that the planned flare tower will be <45m tall. In an email sent on November 2, 2023, Rafael Mier Pérez of Técnicas Reunidas provided a Final Grade Level (FGL) of approximately ±385 feet for the proposed project. It was also clarified that FGL is typically 7 to 8 feet from bottom of foundation elevation to accommodate different underground ducts/piping systems. We understand that final plans may consider multi-level FGL elevations in an effort to minimize cut-fill quantities. GNN shall review final site layout plan(s) to confirm our recommendations remain valid.

Mean Vertical Pressures (Qd) and Admissible Long-Term Settlements were provided by Mr. Pérez via email on June 23,2023 in Attachment B_10560-000-CIV-SP-0002_REV_A (LOADS AND SETTLEMENS LAYOUT). A minimum uniform soil pressure of 2,016 psf (14 psi) and a maximum pressure of 5,040 psf (35 psi) are estimated for the proposed structures. However, based on our understanding several industrial facilities, mostly the critical ones and some others may have higher maximum pressures, but the final details will be adjusted in later phases. If loading conditions differ from those described below, GNN should perform re-analysis.

Based on preliminary information available at the time of this report preparation, Table 1 below summarizes structure type, mean vertical loading (mean vertical soil uniform pressure) allowable settlements used in our analysis for various structures and components. Table 1 also includes the current surface elevations across each proposed structure and points of geotechnical exploration for the respective structures.

Table 1: Planned Structures, Loading Criteria, Current Elevations & Exploration

Structure ID	Planned Block (per Site Plan)	Proposed Structure/Facility	M.V.P.* (psi / psf)	L.T.S.**	Current Surface Elevation†	Geotech Points of Exploration
	Truck Access	Weight Scale (inbound)	-	-	386′ - 387′	BH-01‡
ST-1	840 Buildings	2,529.51 ft^2 Chemicals Storage Building	20 / 2,880	1"	383′ - 385′	BH-02‡, BH-03‡
ST-2		10,537.76 ft^2 Building at Main Access	14 / 2,016	1"	382′ - 384′	
ST-3		4,553.13 ft^2 Warehouse & Workshop Bldg.	16 / 2,304	1"	383′ - 384′	
ST-4	431 Bulk Storage Unit	32,184.16 ft^2 Building Structure	16 / 2,304	1"	385.5′ - 393′	BH-04+PZ, BH-08, BH-14, CPTu-01
ST-5	580 Effluent Waste Water System	2,887.34 ft^2 Building Structure	16 / 2,304	1"	381′ - 383′	BH-05, BH-06, BH+PZ-09, CPTu-04
ST-6		1,324.96 ft^2 Building Structure	25 / 3,600	1"	381′	
ST-7		2,637.15 ft^2 Building Structure	14 / 2,016	1"	381′ - 382′	
ST-8		2,981.60 ft^2 Building Structure	16 / 2,304	1"	380.5′ - 383′	
ST-9		4,133.34 ft^2 Building Structure	14 / 2,016	1"	381′ - 387′	
ST-10	500 Raw, Demi, Pure, Service Water	3,898.09 ft^2 Building Structure	14 / 2,016	1"	381′ - 383.5′	BH-07, BH-10
ST-11		6,402.45 ft^2 Building Structure	16 / 2,304	1"		
ST-12		4,526.74 ft^2 Building Structure	14 / 2,016	1"	382′ - 383′	
ST-13		1,442.36 ft^2 Tank Structure	14 / 2,016	1"	383′ - 385′	
	432 Truck Loading Station		-	-	384′ - 391′	BH-11, TP-07, TP-08
ST-14	500 Fire Water System	4,047.13 ft^2 Building Structure	37.33 / 5,375	1"	379′ - 384′	BH-12
ST-15	571 BFW & 573 Steam Unit	4,876.05 ft^2 Building Structure	14 / 2,016	1"	380′ - 384′	BH-13
ST-16	810 Central Control Room 820 IER 844 Laboratory	6,163.54 ft^2 Building Structure	28 / 4,032	1"	380′ - 384′	BH-15, CPTu-05

ST-17	410 Limestone Storage	4,391.67 ft^2 Building Structure	14 / 2,016	2"	384.5′ - 386′	BH-16
ST-18	410 Milling	2,970.23 ft^2 Building Structure	28 / 4,032	1"	384.5′ - 387′	BH-17
ST-19	830 Substation	6,469.11 ft^2 Substation Structure	28 / 4,032	2"	381′ - 388′	BH+PZ-18, CPTu-06
ST-20	420 Calcium Nitrate	1,410.06 ft^2 Building Structure	30 / 4,320	1"	386′ - 389′	BH-19
ST-21	400 Ammonium Nitrate Solution Unit	1,205.55 ft^2 Building Structure	14 / 2,016	1"	383′ - 385′	BH-21
ST-22		4,391.67 ft^2 Building Structure	14 / 2,016	1"	381.5′ - 385′	
ST-23	410 Granulation	3,681.65 ft^2 Building Structure	26.88 / 3,871	1"	384′ - 388′	BH-20
ST-24	572 Power Generation	4,068.75 ft^2 Power Generation Structure	22.40 / 3,226	1"	379.5′ - 384′	BH-22, CPTu-07
ST-25	600 ASU	3,358.34 ft^2 Building Structure	28 / 4,032	1"	386.5′ - 390′	BH-23
		Misc. Auxiliary Structures	-	-		BH-28, CPTu-09
ST-26	200 Ammonia	4,174.31 ft^2 Building Structure	28 / 4,032	2"	380′ - 387′	BH-24
ST-27	300 Nitric Acid Unit	2,023.61 ft^2 Tank Structure	42 / 6,048	2"	385′ - 388′	BH-26
		Misc. Auxiliary Structures	-	-	380′ - 388′	BH-25, CPTu-02
ST-28	200 Ammonia Storage	3,724.31 ft^2 Ammonia Tank Structure	28 / 4,032	2"	393′ - 399′	BH-27, TP-11
ST-29		Refrigeration Package NH3	-	-	391.5′ - 394′	BH-29
		Storm Water Retention Pond	-	-	391′ - 392.5′	CPTu-10
ST-30	100 Hydrogen Production Unit	5,543.41 ft^2 Hydrogen Building (central)	16 / 2,304	2"	381.5′ - 388′	BH-30, CPTu-08
ST-31		5,543.11 ft^2 Hydrogen Building (east)	16 / 2,304	2"	382′ - 387′	BH-31, BH-35
ST-32		5,543.41 ft^2 Hydrogen Building (west)	16 / 2,304	1"	385′ - 395′	BH-34, BH-42
ST-33		957.98 ft^2 Building Structure	14 / 2,016	1"	391′ - 399′	BH-33
ST-34	Cooling Water System	7,876.31 ft^2 Building Structure	14 / 2,016	2"	385′ - 390′	BH-36, BH-37, BH-38
ST-35	High Voltage (HV) Substation	7,265.63 ft^2 Substation Structure	37.33 / 5,375	2"	385′ - 393′	BH-39, CPTu-03
ST-36		828.82 ft^2 Transformer 115/34.5kV (east)	42 / 6,048	1"	389′ - 391′	BH+PZ-40
ST-37		828.82 ft^2 Transformer 115/34.5kV (west)	42 / 6,048	1"	389.5′ - 390′	BH-41
ST-38	750 Flare	2,678.41 ft^2 Flare Stack Structure	84 / 12,096	2"	391′	BH-32

**M.V.P.- Mean Vertical Pressures (Qd)*
***L.T.S.- Admissible Long-Term Settlements*
† Current Surface Elevation obtained for Topographic Survey by Rogers Surveying
‡ Borings Not Drilled

3.0 FIELD EXPLORATION & IN-SITU TESTING

Field exploration activities to study and characterize subsurface conditions at the project site were conducted between July 24th and September 29, 2023. Prior to commencement of the various field exploration activities, a Cultural and Archeological Survey of the project site was conducted by HDR during the week of July 17-21, 2023. Based on the results of the survey, HDR prepared maps with defined ingress and egress routes to access the various points of exploration with trucks and equipment to avoid any sensitive areas identified on the site. A site meeting was held on July 24th with GNN, HDR, and Atlas Agro representatives to observe and discuss the noted cultural and archeological related site constraints regarding access to the planned points of exploration and in-situ testing locations.

After obtaining authorization to access the site, on Monday July 24th, a GNN project engineer performed an initial project site walk-through to locate and stake specific locations for the planned points of exploration and testing. Public utility clearances were obtained prior to commencement of field exploration. The various methods of exploration and testing performed for our subsurface evaluation included:

- Exploratory Soil Borings,
- Boreholes for Down-hole Seismic Test
- Boreholes with peizometers for groundwater monitoring
- Exploratory Test-pit Excavations
- Soil Infiltration Testing in Test-pits
- Cone Penetrometer Testing (CPT)
- Geophysical surveys - Seismic Refraction, Refraction Microtremor (ReMi), Electrical Resistivity Testing
- Collection of Samples for Laboratory Thermal Resistivity Testing

All field exploration activities were coordinated with HDR cultural resource management personnel to escort our exploration teams across the site to preserve, to the best degree possible, any potentially sensitive cultural/archaeological resources. Selected areas of the site were designated as culturally/archaeologically significant and as such these areas were avoided. Boreholes BH-01, BH-02 and BH-03 were not drilled due to archaeological restrictions. The plotted locations of borings BH-8, BH-27, BH-29, BH-32, BH-33, BH-34, and BH-36 were offset slightly to avoid ground disturbance within 100 feet of a known cultural resource. The cultural resource monitors and geotechnical staff identified appropriate locations to offset these test locations. The various methods of exploration are discussed in further detail below.

3.1 Exploratory Soil Borings

Due to the various access constraints/challenges and application of various drilling methodologies utilized, field exploratory drilling activities were conducted in multiple rounds and mobilizations.

The first round of drilling was completed between August 14 and August 18, 2023. This round included thirty-five (35) exploratory borings drilled by Geowest Drilling, Inc. and Geologic Drill Partners, Inc. The borings completed during this round included borings BH-04+PZ through BH-21, BH-24, BH-26 through BH-31, and BH-33 thru BH-42. The borings were drilled using two (2) Acker Recon track mounted drill rigs with hollow stem augers (HSA) and automatic hammers and a DeepRock XL trailer mounted drill rig using HSA and a manually activated rope-and-cathead hammer system. These borings were drilled to depths ranging from 15 to 66.5 feet BGS. Most of the borings were terminated due to auger refusal on dense gravels, cobbles and boulders. Borings BH-04+PZ, BH-09+PZ, BH-18+PZ, and BH-40+PZ each had a piezometer installed for groundwater measurements to be taken throughout the exploration period.

Due to the dense gravels, cobbles, and boulders encountered in the borings, many borings required multiple attempts to advance the augers a few feet below the surface. Because of this difficulty, several borings required ‘predrill excavation’ of the upper 8 to 14 feet before drilling could commence. The predrill excavations consisted of excavating a hole to get beyond the upper layer of very dense gravels with cobbles and boulders that were causing premature auger refusal. The lead auger stem was then placed within the hole and the excavated soils were loosely backfilled around the auger. The drill rig then repositioned and connected to the auger to begin drilling. This predrill excavations were completed with a Link-Belt 460 operated by Big D’s Construction and a Komatsu 238US LC excavator operated by Geowest Drilling, Inc.

The second round of drilling was completed between August 23rd & September 1st 2023 and included one (1) exploratory boring, boring BH-25 (DH-25), drilled by Johnson Exploration Drilling using a Mobile B-53 truck-mounted drill rig using the ODEX air rotary drilling method with a rope and cathead hammer system. This boring was drilled to a total depth of 51.5 feet BGS and was terminated to due heaving sand conditions that clogged and stopped the ODEX hammer system function. Boring BH-25 and the previously installed piezometers were abandoned according to Washington State guidelines upon completion of this round of drilling.

The third round of drilling was completed on September 7, 2023 and consisted of one (1) exploratory boring BH-32, drilled by HazTech Drilling using a CME-75 truck mounted drill rig using HSA and an automatic hammer. The boring was drilled to a total depth of 62 feet BGS before encountering auger refusal.

The fourth round of drilling was completed between September 25 and 29, 2023. This round consisted of three (3) exploratory borings drilled by Western States Soil Conservation Inc. using a Geoprobe 8150LS track mounted sonic drill rig. This included drilling borings BH-22 (DH-22), BH-23 (DH-23), and redrilling boring BH-25 (DH-25). Upon completion of drilling, these borings were cased with a 3" inside diameter PVC pipe grouted in place for the down-hole seismic tests. Boring BH-22 (DH-22) and BH-23 (DH-23) were cased to a depth of 60 feet BGS and BH-25 (DH-25) was cased to a depth of 76 feet BGS.

The borings were logged by a GNN field engineer or geologist. Upon completion, all borings were backfilled with granular bentonite according to Washington State guidelines. Boring locations are shown on the *Site Exploration Maps* (Figure 2 and 2A, Appendix I). The following table presents the boring location area, date(s) of drilling, drilling methods, predrill excavation, predrill excavation depths, and final depths for each of the borings:

Table 2: Summary of Exploratory Borings

Boring Test Pit ID	Coordinates		Associated Structure	Depth, ft BGS	Field Notes
	Northing	Easting			
BH-04+PZ	374218.62	1946492.60	Bulk Storage Unit	61.5	1st drilling attempt met auger refusal @ 4', hole was moved and drilling resumed
BH-05	374274.97	1945697.26	Effluent Waste Water System	41	1st drilling attempt met auger refusal @ 3', hole was relocated a few feet and drilling resumed
BH-06	374392.45	1945605.06	Effluent Waste Water System	41	shallow large boulders, 1st drilling attempt met auger refusal @ 2', hole was relocated a few feet, 2nd attempt met refusal @ 3.5' hole was moved a second time and drilling resumed
BH-07	374417.87	1945883.46	Raw Water Tank, DEMI Water Tank, Pure Service Water area	30.5	excavated to 8' then began drilling, 1st drill attempt met refusal at 12', moved hole a few feet and drilling resumed
BH-08	374526.64	1946577.26	Bulk Storage	30.25	

BH-09+PZ	374651.74	1945603.61	Effluent Waste Water System	46.5	shallow large boulders cemented to 6', excavated to 9' then began drilling
BH-10	374666.25	1945812.73	Raw Water Tank, DEMI Water Tank, Pure Service Water area	25.5	shallow large boulders, cemented to 5', excavated to 9' then began drilling, 1st drilling attempt met auger refusal at 12', moved hole a few feet and resumed drilling
BH-11	374721.83	1946249.76	Truck Loading Station	35.25	excavated to 9' then began drilling
BH-12	374822.44	1945652.26	Fire Water Area	43	shallow large boulders, cemented to 6.5'
BH-13	374839.32	1945825.48	BFW & Steam Unit	21	
BH-14	374907.87	1946490.08	Bulk Storage Unit	42	
BH-15	374944.95	1945698.36	Laboratory	21	shallow large boulders > 24", excavated to 13' then began drilling
BH-16	375004.46	1946130.02	Limestone Storage	27.5	shallow large boulders, excavated to 9' then began drilling
BH-17	375047.67	1946402.58	Milling Area	46.5	excavated to 10' then began drilling
BH-18+PZ	375121.55	1945869.89	Substation	35.5	large boulders
BH-19	375202.19	1946252.48	Calcium Nitrate Area	31.5	auger refusal at 4.5', moved hole a few feet and resumed drilling
BH-20	375229.74	1946075.55	Ammonium Nitrate Solution Unit	21	shallow large boulders, excavated to 11' then began drilling
BH-21	375242.36	1946446.05	Granulation Area	20.5	excavated to 9' then began drilling
DH-22	375261.09	1945836.69	Power Generation	80	Sonic Drilling, down-hole seismic test
DH-23	375428.99	1945607.61	ASU	60	Sonic Drilling, down-hole seismic test
BH-24	375492.75	1945841.47	Ammonia Area	30.5	large boulders
DH-25	375499.73	1946129.99	Nitric Acid Area	51.5	ODEX drilling system terminated due to heaving sands
DH-25	375457.13	1946395.79	Nitric Acid Area	80	Sonic Drilling, down-hole seismic test
BH-26	375464.26	1945124.76	Nitric Acid Area	21	
BH-27	375554.71	1945624.62	Ammonia Storage	27	1st drilling attempt met refusal at 3', hole moved to within previously excavated TP-11 and drilling resumed at 14'
BH-28	375568.60	1945317.35	ASU area	17	

BH-29	375686.32	1946001.88	Ammonia Storage	23	
BH-30	375702.00	1946476.62	Hydrogen Production Unit	24.25	1st drilling attempt met refusal at 7', moved a few feet and drilling resumed
BH-31	375978.16	1945078.77	Hydrogen Production Unit	16.5	1st drilling attempt met refusal at 5', moved a few feet and drilling resumed
BH-32	375831.90	1945649.66	Flare	61.5	HazTech
BH-33	375913.64	1945747.90	Hydrogen Production Unit	26	
BH-34	375955.48	1946311.36	Hydrogen Production Unit	28	excavated to 9' then began drilling
BH-35	375727.00	1946774.70	Hydrogen Production Unit	26	1st drilling attempt met auger refusal at 5', moved a few feet and drilling resumed
BH-36	375202.19	1946252.48	Cooling Water System	33	shallow large boulders, excavated to 9' then began drilling
BH-37	375920.81	1946665.92	Cooling Water System	26.5	shallow large boulders
BH-38	376140.40	1946762.79	Cooling Water System	15	1st attempt met refusal at 7', moved a few feet and drilling resumed
BH-39	376119.56	1946261.12	HV Substation	20.5	
BH-40+PZ	376220.38	1945963.13	HV Substation	66.5	shallow large boulders, excavated to 9' then began drilling
BH-41	376216.10	1945755.13	HV Substation	16.5	shallow large boulders, excavated to 9' then began drilling
BH-42	375685.91	1945714.02	Hydrogen Production Unit	32	excavated to 8' BGS then began drilling
TP-1	374276.15	1945916.95	Truck Loading Station	14	cobbles and boulders
TP-2	375023.26	1945524.94	Laboratory	15	
TP-3	375115.69	1946201.03	Limestone Storage area	15	
TP-4	375366.42	1945951.23	Power Generation area	14	cobbles and boulders
TP-5	375607.76	1945492.75	Hydrogen Production Unit	14	cobbles and boulders, cemented to 6' BGS
TP-6	376032.51	1946601.07	Cooling Water System	15	cobbles and boulders
TP-7	398730.47	1945801.59	Truck Loading Station	14	cobbles and boulders
TP-8	374728.51	1946091.32	Truck Loading Station	13	cobbles and boulders, some caving at 5'

TP-9	374718.48	1945555.87	Effluent Waste Water System	13	cobbles
TP-10	375434.66	1946689.56	Well Easement		
TP-11	375452.08	1945115.35	Ammonia Storage	14	cobbles at 9', partially cemented
TP-12	376076.80	1945661.56	HV Substation	10	

Due to the risk of sand heave, borings that encountered clean sands below groundwater required the introduction of drilling mud into the auger stem to prevent blocking of the auger stem.

Samples were obtained from the test borings using a Standard Penetration (SPT) sampler. The SPT sampler has a 2-inch outside diameter and a 1.38-inch inside diameter. Samples were obtained by driving the sampler with a 140-pound automatic or rope-and-cathead hammer, dropping 30 inches in general accordance with ASTM D1586. The number of blows required to advance the samplers through each 6-inch increment is recorded in the field. The SPT resistance, or N-value, is defined as the number of blows required to drive the sampler from 6 inches to 18 inches below the auger tip, with the value reported as the number of blows per one foot of penetration. Recovered soil samples were sealed in containers and returned to our laboratory.

It shall be noted that SPT N-values shown on the boring logs represent the uncorrected field values. Engineering analysis and related strength/density correlations often require SPT N-values that have been corrected for hammer efficiency, borehole diameter, sampler type and rod length, commonly known as N_{60} (normalized for 60% hammer efficiency). Rope and cathead hammers, such as the ones used by the ODEX and XL trailer mounted drill rigs, typically yield a hammer efficiency of 60% and therefore hammer efficiency has no net effect on corrected N_{60} values. Alternatively, auto-hammers, such as the ones utilized by the CME 75, Acker Recon and sonic drill rigs, yield a hammer efficiency of 80% on average and therefore typically slightly underestimate the N-values. A further correction accounting for the effective overburden pressure at the depth of SPT sample is known as $N_{1(60)}$. Tabulated N_{60} and $N_{1(60)}$ values for SPT samples in selected relevant borings have been presented in Appendix IV after the boring logs.

Initial attempts to drill with hollow-stem auger met refusal at depths ranging from approximately 2 to 5 feet. Therefore, a field decision was made to pre-excavate the upper 5 to 10 feet at selected locations and begin drilling from roughly 10 feet BEG to allow for exploration to greater depths without early refusal. Consequently, SPT sampling was not conducted within the pre-excavated zone.

The soils observed during our field exploration were classified according to the Unified Soil Classification System (USCS), utilizing the field classification procedures as outlined in ASTM D2488. A copy of the USCS Classification Chart is included in Appendix IV. Photographs of the field exploration activities are presented in Appendix V following this report. Depths referred to in this report are relative to the existing ground surface elevation at the time of our investigation. The surface and subsurface conditions described in this report are as observed at the time of our field investigation.

Note that the attached boring and test pit logs apply only at the locations of the borings and test pits and at the time of drilling and excavation. Subsurface conditions may differ at other locations and may change at these points of exploration with the passage of time. The tabulated data presented on the logs is a simplification of the actual conditions encountered. The descriptions provided are qualitative field descriptions and are not based on quantitative engineering analysis.

3.2 Test-Pit Exploration

A total of twelve (12) exploratory test-pit excavations were completed across the project site. The exploratory test-pits were excavated by Big D's Construction using a Link-Belt 460 excavator equipped with a toothed bucket to depths ranging from approximately 10 to 15 feet below existing ground surface (BGS). The excavation sidewalls and excavated soil were observed by GNN's Regional Testing Manager and characterized accordingly in the test-pit logs. Surface and subsurface soil conditions and other deleterious materials observed are described in the logs as well. Upon completion, the test-pits were loosely backfilled with the excavated spoils. The exploratory test locations are shown on the *Site Exploration Map* Figure 2 in Appendix I.

Bulk soil samples were collected, sealed in containers and returned to GNN's laboratory for index and physical testing and to evaluate potential reuse of onsite soils. The soils observed during field exploration were classified according to the Unified Soil Classification System (USCS), utilizing the field classification procedures as outlined in ASTM D2488. A copy of the USCS Classification Chart is included in Appendix IV. Photographs of the site are presented in Appendix V following this report. Depths referred to in this report are relative to the existing ground surface elevation at the time of the investigation. Surface and subsurface conditions described in this report are as observed at the time of the field investigation. The table below shows the depths and thicknesses of overburden soils, underlying gravels, and total depth as observed during the field exploration.

Table 3: Test-Pit Exploration Data

Test Pit No.	Eolian Dune Sand (Qd) / Sand with Silt (Qhp) Overburden Thickness	Sandy Gravel / Gravelly Sand (Qhp) Thickness	Total Depth Explored (feet, BGS)
TP-1	3 feet	11 feet	14
TP-2	6 feet	9 feet	15
TP-3	3 feet	12 feet	15
TP-4	3 feet	11 feet	14
TP-5	3 feet	11 feet	14
TP-6	4 feet	11 feet	15
TP-7	3 feet	11 feet	14
TP-8	1 foot	12 feet	13
TP-9	4 feet	9 feet	13
TP-10	7 feet	8 feet	15
TP-11	3 feet	11 feet	14
TP-12	3 feet	7 feet	10

Plate Load Test: Due to site topography where test-pits were located, disturbed soil conditions and sloughing in the test pits excavations, performing plate load test to determine K value and bearing capacity would provide erroneous results and would not be representative of the areas to be tested; the presence of shallow gravels with cobbles and boulders would create a hard spot beneath the test area. Plate load test is typically performed on a "prepared" building pad, footing excavation base and pavement subgrade.

3.3 Soil Infiltration Testing

GNN conducted seven (7) soil infiltration tests at the site. The infiltration tests were performed in general conformance with the methods prescribed in Appendix 6.B.3 of the Stormwater Management Manual for Eastern Washington (Ecology 2019). The test methods performed included single-ring infiltrometer for estimating infiltration rates for surficial soils and small-scale pilot infiltration test (PIT) for estimating saturated hydraulic conductivity. Soils samples were collected at the test depths for laboratory Cation Exchange Capacity (CEC) analysis. Results of infiltration testing are discussed in detail in Section 7.0 of this report.

3.4 Cone Penetrometer Testing (CPT)

The cone penetrometer test (CPT / ASTM D-5778) is an in-situ test method used to investigate and analyze subsurface earth materials. The CPT sounding is performed by hydraulicly pushing an instrumented cone attached to a series of threaded hollow-stem rods into the ground at a continuous rate. A cable extends from the cone through the push rods sending raw data to a computer at the surface. The cone provides near-continuous data on the strength of the ground as it is pushed in. The cone records cone tip resistance, qc, and sleeve friction, fs incremental depth intervals. The system produces a computerized log of tip and sleeve resistance, the ratio between the two, and induced pore pressure, from which an interpretation of the subsurface lithology of continuous 2-cm intervals is developed.

The CPT soundings were pushed using an electronic cone penetrometer in general accordance with the current ASTM standard D5778. Ten (10) CPT soundings were completed on July 27 & 28, 2023 to depths of 3’ and 8’ BGS, although a total of 20 attempts of the CPT exploration were made with refusal layer being shallow. Each of the CPT soundings were terminated on refusal conditions at shallow depths and reattempted a few feet away. The exploratory CPT soundings were advanced by In Situ Engineering using a truck-mounted and track mounted rigs. The locations of the CPT soundings are shown on *Site & Exploration Map* (Figure 2) attached to this report. The CPT logs are presented in Appendix X. References for interpretation and correlations of CPT results including CPT-based charts to determine Soil Behavior Type (SBT) are included in Section 15. The following table presents approx. GPS coordinates and approx. elevations for each of the CPT’s:

Table 4: Summary of CPT

CPT ID	Coordinates		Approx. Surface Elevation
	Northing	Easting	
CPT-01	374371.41	1946468.03	391 ft.
CPT-02	375539.22	1946397.81	387 ft.
CPT-03	376131.70	1945864.24	392 ft.
CPT-04	374517.87	1945721.32	381 ft.
CPT-05	374975.62	1945866.82	379.5 ft.
CPT-06	375120.31	1945646.17	385.5 ft.
CPT-07	375253.44	1945742.11	383 ft.
CPT-08	375828.49	1946092.87	384 ft.
CPT-09	375545.43	1945542.94	389.5 ft.
CPT-10	375483.74	1945253.50	392 ft.

The correlation cited by In-Situ Engineering's report is the "UBC-1983" (Robertson, P.K. and Campanella, R.G. (1983). "Interpretation of cone penetration tests: sands and clays". Canadian Geotechnical Journal, Vol. 20 (4), 719-745). This reference discusses the relationship between cone resistance, friction ratio and Soil Behavior Type (SBT). Note that deeper CPT results were skewed/distorted from a homogeneous dense layer that prevented the advancement of the probe with shallow refusal encountered in all CPT attempts.

4.0 GEOPHYSICAL SURVEYS

GNN subcontracted Global Geophysics to complete several geophysical surveys across the project site during the last week of July 2023. The surveys consisted of ten (10) ~450' long seismic refraction transects, refraction micro-tremor (ReMi) testing at four (4) locations along some of the lines, and five (5) electrical resistivity tests at selected locations across the site. In addition, our subcontractor InSitu Engineering performed downhole tests on September 28th and 29th in three boreholes BH-22, BH-23 and BH-35 to acquire shear-wave "S" and compressional-wave "P" velocities as a function of depth. The following sections describe in detail the geophysical surveys performed as part of this study.

4.1 Downhole Seismic Testing

The final round of field in-situ testing consisting of drilling boreholes for downhole seismic testing was conducted within three (3) cased boreholes, BH-22 (DH-22) cased to 60 feet BGS, BH-23 (DH-23) cased to 60 feet BGS, and BH-25 (DH-25) to 76 feet. Boring DH-25 was previously drilled using ODEX drill system during the second round of drilling, however, due to heaving sands, the boring was terminated at 51.5' BGS and was redrilled in order to perform downhole seismic test. These borings were cased with a 3" inside diameter schedule 40 PVC pipe grouted in place with the use of a tremie tube. The tremie tube was fed down the borehole between the casing and the borehole wall and grout was pumped through the tube filling the hole from the bottom up. The grout was allowed to set for several hours and the borehole was filled with water prior to testing.

Downhole seismic testing was performed using a Robertson Geo Model 11234 Suspension log tool. The P-S suspension logger is a low-frequency acoustic probe designed to measure compressional and shear wave velocities (slowness) in soils and soft rock formations. It operates using indirect excitation to acquire high-resolution P and S wave data in the borehole.

The P-S suspension probe contains a unique design of powerful hammer source and two receivers, separated by acoustic damping tubes. To acquire data, the probe is stopped at the required depth and the source is fire causing a solenoid-operated shuttle aligned across the borehole axis to strike plates on opposite sides of the probe in turn, setting up a pressure doublet in the surrounding fluid. The resultant fluid motion produces a tube wave at the borehole wall with velocity close to the shear velocity of the formation together with a compressional wave. As the waves propagate parallel to the borehole axis, they set up corresponding fluid movements that are detected by the two neutral-buoyancy 3D hydrophone receivers, allowing the wave velocity to be directly measured.

The field procedure includes the PS logger being inserted into the borehole, and probe top being zeroed to the ground surface. This positioning places the receiver point (which is midpoint between the geophones) at 8.04 feet (2.45 m) BGS, which is the depth of the “shallowest reading” of the probe. The probe is then lowered to the bottom of the drilled boreholes. Logging starts from bottom of the boring, minus the preset length of rathole for the driver & filter section of the instrument. The probe is then incrementally raised by the winch up to the surface, stopping for acquisition of testing data at every 1.64 feet (0.5 m) interval, which are called “The Stations”.

Upon completion of the downhole seismic testing, the casing was removed from each of the bore holes and filled with bentonite chips in accordance with Washington State guidelines.

4.2 Dynamic Soil Properties

The results of the downhole seismic testing (shear and compression wave velocity testing) are included in Appendix XI and summarized in the following sections:

4.2.1 Shear Wave Velocity

Shear Wave Velocity (Vs), ft/sec

Upper Sandy Stratum		
BH-22 Run-3	*B-23 Run-2*	*B-25 Run-2*
585.9	481.6	818.2
781.5	670.7	516.9
804.2	814.9	444.2
683.9	769	676.5
713.9	**684.1**	**614.0**

Sandy Gravel Stratum		
BH-22 Run-3	*B-23 Run-2*	*B-25 Run-2*
834.4	872.7	1060.7
1189	854.5	1218.1
1558.4	834.2	1155.9
981.6	786.2	1171.7
1134	752.5	1335.5
1093.6	899.9	1724.9
921.6	640.8	2590.4
1084.2	1263.1	1796.9
1478	1731.6	1968.6
1519.4	1850.2	2161.1
1567.3	1337.3	2828.7
1692.8	1878.5	1367
1562.4	1382.6	1067.6
		1108.5
		709.1
		1316.2
		1598.1
		1431.4
		1227.4
1278.2	**1160.3**	**1517.8**

Deeper Silty Sands / Silt
B-25 Run-1
1427.4
1451.7
1386.3
1567.3
1458.2

The average shear wave velocity (Vs) of the soil strata are:

- Upper Sandy soil unit varied from 450 to 800 feet per second (ft/s)
- Sandy Gravel/Gravel with sand and silt varied from 750 to 1,700 ft/s
- Deeper Silty Sand/Silt 1,400 ft/s

4.2.2 Compression Wave Velocity:

Compressional Wave Velocity (Vp), ft/sec						
Upper Sandy Stratum				**Sandy Gravel Stratum**		
BH-22 Run-3	*B-23 Run-2*	*B-25 Run-2*		*BH-22 Run-3*	*B-23 Run-2*	*B-25 Run-2*
6038.4	6835.1	6001.5		7400.4	6835.1	6650.4
6038.4	6433	6309.3		7689.5	7080.9	7456.5
6605.7	6835.1	6075.6		6882.9	7030.4	6309.3
6561.7	6835.1	6309.3		6882.9	7184.3	6931.4
6311.1	**6734.6**	**6173.9**		6741.5	7400.4	6835.1
				6741.5	6561.7	7345.2
				6650.4	7030.4	6309.3
				6931.4	6882.9	6309.3
				6741.5	6190.3	6931.4
				6741.5	6309.3	7811.5
				7290.8	6249.2	7237.1
				6695.6	5180.3	7237.1
				6695.6	6229.4	6391.2
					7290.8	6475.3
					6650.4	6001.5
					6835.1	7132.3
					6433	6931.4
						6628
						7456.5
				6929.7	**6628.0**	**6862.1**

Deeper Silty Sands / Silt
B-25 Run-1
6151.6
6391.2
5824
6269.1
6190.3
6001.5
6138.0

The average compression wave velocity (Vp) of the soil profile tested varied from 6,000 to 7,000 feet per second (ft/s) with 6,000 ft/s for the Upper Sandy and Deeper Silty Sand/Silt strata and 7,000 ft/s for Sandy Gravel/Gravel unit.

4.2.3 Poisson's Ratio

Poisson's Ratio (μ)					
Upper Sandy Stratum			**Sandy Gravel Stratum**		
BH-22 Run-3	*B-23 Run-2*	*B-25 Run-2*	*BH-22 Run-3*	*B-23 Run-2*	*B-25 Run-2*
0.495	0.498	0.491	0.494	0.492	0.488
0.491	0.495	0.496	0.488	0.493	0.482
0.492	0.492	0.498	0.473	0.488	0.484
0.495	0.494	0.494	0.49	0.493	0.487
0.493	**0.495**	**0.495**	0.485	0.494	0.477
			0.486	0.493	0.467
			0.49	0.489	0.416
			0.464	0.495	0.456
			0.479	0.479	0.446
			0.477	0.437	0.446
			0.471	0.452	0.425
			0.466	0.483	0.482
			0.471	0.457	0.489
				0.48	0.484
					0.494
					0.475
					0.474
					0.478
					0.482
			0.480	**0.480**	**0.470**

Deeper Silty Sands / Silt
B-25 Run-1
0.468
0.472
0.474
0.471

The compression and shear wave velocity information was used to compute Poisson's ratio (υ). The following equation relates shear and compression wave velocity with Poisson's ratio:

$$v = \frac{\left(\frac{V_p{}^2}{2V_s{}^2} - 1\right)}{\left(\frac{V_p{}^2}{V_s{}^2} - 1\right)}$$

4.2.4 Soil Stiffness

Elastic theory relates shear wave velocity with the shear modulus at small strain using the following equation:

$$G_{max} = \rho(V_s)^2 = \frac{\gamma(V_s)^2}{g}$$

<u>where</u>:

G_{max} = shear modulus at small strain (psf)
V_s = shear wave velocity (ft/s)
ρ = mass density (slugs/ft^3)
γ = unit weight (pcf)
g = acceleration of gravity (32.2 ft/s^2)

Modulus of Elasticity (Young Modulus) is computed using the following equation:

$$E = 2{*}G_{max}\,(1+\nu)$$

The following values are recommended for design purposes:

Table 5: Recommended Dynamic Soil Properties

Soil Stratum	Estimated Average In-situ Moist Unit Weight, pcf	Shear Modulus, ksf	Modulus of Elasticity, ksf	Poisson's Ratio
Sand w/ silt	108	1,000	2,500*	0.40
Sandy Gravel/ Gravel w/ sand & silt	130	5,800	9,000*	0.37
Silty Sand/Silt	110	5,000	6,000*	0.38

*performance-based value
ksf= kips per square foot

For foundation design, the structural engineer will need to reduce the shear modulus based upon the level of strain imparted to the soil by the foundation. We generally recommend a 10 percent reduction in the soil shear modulus to take into account the dynamic nature of the loading and the soil modulus strain softening behavior.

4.3 Seismic Refraction

Seismic refraction is the traditional method for determining the depth-to and rippability of underlying buried bedrock material. The seismic refraction method is based on the measurement of arrival times of seismic energy from a source (shot) to a receiver (geophone). The seismic energy travels as a body wave through the subsurface and when the wave encounters a transition to denser (higher velocity) material, it is refracted into the lower layer as a head wave according to Snell's Law. When the wave's ray-path is incident to the density transition at the critical angle, the refracted wave travels along the interface between the two layers at a higher velocity (V2). The direct body wave arrivals, traveling at a slower velocity (V1), are recorded at the geophones. At some distance from the source, the refracted head waves, traveling at a velocity of V2, arrive before the body waves. This distance is called the crossover distance. The first-arrival times from several shot locations are picked from data recorded on a seismograph and plotted on graphs of travel-time versus distance. The shot-receiver geometry allows for measurement of travel times to calculate velocities (p-wave velocity, V_p) that are then analyzed to produce profiles of the depth to, and topography of, the density interface and velocity layering of the subsurface.

The seismic refraction survey was conducted using a Geometrics Geode 24-channel digital seismograph. The sensors used were Mark Products 4.5-Hz vertical geophones and the seismic energy source was a PEG-40kg Propelled Energy Generator. The typical field procedure consisted of laying out the cables and planting the geophones at 10 ft intervals. The shots were set off at seven locations along the geophone array. Data was collected and saved in digital format and a field record was produced on the computer screen to check the data quality in real time.

The seismic refraction survey was carried out along ten (10) transects. The objective of this study was to study subsurface conditions to 100 feet BGS beneath the seismic transects. Based on the results of the seismic refraction survey three geological units were interpreted. The surface layer composed of unconsolidated topsoil, the second layer composed of highly weathered rock, and the basal layer composed of weathered rock. Seismic Refraction report is included in Appendix XII.

The seismic refraction method (ASTM D5777-18) provides the velocity of compressional P-waves in subsurface materials while shear S-wave profile is obtained from MASW/ReMi survey. Note that the seismic refraction survey uses a “fixed” geophone array, while the MASW survey uses a “moving” geophone array. The penetration of 1D S-wave model from the surface wave depends on the following factors: geophone array length, seismic source and the frequency of the vibrations. 1D S-wave velocity profile provided is centered at the center of the geophone array, and low frequency ambient vibrations are used to get V_{s100}. The refraction is a fixed geophone array using an active source. The deepest sounding is at the center of the array when pounding near both ends of the geophone array (geophone 1 and 24), shallowest soundings near geophone 6 and 18 when pounding in the middle of the geophone array (between geophone 12 and 13). Although not in our scope, with some interpolation and extrapolation, the software could re-process the refraction data to get a shallow 2D S-wave velocity profile (less than 40-50 ft); this inherently comes with limitations since these are fixed geophone arrays. The S-wave velocities from ReMi match fairly well with the S-wave velocities from the downhole test (P-S logging).

4.4 Refraction Microtremor Survey

Refraction Microtremor (ReMi) survey was conducted in conjunction with seismic refraction survey to characterize the subject site for seismic design. ReMi testing was performed on July 27-28, 2023 at four locations to estimate the depth to- and shear-wave velocities of the various subsurface soil layers. Testing was conducted with seismic lines orientated north-south and east-west directions using a Geometrics Geode 24-channel digital seismograph with acquisition software. The sensors were Mark Products 4.5-Hz vertical geophones placed at 10 ft spacing and the seismic energy source was ambient noise. The ReMi method determines variations in surface wave velocities with increasing distances and wavelengths. The data from these measurements are used to model the shear wave velocities of the subsurface. This information can be used to infer rock/soil types, stratigraphy, and soil conditions. It should be understood that the depths of subsurface soil/bedrock layers below ground surface obtained from geophysical testing are estimates and can vary significantly across the site in lateral extent. Refraction Microtremor survey report is included presented in Appendix XIII.

Table 6: Results of ReMi survey are summarized as follows:

Seismic Line	Site Area/Structure Location*	Average Shear-Wave Velocity (Vs) 100 ft
Line SP-02, station 115’	southeast quadrant of site (within the Bulk Storage Unit)	1617.1 ft/sec
Line SP-03, station 345’	southwest quadrant of site (within Effluent Wastewater/Pure Service Water)	1662.8 ft/sec
Line SP-05, station 115’	near south central (milling and limestone storage)	1506.5 ft/sec
Line SP-06, station 345’	central portion of site (Ammonium Nitrate Solution Unit, Calcium Nitrate, Granulation)	1562.9 ft/sec

** Refer to Figure 2 in Appendix I*

It shall be noted that the difference ReMi and Seismic Refraction is that when a source impacts on the ground surface, there are waves travel along the ground surface (such as ground roll), waves travel down into earth and reflect back at the interface (reflection), and waves travel down and along the interface and back to surface (refraction). ReMi method uses the ground roll, and the seismic refraction uses the refracted wave. They use very different algorithms and modeling processes. The difference between the models are expected to be very different. Processing of s-wave velocities from seismic refraction survey is beyond our current scope

4.5 Electrical Resistivity Survey

The electrical resistivity sounding technique measures the differences in the electrical properties of geologic materials below the existing ground surface. These differences can result from variations in lithology, water content, and pore-water chemistry. The method involves transmitting an electric current into the ground between two electrodes and measuring the voltage between two other electrodes. The direct measurement is the apparent resistivity of the area beneath the electrodes. The measurements include deeper layers as the electrode spacing is increased. The purpose of electrical resistivity surveys is to study the subsurface conditions to 150 feet BGS at five locations.

Electrical resistivity testing was conducted on July 28 and 29, 2023 in accordance with ASTM method G57 "Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method" (equivalent to IEEE Std. 81) for the design of electrical grounding system. The resistivity soundings were conducted along 10 traverses at 5 locations selected by Técnicas Reunidas with an L&R MiniRes resistivity meter. The meter was properly calibrated for all test locations and no instrument adjustments had to be made. Tests were conducted in two perpendicular alignments at every location (North-South and East-West) at electrodes spacing of 1.5', 2.5', 5', 7.5', 10', 15', 30', 50', 65' and 150'. Plots of A-Spacing verses measured apparent resistivity are included in the report along with the tabulated values. Results of soil resistivity testing, along with a map showing locations of the traverses, are shown in Appendix XIV.

4.6 Thermal Resistivity Laboratory Testing

Thermal resistivity tests, to determine the RHO values from dry-out curves, were performed in accordance with IEEE standard 442-2017 on native onsite sandy soil samples for use as backfill for electrical cable trench. Test samples were collected at locations selected by Técnicas Reunidas and shipped to GEOTHERM for laboratory analysis. Laboratory tests included measurement of the soil's moisture content, maximum Proctor dry density and optimum moisture content (ASTM D1557 method) and thermal dryout characteristics, which is a function of moisture content. Both the bulk samples collected were re-compacted to a density equivalent to approximately 95 percent of the laboratory Proctor density near optimum moisture contents for testing. Results of the thermal resistivity test data are presented in Appendix XV.

Note that soil samples for laboratory thermal testing were collected at a depth of 18 inches below existing grades. However, these test results may be of limited use as proposed grades will change. Therefore the results of these tests during this initial phase of engineering should be treated as preliminary and additional testing should be re-performed following site grading.

5.0 LABORATORY TESTING

Representative samples of the onsite soils and groundwater obtained in the field during our subsurface exploration were selected for testing to determine the index and engineering properties of the soils in general accordance with ASTM procedures and Standard Methods (SM). The following laboratory tests were performed:

Table 7: Laboratory Tests Performed

Test	To Determine
Natural Moisture Content ASTM D2216	Soil moisture content indicative of in-situ condition at the time samples were taken
Natural Dry Density ASTM D7263	Dry unit weight of samples, representative of in place conditions.
Specific Gravity ASTM D854	The weight of the solid portion of the soil in respect to the weight of water
Particle Size ASTM D422	Soil classification proportion of sand, silt, and clay-sized particles
Atterberg Test, ASTM D4318	A method of describing the effect of varying water content on the consistency of fine-grained soils
Moisture-density Relationship ASTM D1557	The optimum moisture content for compacting soil and the maximum dry unit weight (density) for a given compaction effort.
Consolidation ASTM D2435	The amount that a soil sample compresses with loading and the influence of wetting on its behavior. For use in settlement analysis, determining expansive potential and foundation design.
California Bearing Ratio ASTM D1883	The capacity of a subgrade or sub base to support a pavement section designed to carry a specific traffic load
Soil pH SW-846 9045D	Electrometric procedure for measuring pH in soils
Resistivity ASTM G-187	Measurement of soil resistivity to assist in the determination of soil's corrosive nature
Redox Potential ASTM D1498-76	Electrometric measurement of oxidation reduction potential (ORP)
Chloride EPA 300.0	Determination of chloride inorganic ions in soil
Sulfide (Acetate Paper) SM4500-S2-D	Determination of the total Sulphur content of soil
Sulfate Content EPA 300.0	Potential of soil to deteriorate normal strength concrete.
Salinity SM-2520B	Soil salinity refers to dissolved salts such as sodium chloride, calcium chloride and magnesium chloride.
Organic content AASHTO T267	Identification of materials containing organic matter by loss on ignition such as peat, organic muck, and soil containing relatively

	undecayed or undecomposed vegetative matter or fresh plant materials such as wood, roots, grass, or carbonaceous materials such as lignite, coal
Cation Exchange Capacity (CEC)	CEC is a property of a soil that describes its capacity to supply nutrient cations to the soil solution for plant uptake.
Radioactivity Test	Determine the presence of Radium 226, Radium 228, & Uranium
Water Sampling and Testing	
Test	
pH SM 4500H B	
Total Dissolved Solids SM 2540C	
Chloride EPA 300.0	
Sulfate EPA 300.0	
Lab testing performed on soil samples collected from test pits and borings	

Soil samples for corrosivity suite, Cation Exchange Capacity and groundwater samples were shipped to AMTEST Laboratories for analysis. Results of the laboratory tests are tabulated on the boring and test pits logs and are presented in Appendix VII attached to the end of the report.

A soil and groundwater sample were collected and shipped to Palouse Environmentals for radioactivity testing to include radium and uranium. Results are pending and will be submitted in an addendum.

It shall be noted that certain laboratory tests included within the original testing program were not performed since our laboratory testing program was dictated from the actual subsurface conditions encountered. Due to the presence of dry to very dry upper dune sand soils disturbed during excavations and the underlying gravel soils with cobbles and boulder sized stones embedded in the matrix of gravels, collection of undisturbed samples for some of the laboratory testing was not possible. Furthermore remolding the granular soil samples with varying amounts of gravels will not be in an undisturbed state representing an insitu condition. Performing tests on remolded granular samples would have given erroneous results. As such, we decided not to perform some tests. For example, direct shear test could not be performed due to the inability to collect undisturbed samples, and consolidated drained and unconsolidated undrained triaxial compression test were not performed since soils at the site are not cohesive. The data obtained from borehole SPT testing and the analysis of the index and physical testing results and other engineering properties was sufficient to provide reasonable estimation of soil shear strength parameters of both sand and gravel soils present at the site.

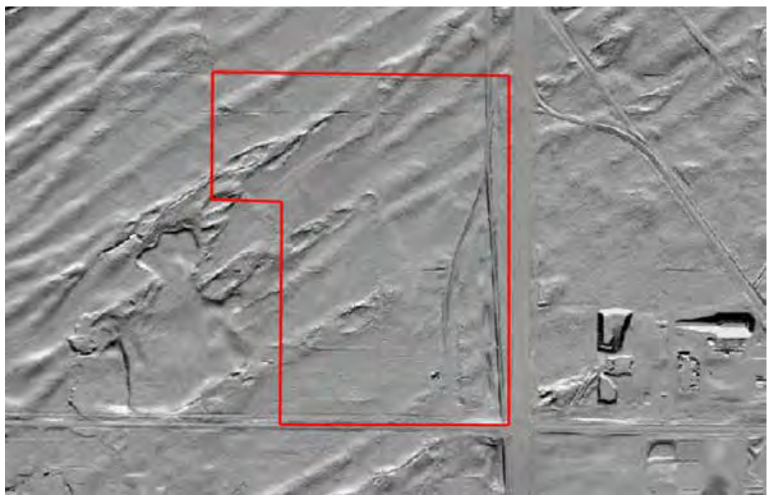
6.0 SITE CONDITIONS

The approximately 141-acre project site is located northwest of the intersection of Stevens Drive and Horn Rapids Road, situated north of the City of Richland in Benton County, Washington (see Figure 1 in Appendix I). The majority of the site is located in the NE ¼ of Section 15, Township 10 North and Range 28 East, while the northern portion of the project falls within the southern portions of the SW & SE ¼ of the SE ¼ of Section 10, Township 10 North and Range 28 East of the Willamette Meridian.

The project site is bound by Stevens Drive to the east and Horn Rapids Road to the south. Adjacent properties to the west and north generally consist of vacant/undeveloped desert lands. Surface conditions across the site generally includes a moderate to dense growth of native grass and brush including some areas with moderate to dense cover of mature sagebrush.

Existing railroad tracks, identified on published maps as 'US Government Railroad', extend north-south across the eastern edge of the parcel along the west side of Stevens Drive. Two parallel alignments of overhead powerlines, also extending north south, are situated to the west of the railroad tracks. Access to the project site for field explorations activities was made by turning north from Horn Rapids Road via a narrow, down-sloped, gravel covered drive lane immediately west of the railroad tracks. A number of existing unpaved roadways and trails crisscross and extend across various portions of the site. Relatively well defined 'two-track' trails extend along the south, east, and northern boundaries of the site, with the northern boundary trail aligned in between two parallel overhead powerline alignments. Kenny Ferguson of the Hanford Mission Integration Solutions indicted that DOE has 2 feeder fiber optical cables buried on the North side of the of the wire fence, between that and the access road. Their direct cables are buried 24" – 30" deep but since the **sand shifts so much** there are areas that are potentially shallower.

The majority of the project site is characterized by hummocky and undulating dune topography. Existing elevations across the subject site generally range from approximately 407 feet to about 378 feet for a total site relief on the order of 30 feet. Existing native site slopes across the site are associated with the dunes that have formed as a result of the northwesterly winds present at the site. It should be noted that the maximum dune slope is 4H:1V (25%). Dune slopes in the northwestern portion of the subject site are typically taller and steeper than those within the southeast portion of the site. The overall gradient across the site generally slopes to the southwest. The site also slopes from the northwest and southeast corners to the center of the site where there is a gently sloping draw that trends northeast to southwest across the site. The lidar image below shows the southwest-northeast trending sand dunes, generally aligning with the prevailing wind direction in the region. Also visible in the Lidar image are the north-south aligned roads along the eastern property boundary and center of the site and the east-west aligned roads that run along the northern portion the site.



6.1 Site Reconnaissance, Technical Literature and Aerial Photo Review

A review of selected information pertaining to the site and surrounding area was performed that included published technical literature, published geologic maps, historic USGS maps, aerial photographs and previous geotechnical and geologic reports prepared for other sites in the vicinity. The review was performed to identify typical geotechnical and geologic constraints that may affect the proposed development, including soil and bedrock conditions, groundwater, slopes, drainage, erosion, and geologic hazards.

An initial field reconnaissance of the subject property was performed prior to our subsurface exploration to determine accessibility for site exploration, mark proposed points of explorations, observe the on-site surficial geologic and geotechnical conditions to confirm the data obtained from our technical literature review.

A review of selected available historic aerial photographs and published USGS topographic maps, along with the noted onsite observations shows some evidence of previous surficial disturbance and grading activity across portions of the site.

Selected topographic maps produced by the USGS were reviewed for information concerning the development history of the property and vicinity. The 7.5-minute Quadrangle maps that were reviewed included the 1917 *Pasco Quadrangle* map and the 1951/80, 1978 and 1992 *Richland Quadrangle* maps. The 1917 *Pasco* map shows two structures on the site, one near the northeast corner and the other near the southern border. Also visible on the 1917 map is an apparent irrigation canal or stream that cuts across the northwest corner of the site. On this map, near the center of the site, a north-south aligned roadway can be seen (coincidental to the current primary north-south roadway used for field exploration) as well as an apparent east-west aligned road. The 1917 map also indicates the presence of 'Fruitvale School' directly north of the site. The 1951 *Richland* map and subsequent maps no longer show the previous road alignments, previous structures, or the 'Fruitvale School'. The 1978 map shows the U.S. Government Railroad tracks as well as the power lines parallel to the tracks. The 1992 map shows the east-west aligned power lines that are currently present along the northern border of the site.

Selected available historic aerial photographs were also reviewed. The earliest available aerial photo from 1948 clearly shows both the north-south and east-west trending roads seen on the USGS maps as well as some surficial scarring/disturbance related to human activity. There is also a curvilinear alignment visible on the southeast portion of the site that was encountered during field activities. The available aerial photos from 1952 to 1988 show the same surficial scarring as well as additional surficial disturbances across the site. The 1988 aerial shows an additional northeast-southwest aligned trail extending off from the road that runs north-south down the center of the site. The 1996 aerial photo shows surficial disturbances likely related to the installation of the monitoring wells. The 2009 aerial photo shows an area of land in the northwest portion of the site cleared of vegetation and apparently charred from a presumed fire. The additional aerial photos from 2013 to 2021 show no significant changes across the site. Historic aerial photographs reviewed are presented in Appendix III.

6.2 Regional & Local Geology

Benton County lies on the Columbia Basin physiographic province, a broad plain situated between the Cascade Range to the west and the Rocky Mountains to the east. The Columbia Basin was formed by a thick sequence of Miocene Age tholeiitic basalt flows, called the Columbia River Basalt Group (CRBG) that erupted from fissures in north central and northeastern Oregon, eastern Washington, and Western Idaho. Subsurface materials in the project vicinity include basalt flows from the Wanapum and Saddle Mountains Basalt Formations. The uppermost layers of the CRBG are fractured bedrock of the Wanapum Basalt formation. Regionally, the top surface of the Wanapum Basalt is known to slope toward the northeast, although local variations exist in the area.

Near the end of the Pleistocene, the Columbia Basin was subjected to a series of incredibly massive, high energy floods known as the Missoula Floods. During this time, a lobe of the Cordilleran ice sheet extended south into Idaho, damming up the Clark Fork River and creating Glacial Lake Missoula, impounding as much as 500 cubic miles of water. These ice dams periodically failed and then reformed numerous times during this period, draining the lake suddenly and unleashing a series of massive torrents of water that significantly scoured and altered landscapes in the Columbia Basin including significant erosion and deposition.

The subject site is situated within a basin bordered by the Rattlesnake Hills anticline to the west, the Saddle Mountains anticline to the north, and the White Bluffs on the east bank of the Columbia River to the east, north of Richland, Washington. Based on the *Field Trip Guide to the Hanford Site*, (Reidel, et. al. 1992), the physiography of this area is described as an "area of low-relief between anticlinal ridges of the Yakima Fold's physiographic region".

Based on the Washington State Department of Natural Resources, Division of Geology and Earth Resources, 2023, *Washington Interactive Geologic Map: 1:24,000 scale:* Washington Division of Geology and Earth Resources, the site is mapped as Quaternary dune sand [Qd] described as undifferentiated dune sand in the western portion and Pleistocene outburst flood deposits, specifically Quaternary Pasco Member of the Hanford Formation [Qhp] described as torrentially deposited sand and gravel ranging in size from medium grained sand to boulders in the eastern portion. Underlying the Pasco Member of the Hanford Formation [Qhp], is the Touchet Member of the Hanford Formation [Qht], described as glacial slack-water deposits of fine-grained sands and silts.

7.0 SUBSURFACE CONDITIONS

Our understanding of the subsurface soil conditions across the ~141-acre site is based on a total of thirty-nine (39) borings, twelve (12) test-pits, as well as a suite of geophysical surveys. Boring and test-pit logs provided in Appendix IV include more specific descriptions of the subsurface conditions encountered.

In general, the site is blanketed with a variably thick cover of eolian fine sands and silts, identified as Quaternary dune sands (Qd), overlying gravel and sandy gravels with subrounded to rounded cobbles and boulders, identified as the Pasco Member of the Hanford Formation (Qhp). The upper silts/sands typically exhibit apparent ‘loose’ to ‘medium dense’ in-place density, while the deeper gravel/sandy gravels were noted to range from ‘dense’ to ‘very dense’ with cementation in some of the gravelly layers. Across the site, the overlying sand/silt (Qd) layer varies in thickness from as little as 1.5 feet to as much as 17 feet. The underlying gravelly (Qhp) layers are discontinuous across the site and vary from sandy gravel to gravelly sand and have varying quantities of cobbles and boulders often greater than 2 feet in size. Underlying the gravelly layer (Qhp), at a depth of around 55 to 60 feet BGS, an approximately 15 feet thick slightly cemented layer of non-plastic Silt with Sand/Sandy Silt (ML) was encountered. This silty layer, only encountered in borings BH-22 (DH-22) and BH-25 (DH-25), was noted to appear ‘very dense’ and correlates to the Touchet Member of the Hanford Formation (Qht).

Table 8: Generalized Soil Types

<table>
<tr><th>Soil Layer ID</th><th>Geologic Unit</th><th colspan="2">USCS</th><th>Soil Type Description</th><th>Max. Dry Density (pcf)</th></tr>
<tr><td>S-1</td><td>Quaternary Dune Sand [Qd]</td><td colspan="2">Silty Sand (SM)</td><td>Fine to medium sand, loose to medium dense</td><td>107 - 109</td></tr>
<tr><td>S-2</td><td rowspan="4">Outburst flood deposits, Pasco Member of Hanford Formation [Qhp]</td><td colspan="2">Poorly graded Sand with Silt (SP-SM)</td><td>Fine to coarse sand, loose to medium dense</td><td>115 - 120</td></tr>
<tr><td>S-3</td><td colspan="2">Poorly graded Gravel with Sand (GP)</td><td>Fine to coarse gravels, with varying amounts of cobbles and boulders, rounded, dense to very dense</td><td>> 130</td></tr>
<tr><td rowspan="2">S-4</td><td rowspan="2">Interbedded</td><td>Well graded Sand with Silt (SW-SM)</td><td>Fine to coarse sand, with varying amounts of gravel, medium dense to dense</td><td rowspan="2">122- 130*</td></tr>
<tr><td>Poorly graded Gravel with Sand (GP)</td><td>Fine to coarse gravels, with occasional cobbles/boulders, rounded, medium dense to very dense</td></tr>
<tr><td>S5</td><td>Outburst flood deposits, Touchet Member of Hanford Formation [Qht]</td><td colspan="2">Silt (ML) / Silty Sand (SM)</td><td>Fine grained sand, very dense</td><td>120*</td></tr>
</table>

*Estimated max relative density values since representative soil samples of sufficient size could not be obtained.

Based on review of the site topography in relation to the elevations to the top of the Outburst Flood Deposits we noticed the dip in this layer in the north-central portion of the site. The elevation dips to as low as 377' at a certain location, just west of the Nitric Acid and Ammonium Nitrate Solution Unit areas. In contrast, further northwest (Ammonia Tank) and further southeast (Bulk Storage Unit) of this location, the layer comes up to elevations near or above 390'. Table 6A provides estimated soil parameters for Generalized Soil Types noted in Table 6 above.

Table 8A: Estimated Soil Parameters

<table>
<tr><th>Soil Layer ID</th><th>Geologic Unit</th><th>Soil Type (USCS)</th><th>Atterberg Limits</th><th>Total Unit Weight (pcf)</th><th>Internal Friction Angle (deg.)</th><th>Cohesion (psf)</th><th>SPT</th><th>Cone Resistance (tsf)</th><th>Elasticity Modulus (ksf)</th><th>Poisson's Ratio</th></tr>
<tr><td>S-1</td><td>Quaternary Dune Sand [Qd]</td><td>Silty Sand Loose</td><td>NP</td><td>100</td><td>28</td><td>0</td><td><10-20</td><td>25 – 60</td><td>-</td><td>-</td></tr>
<tr><td>S-2</td><td>Outburst flood deposits, Pasco Member of Hanford Formation [Qhp]</td><td>Sand with silt Loose to Medium dense</td><td>NP</td><td>115</td><td>31</td><td>0</td><td>10-30</td><td>50 - 200</td><td>3,609</td><td>0.40</td></tr>
<tr><td>S-3</td><td>[Qhp]</td><td>Gravel with sand & varying amounts of cobbles/boulders Dense to very Dense</td><td>NP</td><td>135</td><td>38</td><td>0</td><td>40-50+</td><td rowspan="3">-</td><td rowspan="3">19,104</td><td rowspan="3">0.37</td></tr>
<tr><td rowspan="2">S-4</td><td rowspan="2">[Qhp]</td><td>Sand with silt and varying amounts of gravel Medium Dense to Dense</td><td>NP</td><td>120</td><td>34</td><td>0</td><td>15-40</td></tr>
<tr><td>Gravel with sand & occasional cobbles/boulders</td><td>NP</td><td>130</td><td>36</td><td>0</td><td>30-50+</td></tr>
<tr><td>S-5</td><td>Outburst flood deposits, Touchet Member of Hanford Formation [Qht]</td><td>Silt and Silty Sand very dense</td><td>NP</td><td>110 - 120</td><td>31</td><td>Silt: 100</td><td>50+</td><td>-</td><td>18,217</td><td>0.38</td></tr>
<tr><td colspan="3">Imported Crushed Rock (compacted)</td><td>NP</td><td>135-140</td><td>40</td><td>0</td><td></td><td></td><td></td><td></td></tr>
</table>

Notes:

- For Effective unit weights for S-4 layer soil units and S-5 layer subtract 62.4 pcf.
- **Dune sand is not suitable for foundation and infrastructure support and shall be completely removed**
- Laboratory testing data is provided in Appendix VII *Laboratory Soil Testing Results*

7.1 NRCS Soil Survey

There is no data available from the Natural Resources Conservation Service (NRCS) Web Soil Survey. The NRCS identifies the site as Hanford Atomic Energy Reservation, Washington.

7.2 Groundwater

When groundwater was encountered, the depth to groundwater was recorded at the time of drilling. Due to the auger refusal at several of the borings, only thirteen (13) of the borings were drilled deep enough to encounter groundwater. Groundwater was encountered in borings BH-04, BH-05, BH-06, BH-09, BH-12, BH-14, BH-17, BH-18, BH-22, BH-23, BH-25, BH-32, and BH-40. Groundwater samples were collected and shipped to AMTEST Laboratories for chemical analysis to determine pH, Chloride, Sulfate, and total dissolved solids (TDS). Groundwater analysis reports are included in Appendix VIII.

In an effort to obtain stabilized groundwater readings, four (4) piezometers were installed at selected locations across the site. Borings with piezometers installed include BH-04+PZ located on the southeast side of the project site, BH-09+PZ located near the western boundary of the project site, BH-18+PZ, north of BH-09+PZ, and BH-40+PZ near the north central portion of the site. Upon completion of our second round of drilling, the piezometers were abandoned in general accordance with the Washington Department of Ecology (WA-DOE) guidelines.

Along with measuring the depth to groundwater at the time of drilling, the depth to groundwater was measured a minimum of three (3) subsequent times in each of the installed piezometers during the first two (2) rounds of drilling with the final reading taken on September 1, 2023. Table 7 below shows groundwater depths in the borings and corresponding elevations during and after drilling and subsequent groundwater measurements taken in piezometers:

Table 9: Groundwater Levels

Boring ID	Groundwater Level Depth and Elevation (MSL), feet					
	At time of Drilling (Elev.)	End of Drilling (Elev.)	GW levels measured on 8/17	GW levels measured on 8/18	GW levels measured on 8/23	GW levels measured on 9/1*
BH-04+PZ	42 (350)	41.1 (350.9)	41	41.1	41.1	41.1
BH-05	33 (352)					
BH-06	29 (352)					
BH-09+PZ	29.5 (353.5)	30.5 (352.5)	31.5	30.3	30.5	29.5
BH-12	28 (352)					
BH-14	40 (348)					
BH-17	37 (351)					
BH-18+PZ	29.5 (350.5)	27.8 (352.2)	28	27.4	27.8	28
BH-22 (DH-22)	31.5 (349.5)					
BH-23 (DH-23)	39.5 (349.5)					
DH-25	31.5 (349.5)					
BH-32	38 (353)					
B-40+PZ	39 (352)	39 (352)	39	39	39	39.4

***After Drilling** elevation identified on the log is based on the final reading on 9/1.

To further assist in our evaluation, we reviewed the WA-DOE database of nearby well logs (Appendix XVI) and USGS Water Data for Nation online database to estimate groundwater levels in the vicinity. Based on our review of available data, and the groundwater data obtained during our field exploration, groundwater was found to be approximately 28 to 42 feet BGS and at an elevation of approximately ±350 feet. Groundwater at the site generally correlates to the nearby Columbia River pool elevation and generally appears to flow towards the east/northeast. Based on the four stabilized measurements from the piezometers, we performed calculation using the online EPA tool (hydraulic gradient) to determine groundwater direction, it is roughly N87°E, generally perpendicular to Columbia River. Groundwater levels are likely to fluctuate throughout the year with irrigation, precipitation, drainage, variable river stages, regional pumping from wells and other hydrogeological factors and evaluation of such factors is beyond the scope of this study.

8.0 SOIL INFILTRATION TESTING

GNN conducted seven (7) soil infiltration tests at the site. The infiltration tests were performed in general conformance with the methods prescribed in Appendix 6.B.3 of the Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, SWMMEW August 2019). Test methods included a single-ring infiltrometer for estimating infiltration rates for surficial soils and small-scale pilot infiltration test (PIT) for estimating saturated hydraulic conductivity. PIT is an in-situ field test procedure that approximates saturated conditions and allow inspection of soil stratigraphy beneath the infiltration test. Each infiltration test-pit was excavated to the test depth. The results of the testing are provided in the table below.

Table 10: Soil Infiltration Test Results

Test ID	Test Depth (BGS)	Generalized Soil Layer	Soil Type	Field Measured Infiltration Rate
TP-3/IT-1	3 feet	S-2	Poorly Graded Sand with Silt (SP-SM)	**9.5 inches/hour**
TP-4/IT-2	8 feet	S-3	Poorly Graded Gravel with Silt & Sand (GP-GM)	**23.3 inches/hour**
TP-7/IT-3	4 feet	S-3	Poorly Graded Gravel with Sand (GP)	**19.8 inches/hour**
TP-9/IT-4	3 feet	S-1	Silty Sand (SM)	**11.3 inches/hour**
TP-10/IT-5	5 feet	S-1	Silty Sand (SM)	**10.2 inches/hour**
TP-11/IT-6	3 feet	S-1	Silty Sand (SM)	**9.8 inches/hour**
TP-12/IT-7	6 feet	S-3	Poorly Graded Gravel with Sand (GP)	**23.1 inches/hour**

Infiltration testing was performed in test-pits TP-3/IT-1, TP-4/IT-2, TP-7/IT-3, TP-10/IT-5, and TP-12/IT-7 by using a small-scale Pilot Infiltration Test (PIT) method. Water was introduced into the test-pits using a water truck. After a pre-wetting period, the falling head of water within the test-pit was measured.

Infiltration testing within test-pits TP-9/IT-4 and TP-11/IT-6 was conducted using a Single Ring falling head test consisting of a 2-foot section of a 12-inch steel pipe buried in the ground approximately 12 inches below ground surface. The falling head of water within the pipe was measured at a timed interval. After each interval, the pipe was refilled to the same level and continuous readings were recorded until a relatively constant rate was achieved. Continuous readings of the falling water volumes were recorded until a relatively constant rate was achieved, and the final infiltration rate was recorded.

Soils samples were collected from several test pits for laboratory Cation Exchange Capacity (CEC) analysis, results are presented in the table below. Cation exchange capacity (CEC) of the treatment soil must be ≥5 milliequivalents (meq) CEC/100 grams (g) dry soil (2019 SWMMEW, SSC-6, Chapter 5 - Page 333,).

Table 11: Cation Exchange Capacity (CEC) Analysis Results

Test Pit & Sample depth, BGS	Soil pH	Cation Exchange Capacity (meq/100g)
TP-1 @ 3’	5.5	4.8
TP-2 @ 4’	7.0	4.5
TP-3 @ 4’	6.5	6.5
TP-4 @ 6’	7.2	5.8
TP-5 @ 3’	6.3	8.2
TP-7 @ 4’	6.2	4.6
TP-8 @ 2’	6.1	8.7
TP-9 @ 3’	6.2	3.7
TP-10 @ 5’	5.8	4.2
TP-11 @ 3’	5.9	6.8

An appropriate factor of safety should be applied to the field measured infiltration rates to determine long-term design infiltration rates. Determination of safety factors for long-term infiltration design should consider the following: pretreatment, potential for bio-fouling, system maintainability, horizontal and vertical variability of soils, and type of infiltration testing. For design purposes, we recommend using a factor of safety of 2.0 to 2.5 applied to the un-factored rate.

An estimation of the correction factor for siltation and bio build-up is suggested by the SWMMEW. For reference purposes, a correction factor of 0.9 is recommended by 2019 SWMMEW, Table 6.4, Chapter 6, page 594. GNN recommends a correction factor for siltation and bio build-up be no greater than 0.9.

The design engineer should carefully consider and evaluate any situation where a storm pond will be situated upslope from a building or retaining structure or behind the top of a slope inclined >15%. The minimum setback from such a slope is equal to the height of the slope (h).

Soil composition and matrix will be altered from mass grading. Once type(s) of structures/facilities (i.e. bio-swale/pond, infiltration gallery, drywell, etc) are selected for stormwater management and disposal and grading and drainage plans are prepared, we recommend that additional infiltration tests be performed at selected stormwater infiltration locations to verify design rates.

GNN recommends that stormwater swales and infiltration ponds be designed with a treatment zone in accordance with the SWMMEW. A typical treatment zone section consists of a thin sod layer atop a zone of topsoil with an infiltration rate between 0.25 and 0.50 in/hr. The Geotechnical Engineer or their representative shall verify the swales at time of construction.

9.0 SOIL CORROSIVITY

A full corrosion suite including pH, electrical resistivity, redox potential, soluble sulfate, soluble chloride and sulfide was conducted on selected subsurface soil samples collected from tests pits within the project site to estimate corrosion potential on iron/steel piping. Results of laboratory testing are summarized in the following table and attached in Appendix VII:

Table 12: Summary of Corrosivity Testing Results

Test Pit & Sample depth, BGS	pH	Resistivity (ohms cm)	Redox* Potential (mV)	Water Soluble Chloride (µg/g)	Water Soluble Sulfate (µg/g)	Sulfide (µg/g)	Salinity (g/kg)
TP-1 @ 3’	5.5	27000	386	< 10	< 10	< 2.5	0.05
TP-2 @ 4’	7.0	24000	406	< 10	11	< 2.5	0.13
TP-3 @ 4’	6.5	25000	403	< 10	< 10	< 2.5	0.11
TP-4 @ 6’	7.2	22000	416	< 10	< 10	< 2.5	0.13
TP-5 @ 3’	6.3	12000	379	< 10	31	< 2.5	0.12
TP-9 @ 3’	6.2	48000	437	< 10	16	< 2.5	0.05
TP-7 @ 4’	6.2	33000	405	< 10	30	< 2.5	< 0.05
TP-8 @ 2’	6.1	12000	401	< 10	27	< 2.5	0.16
TP-10 @ 5’	5.8	31000	391	< 10	27	< 2.5	0.08
TP-11 @ 3’	5.9	25000	395	< 10	17	< 2.5	0.09

Type of Soil: Sand; State of Soil: Naturally deposited and relatively Uniform; Water Content: Less than 20%
*Reduction-Oxidation potential (positive values indicates an oxidizing environment)

The above coefficients are used to determine soil aggressivity to iron and steel. Based on these results, the onsite soils to the depths tested are considered slightly aggressive to non-aggressive. (Refer to *Corrosion of Building Materials by Dietbert Knofel, 1975*).

An important factor for evaluating soil corrosivity to buried metal is electrical resistivity. The electrical resistivity of a soil is a measure of resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. As the resistivity of the soil decreases, the corrosivity generally increases. The following correlation between soil resistivity and expected corrosion attack is used in our assessment of soil aggressivity (*from Dietbert Knofel page 64, Table 6.7; Source: Waters et al.*):

Specific Resistivity (ohm-cm)	Exposed Corrosion Attack
<1000	very strongly aggressive
1000 to 3,000	strongly aggressive
3,000 to 5,000	aggressive
5,000 to 10,000	moderately aggressive
10,000 to 20,000	slightly aggressive
>20,000	virtually nonaggressive

Electrical resistivity results from field measurements (Wenner Four-Electrode Method) indicate that the soils in the upper 10 feet depth are “slightly to moderately aggressive” towards iron and other buried metal. Based on a scale published in “Corrosion of Building Materials”, the results of other parameters used in the determination of soil aggressivity i.e. pH, redox potential, sulfate, chloride and sulfide indicate near-surface soils to depth tested be slightly aggressive. Other soils found along the project alignment may be more, less, or of a similar corrosive nature.

9.1 Sulfate Attack on Concrete

Sulfate and other salts can attack the cement within concrete causing weakening of the cement matrix and eventual deterioration by raveling. Sulfate attack occurs when sulfates react with compounds in the cement paste such as monosulfate, portlandite, and C–S–H gel. This attack is in the form of a chemical attack, a chemical reaction between sulfate and the cement used in the concrete. Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 4.3.1 of the ACI Design Manual 318. Concrete should be designed in accordance with the provisions of the ACI Design Manual 318, Chapter 4.

Chloride ions can cause corrosion of reinforcing steel. ACI 318 provides commentary relative to the effects of chlorides present in the soil from both internal and external sources. It is possible that long term saturation of foundations with chloride rich water could allow the chloride access to the reinforcing steel. Therefore, if the site is adequately drained in accordance with sound engineering practice and the applicable codes, this should be a low threat.

A minimum concrete cover of cast-in-place concrete should be in accordance with Section 7.7 of the 2007 edition of ACI 318. Additionally, the concrete should be thoroughly vibrated during placement. The information provided above should be considered preliminary. These values can potentially change based on several factors, such as importing soil from another job site and the quality of water used during grading.

10.0 SEISMICITY AND SEISMIC HAZARDS EVALUATION

10.1 Seismic Conditions

The Tri-Cities area is generally not considered to be located within an area of high seismic activity. There are no confirmed major faults in the Benton County region capable of producing strong earthquakes.

10.2 Earthquakes

Earthquakes caused by movements along crustal faults, generally in the upper 10 to 15 miles, occur on the crust of the North America tectonic plate when built-up stresses near the surface are released. The two largest crustal earthquakes felt in the state of Washington included the 1872, M 6.8 earthquake near Lake Chelan and the 1936, M 6.0 Walla Walla earthquake. The following tables provides information gathered from the online USGS database regarding historic earthquakes (>3.5 M) within the past 50 years for epicenters within 100 kilometers of project site, sorted by magnitude (largest to smallest):

Table 13: Earthquakes Within 100-kilometers of Project Site

Date(s) of Event	Magnitude (M)	Seismic Zone	Distance from Site (kilometers)
December 20, 1973	4.4	14 km WNW of Othello, WA	56.6
April 8, 1979	4.3	6 km S of College Place, WA	79.2
November 28, 1991	4.3	7 km S of Walla Walla East, WA	84.8
July 14, 1992	4.1	6 km S of Walla Walla East, WA	85.2
November 18, 1997	3.9	20 km NW of Bickleton, WA	93.8
August 7, 1992	3.9	8 km WSW of Irrigon, OR	59.2
February 10, 1985	3.9	15 km SSE of Boardman, OR	76.6
June 28, 1975	3.8	12 km SSE of Prosser, WA	42.5
March 22, 1983	3.8	6 km S of College Place, WA	78.9

July 9, 1988	3.7	8 km SW of Royal City, WA	62.5
September 4, 2011	3.7	14 km N of Richland, WA	6.1
May 18, 2005	3.7	11 km SSW of Benton City, WA	28.5
February 17, 1979	3.6	7 km SE of Mabton, WA	53.6
July 1, 1975	3.6	18 km NW of Ione, OR	100.0

Based on seismic scenarios published by the Washington State Department of Natural Resources (DNR), as seen on the *Cascadia Earthquake Hazard Map* (Figure 6, Appendix II), a large 9.0M Cascadia earthquake event would result in a shaking intensity of '5' (moderate shaking) on the Modified Mercalli Intensity (MMI) scale at the site.

10.3 Faulting

For the purpose of fault activity classification, faults are often grouped into the following categories:

- Historic - Displacement during historic time (approximately the last 200 years)
- Holocene - Displacement has occurred within the last 10,000 years
- Late Quaternary Displacement - has occurred within the last 130,000 years
- Quaternary - Evidence of displacement within the last 1.6 million years
- Pre-Quaternary - No recognized evidence of displacement in Quaternary time

We list recognized faults located in the vicinity of the project site (United States Geological Survey U.S. Quaternary Faults) in Table 12 below. Each fault is classified as Class A, defined by the USGS as suspected of Quaternary-age deformation. Published attenuation relationships indicate ground motions decrease significantly with distance. The faults listed are considered to have the greatest potential to impact the project site if they were to rupture.

Table 14: Nearby Quaternary Faults

Fault Name	USGS Fault No.	Fault Class	Distance From Site	Average Strike	Dip Direction	Most Recent Deformation	Slip Rate (mm/yr)
Saddle Mountain Structures	562	A	~26 mi / ~42 km	N71°W	18-33° S	<130 ka*	0.2 to 1.0
Umtanum Ridge Structures	563	A	~13 mi / ~21 km	N88°W	30-70° SE	<130 ka	<0.2

Rattlesnake Hills Structures	565	A	~4mi / ~7 km	N61°W	19-35° S	<1.6 ma*	<0.2
Horse Heaven Hills Structures	597	A	~10 mi / ~17 km	N90°W	22-42° S	<1.6 ma	<0.2
Columbia Hills Structures	568	A	~25 mi /~40 km	N75°E	2-80° S	<1.6 ma	<0.2
Wallula Fault System	846	A	~15 mi / ~24 km	N53°W	70-90°, V	<15 ka	<0.2

*ka= kilo annum= 1,000 years
*ma= mega annum= 1,000,000 years

10.4 Earthquake Induced Geologic Hazards

Geologic hazards that may affect the development include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, ground subsidence, and erosion. A discussion follows on the specific hazards to this site:

10.4.1 Liquefaction: Liquefaction is a seismic phenomenon in which loose, saturated cohesionless soils behave like a fluid when subjected to high-intensity ground shaking. This phenomenon generally occurs in areas of high seismicity, where groundwater is shallow and low-density sandy soils or relatively non-plastic fine-grained soils are present. Studies indicate that saturated, loose and medium-dense near-surface cohesionless soils exhibit the highest liquefaction potential. Dry dense cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. The published *Liquefaction Susceptibility Map of Benton County, Washington* (dated September 2004) prepared by Washington State Department of Natural Resources (Figure 4, Appendix II), indicates the potential for liquefaction to occur at this site is considered ‘very low’ to ‘low’. Based on the site geology and subsurface groundwater conditions, the risk of liquefaction of the site soils is very low. In addition to literature review, a site-specific liquefaction analysis was completed for the site using subsurface data obtained from borings BH-06 and BH-40.

Our analysis of the potential soil liquefaction susceptibility at the project site was performed using the 1997 NCEER Liquefaction Workshop method that modifies the Seed, et. al. 1985 method. This method is an empirical approach to quantify the liquefaction hazard using SPT blow count data from the exploratory borings performed at the site, along with an estimation of earthquake magnitude and site modified peak ground acceleration (PGA) derived from the seismic hazard analysis (ASCE 7-22). The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio versus a corrected blow count $N_{1(60)}$. Liquefaction analysis was also performed using Idriss & Boulanger Method (2004), a semi-empirical procedure for evaluating liquefaction potential during earthquake, and using a 2003 probabilistic method by Seed, et al. An estimation of the resulting induced ground subsidence from soil liquefaction was calculated using the 1987 Tokimatsu and Seed method by a computer spreadsheet, Liquefy v2.3.xls (Stringer, 2007). The Q_{cIN} readings and SPT blow counts were adjusted to an equivalent clean sand blow count, $N_{1(60)\text{-}CS}$, according to the estimated fines content of the soil.

The site- and depth-specific data for soil densities (SPT) and soil types obtained from borings BH-06 and BH-40 were used for our analysis. Soils encountered within these borings consisted primarily of loose to medium dense sand overlying medium dense to very dense gravels. Groundwater was encountered in boring BH-06 and BH-40 at ~29 and 39 feet BGS respectively. Additionally, while available data indicates relatively low seismic activity in the region, we have estimated possible 5.5 and 6.5 magnitude earthquakes producing a PGA of 0.20g at the site for our analysis.

The results of our liquefaction susceptibility analysis indicate that no significant measurable manifestation of liquefaction is likely to occur at the subject site during the design basis earthquake for 10% risk in 100 years assuming relatively steady groundwater conditions. The potential for liquefaction induced settlement is very low. Liquefaction analyses outputs are included in Appendix IX.

10.4.2 Lateral Spreading: Lateral spreading is a type of liquefaction induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, and structures. Due to the lack of a nearby free face and very low potential for liquefaction, the potential for lateral spreading is considered very low.

10.4.3 Surface Fault Rupture: For the purposes of this report, an active fault is defined as a fault that has had displacement within the Holocene epoch or last ~10,000 years. The Tri-Cities region is subject to areas of known faulting and deformation related to activity along the Yakima Fold Belts. The nearest known active fault trace, approximately 4 miles west/southwest of the site, is identified as the *Rattlesnake Hills structures* thrust fault with a slip rate of less than 0.2 mm per year. The exact location and trend of the nearby fault is unknown and is inferred as shown on the map from the *USGS U.S. Quaternary Faults Map* (Figure 5, Appendix II). While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

10.4.4 Secondary Seismic Hazards: Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far inland, so the hazard from tsunamis is non-existent. The potential hazard from seiches in also nil due to the noted low magnitudes of potential seismic shaking.

10.4.5 Earthquake Induced Slopes Instability: Existing elevations across the subject site generally range from approximately 407 feet to about 378 feet for a total site relief on the order of 30 feet. In general, the site slopes gently towards the southwest with the maxim slope at 4H:1V (25%) and the average slope much flatter. Earthquake induced Slope stability / slope stability is not a concern at these flat slopes.

10.4.6 Flooding and Erosion: The subject property is not located in area mapped by FEMA regarding flooding concerns. The subject property is, however, situated in an area where sheet flow and erosion may occur.

Erosion susceptibility from water is based on several factors, including the intensity of rainfall and runoff, soil erodibility, length and steepness of slopes, and surface condition. The erodibility factor of the soils is a measure of the soils resistance to erosion based on its physical characteristics. Typically, very fine sand, silt and clay soils are generally susceptible to erosion. Based on site specific field exploration, observations, and laboratory testing, the surficial soil exposed at the project site consists primarily of sandy/silty soils.

Soil erodibility is only one of several factors affecting the erosion susceptibility. Soil erosion by water also increases with the length and steepness of the site slopes due to the increased velocity of runoff and resulting greater degree of scour and sediment transport. Appropriate erosion and sediment control plan(s) and a drainage plan shall be prepared by the project civil engineer with the final construction drawings.

The need for and design of flood control devices and erosion protection measures is within the purview of the design Civil Engineer and/or Landscape Architect. In general, erosion should be mitigated with best management practices (BMPs) consisting of proper drainage design including collecting and disposal (conveyance) of water to approved points of discharge in a non-erosive manner, placement of vegetative covers and erosion control mats on slope surfaces. Appropriate project design, construction, and maintenance will be necessary to mitigate the site erosion hazards.

11.0 SEISMIC DESIGN CONSIDERATIONS

11.1 Seismic Sources and Seismic Shaking

The contribution of earthquake hazards for the PGA from various seismogenic sources was evaluated using the interactive deaggregation tool provided by the USGS (U.S. Department of the Interior, U.S. Geological Survey, 2022). The interactive deaggregation tool incorporates the results of the 2018 National Seismic Hazard Mapping Program (NSHMP) and separates the earthquake hazards into four sources: interface, slab, fault, and grid. The interface and slab categories are from the Cascadia Subduction Zone (CSZ), and the fault and grid categories represent the shallow crustal sources (the “fault” category is the hazard from discrete crustal faults in the USGS 2018 NSHMP seismic source model; the “grid” category is the hazard also from crustal seismicity but from as-of-yet unknown or discretely modeled faults).

We evaluated potential seismic shaking at the site from deaggregation of the PGA having a 2 percent probability of exceedance in 50 years (2,475-year return period) using the USGS Unified Hazard Tool (NSHM Conterminous U.S. 2018). Seismic sources contributing to this potential ground shaking included gridded sources (no specific location), local crustal faults, and intraplate (e.g., CSZ). The data indicate that the “mean source” for shaking at the site is a magnitude 6.38 earthquake with an epicenter approximately 30.55 kilometers (km) from the site. This represents the "design level" earthquake. The "modal source" a magnitude 5.5 earthquake with an epicenter approximately 11.49 km from the site. The mean value represents the "design level" earthquake, while the modal value represents the most likely actual scenario to be encountered by the structure.

11.2 Ground Motion Amplification (Site Class)

The "Site Class" is a classification based on the properties of the upper 100 feet of the soil and bedrock materials at a site. The Washington Geologic Information Portal identifies this site as having a National Earthquake Hazards Reduction Program (NEHRP) Site Class D designation. However, based on the results of site-specific ReMi survey, the weighted-average shear-wave velocity (Vs) of the upper 100 feet of site soil profile is **1587.2 feet/second (ft/s)**. This average shear-wave velocity corresponds to Site Classification of C (very dense soil and soft rock), as described in Chapter 20, Section 20.3 and Table 20.3-1, and sub-section 20.3.3 of ASCE 7.

ASCE 7: Table 20.3-1 Site Classification			
Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff soil	**600 to 1,200 ft/s**	15 to 50	1,000 to 2,000 psf

$\bar{v}_s$, Average Shear Wave Velocity
$\bar{N}$ or $\bar{N}_{ch}$ Average Field Standard Penetration Resistance for Cohesionless Soil Layers (ASTM D1586)
$\bar{s}_u$ Average Undrained Shear Strength (ASTM D2166 or ASTM D2850)

Therefore, based on V_s100 and subsurface geologic profile encountered in exploratory borings, we recommend that Pacific Green Fertilizer Plant site in Richland, WA be classified as a **Site Class C** as described in section 1613.3.2 of the 2018 IBC (International Code Council, 2018).

11.3 Seismic Design Parameters

We anticipate the design of the new structures will be governed by the 2018 International Building Code (International Code Council, Inc., 2018). Therefore, the seismic design will be completed in accordance with ASCE 7-16 (American Society of Civil Engineers, 2016). However, not knowing the timing of final design for the project, we have also provided the design parameters in accordance with ASCE 7-22 and 2021 IBC. The code-based design earthquake spectral response acceleration parameters were obtained from the National Seismic Hazard Maps and determined using ASCE's online Hazard Tool for Latitude 46.35548°N and Longitude 119.289195°W. Tables 13 and 13A summarize the recommended seismic design parameters in accordance with ASCE 7-16 and ASCE 7-22 for a code-based response spectrum with a return period of 2,475 years.

Table 15: ASCE 7-16 Seismic Design Parameters (IBC 2018)

Seismic Design Parameter	Value (unit)	Definition
	C	IBC Site Classification*
S_S	0.399 (g)	MCE spectral response acceleration at short periods
S_1	0.155 (g)	MCE spectral response acceleration at 1-second period
F_a	1.3 (unitless)	Site coefficient for short periods
F_v	1.5 (unitless)	Site coefficient for 1-second period
S_{MS}	0.519 (g)	Adjusted MCE spectral response acceleration at short periods
S_{M1}	0.232 (g)	Adjusted MCE spectral response acceleration at 1-sec period
S_{DS}	0.346 (g)	Design spectral response acceleration at short periods
S_{D1}	0.155 (g)	Design spectral response acceleration at 1-second period
PGA	0.179	Mapped Peak Ground Acceleration
PGA_M	0.219	Design Peak Ground Acceleration
F_{PGA}	1.221	PGA Site Coefficient

Table 15A: ASCE 7-22 Seismic Design Parameters (IBC 2021)

IBC Site Classification*	C	
	Short Period (0.2 Sec)	**Long Period (1 Sec)**
Maximum Credible Earthquake (MCE) Spectral Acceleration (g)	Ss = 0.43 g	S_1 = 0.13 g
Adjusted Spectral Acceleration (g)	S_{MS} = 0.47	S_{M1} = 0.19
Design Spectral Response Acceleration Parameters (g)	S_{DS} = 0.32	S_{D1} = 0.13
PGA_M (g)	0.2 g	

*Site Classification determined based on site-specific Refraction Microtremor (ReMi) survey to estimate Vs_{100}

12.0 GEOTECHNICAL RECOMMENDATIONS

The following geotechnical recommendations are based on information provided by **TECNICAS REUNIDAS** (Client) regarding the proposed development at the site as discussed in Section 2.0, PROPOSED CONSTRUCTION, and intended for the Client to support front-end engineering efforts for preliminary design and planning purposes with final details regarding site layout and structural loading adjusted in later phases of the project.

Recommendations discussed in this report should be reviewed and modified as needed during the design development phases of the project and/or based on the field conditions exposed during site grading. GNN shall be engaged to review the geotechnical aspects of the approximately 90 percent plans and specifications (finished floor elevations, grading and foundation plans) to confirm that our recommendations were properly understood and implemented and to provide revised, augmented, and/or additional geotechnical recommendations if necessary.

The soil design parameters and recommendations presented in this report are predicated upon appropriate geotechnical monitoring and testing of the earthwork grading and foundation and building pad construction by a representative of GNN's **Geotechnical-Engineer-of-Record (GER)**. During the grading and earthwork operations, a representative of the GER shall observe and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the GER shall inform the design team, and recommend appropriate changes in design to accommodate the observed conditions as required. Any deviation and nonconformity from this requirement may invalidate, partially or in whole, the following recommendations.

12.1 GEOTECHNICAL DESIGN RECOMMENDATIONS

12.1.1 Foundations Design Approach

We recommend the following foundation types for support of structures and components:

1. Lighted loaded structures including pre-engineered metal buildings, storage buildings-Conventional shallow spread foundation (continuous strip and isolated footings).
2. Critical structures with vibrating equipment (machine foundations) - Enhanced foundations - can be a structural mat foundation system or a stiffened grid foundation system (with criss-crossing grade beams that tie the column footings together).
3. Heavily loaded equipment pad/transformer pad - Structural mat
4. Tanks - Structural mat or ring wall foundation.
5. Flare tower - Structural mat and/or shallow spread foundation.

Foundation elements shall not be designed or constructed to straddle a transitional cut to fill subgrade support condition. The recommend foundation embedment depths (Minimum Bottom of Foundation Elevation) in Table 14 are intended to avoid a straddle condition and to provide a uniform bearing support to minimize the risk of un-tolerable differential settlement and angular distortion. For example, based on the existing topography and site layout, this transitional cut-to-fill condition is obvious within the Bulk Storage Building footprint and the HV Substation Pad and may be some other locations as well. The foundation bottom elevations may be revised once the finished floor elevations are established and GNN has had an opportunity to review the final grading and foundation plans to verify that all foundations are supported on a competent uniform stratum.

12.1.2 Spread Foundations Design Recommendations

Continuous wall and isolated spread footings should be at least 16 and 24 inches wide, respectively. The bottom of exterior concrete foundations (Foundation BOC) should be at least 24 inches below the lowest adjacent exterior grade for frost protection and bearing capacity considerations.

Foundations shall bear on a layer of imported crushed rock structural fill placed over recompacted subgrade, dense native gravel soils and/or appropriately placed engineered fill as discussed in the EARTHWORK AND GRADING RECOMMENDATIONS section below.

Utility trenches running parallel to footings should not be excavated within a 1H:1V (horizontal to vertical) downward projection from adjacent footings ("footing influence zone") to avoid potential undermining. Depending on the utility line and structural loading of the footing, utility trenches running perpendicular to footings may require special provisions such as sand-cement slurry backfill of the utility trench in this zone or flexible sleeves through the footings. These conditions should be evaluated on a case-by-case basis. The footings must be embedded so there is a minimum of 10 feet of horizontal distance between the base of the footings and any adjacent slope.

Bearing Capacities

The ultimate bearing capacity q_{ult}, of the soil supporting a spread footing is calculated using the Terzaghi equation as follows:

$$q_{ult} = 0.5\ \gamma B N_\gamma s_\gamma + q N_q + c\ N_c s_c$$

The third term of this equation is associated with cohesive soils (clayey/elastic silt soils) which typically exhibit an undrained mode of failure and where pore pressure build-up is allowed when soil is sheared. For foundations supported by primarily granular soils/structural fill, the third term of the bearing capacity equation drops off, as the cohesion for these granular soils is taken as zero. The first and second terms remain, along with an additional term to calculate the net ultimate bearing capacity, resulting in the following equation:

$$q_{all} = 0.5\gamma B N_\gamma s_\gamma + q N_q\ - q$$

γ = soil unit weight, pcf
B = footing width, feet
N_y, N_q, N_c = dimensionless bearing capacity factors directly related to Φ of soil
q = effective stress at the foundation bearing depth, psf
c = soil cohesion, psf
s_γ,= Shape factor (square footing = 0.8); s_c = Shape factor (square footing = 1.3)

Foundation Settlement

Considering that the site has proper drainage measures implemented during and after construction to avoid infiltration and accumulation of water in the footing bearing zone and the subgrade soils are not saturated during the performance life, the elastic settlement for a spread footing is computed using the following equation:

$$S = \frac{Bq_o}{E_s} (1- v^2)\, I_G\, I_F\, I_E$$

Where:
S= elastic settlement, ft
q_o = gross contact pressure, psf
B = foundation width = 57 feet
ν = Poisson's ration
E_s = elastic modulus = Young's modulus E, psf
I_G = influence factor for variation of E with depth = 1.0 (no variation)
I_F = foundation rigidity correction factor = 1.0 (no benefit assumed)
I_E = foundation embedment correction factor = 1.0 (no benefit assumed)

Table 16 below presents the recommended foundation type, depth, subgrade improvement, improvement based allowable bearing capacity and modulus of subgrade reaction. The improvement based allowable bearing capacities in Table 16 satisfy the allowable settlement requirements. The allowable bearing capacity values include a minimum factor of safety (FS) of 3.

Table 16: Recommended Foundation Type, Depth, Subgrade Improvement, Recommended Allowable Bearing Capacity, and Recommended Subgrade Modulus

Structure ID [1]	Recommended Foundation Type	Minimum Bottom of Foundation Elevation [2]	Allowable Bearing Capacity	Modulus of Subgrade Reaction	Recommended Foundation Subgrade Improvements	
					Min. Crushed Rock Thickness	Native Subgrade Compaction [5]
ST-1	Isolated/Strip Footings	380′ [3]	2,200 psf		6 inches	All foundation excavations shall be removed of any loose dune sand soils [S-1], if encountered. Where native sand with silt soils [S-2] are encountered at the bottom of foundation excavation, scarify minimum 12 inches of subgrade, moisture-condition to near-optimum, and compact to minimum 95% of the maximum dry density (per ASTM D1557). Where native sandy gravel soils [S-3] are encountered at the bottom of foundation excavation, moisture-condition, and proof-roll to a dense and non-yielding condition.
ST-2	Isolated/Strip Footings	380′ [3]	2,200 psf		6 inches	
ST-3	Isolated/Strip Footings	380′ [3]	2,200 psf		6 inches	
ST-4	Isolated/Strip Footings	385′ [4]	2,200 psf		6 inches	
ST-5	Isolated/Strip Footings	378′	2,200 psf		6 inches	
ST-6	Isolated/Strip Footings	378′	4,000 psf		18 inches	
ST-7	Isolated/Strip Footings	378′	2,200 psf		6 inches	
ST-8	Isolated/Strip Footings	378′	2,200 psf		6 inches	
ST-9	Isolated/Strip Footings	378′ [4]	2,200 psf		6 inches	
ST-10	Isolated/Strip Footings	380′	2,200 psf		6 inches	
ST-11	Isolated/Strip Footings	380′	2,200 psf		6 inches	
ST-12	Isolated/Strip Footings	380′	2,200 psf		6 inches	
ST-13	Isolated/Strip Footings	380′	2,200 psf		6 inches	
ST-14	Mat Foundation	379′	5,500 psf	235 pci	30 inches	
ST-15	Isolated/Strip Footings	378′ [4]	2,200 psf		6 inches	
ST-16	Isolated/Strip Footings	378′ [4]	4,200 psf		24 inches	
ST-17	Isolated/Strip Footings	382′	2,200 psf		6 inches	
ST-18	Isolated/Strip Footings	383′	4,200 psf		24 inches	
ST-19	Mat Foundation	378′ [4]	4,200 psf	180 pci	18 inches	
ST-20	Isolated/Strip Footings	383′	4,500 psf		24 inches	
ST-21	Isolated/Strip Footings	377′	2,200 psf		6 inches	
ST-22	Isolated/Strip Footings	377′ [4]	2,200 psf		6 inches	
ST-23	Isolated/Strip Footings	382′ [4]	4,000 psf		18 inches	
ST-24	Isolated/Strip Footings	377′ [4]	4,000 psf		18 inches	
ST-25	Isolated/Strip Footings	384′ [4]	4,000 psf		18 inches	
ST-26	Isolated/Strip Footings	378′ [4]	4,000 psf		18 inches	
ST-27	Mat or Ring Foundation	382′ [4]	6,000 psf	250 pci	36 inches	
ST-28	Mat or Ring Foundation	389′ [4]	4,500 psf	180 pci	18 inches	
ST-29	Isolated/Strip Footings	389′	2,200 psf		6 inches	
ST-30	Isolated/Strip Footings	380′ [4]	2,200 psf		6 inches	
ST-31	Isolated/Strip Footings	380′ [4]	2,200 psf		6 inches	
ST-32	Isolated/Strip Footings	382′ [4]	2,200 psf		6 inches	
ST-33	Isolated/Strip Footings	386′ [4]	2,200 psf		6 inches	
ST-34	Isolated/Strip Footings	383′ [4]	2,200 psf		6 inches	
ST-35	Mat Foundation	382′ [4]	5,500 psf	235 pci	30 inches	
ST-36	Mat Foundation	387′	6,000 psf	250 pci	36 inches	
ST-37	Mat Foundation	386′	6,000 psf	250 pci	36 inches	
ST-38	Mat or Spread Foundation	386′	4,000 psf	200 pci	24 inches	

(1) Refer to **Table 1** for full information regarding the structure type, anticipated mean vertical loading and settlement criteria

(2) The minimum bottom of foundation elevations have been established with the intent of providing for relatively uniform foundation subgrade conditions across the footprint of the proposed structures. The recommended elevations may warrant revision once finished floor elevations have been determined.
(3) The southern part of the site was not explored during the site investigation due to archeological restrictions; hence, the foundation design for this area is based on soil conditions encountered across the site and extrapolated from nearby points of exploration. The Geotechnical Engineer-of-Record (GNN) shall review the soil conditions in real time during foundation excavations to confirm that the exposed conditions are similar to those encountered in other boreholes and if differing conditions are observed the GER shall provide additional design directive as necessary.
(4) Due to these proposed structures currently being sited in areas where existing surface elevations range by 4 feet or more, recommended bottom of foundation elevations are intended to avoid straddling foundation subgrade support conditions. For example, the Bulk Storage Unit building (ST-4) is anticipated to encounter the competent gravelly stratum across the southern portion within shallow foundation excavations; therefore, in order to provide uniform subgrade support conditions, some over-excavation to achieve the recommended bottom of foundation elevation will be required.
(5) Refer to **Table 6** for full descriptions of the generalized soil strata at project site.

The values in the table above represent net bearing pressures; the weight of the footings and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressures apply to the total of dead plus long-term live loads and may be increased by one-third (1/3) for short-term, transient, wind and seismic loading loads. These allowable bearing pressures are applicable for a level ground condition only. The maximum edge pressures induced by eccentric loading or overturning moments should not be allowed to exceed these recommended values.

Settlement

Provided footing subgrades are prepared in accordance with the recommendations presented in this report, based on theory of elasticity we estimate total post-construction settlements will meet the allowable long-term settlements (L.T.S) for project structures. We anticipate differential settlement will be about half of total settlements between adjacent columns and along approximately 50-foot span of continuous footings. We assume there is no stress overlap from adjacent footings. Footings located less than two times the footing width (2B) from each other will increase stresses beneath the adjacent footing, resulting in increased settlement. We expect elastic settlements to generally occur as loads are applied. <u>Settlement estimates should be re-evaluated by GNN when actual building loads and final foundation plans are made available.</u>

Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction at the base of the footings. For design purposes, a passive earth pressure of 300 pounds per cubic foot (pcf) may be used for footings confined by undisturbed dense native gravel unit or compacted granular structural fill. We recommend using equivalent fluid weight of 200 pcf in compacted onsite fine-grained sandy backfill at depths greater than 2 feet below adjacent grades. The allowable passive pressure may be increased by 1/3rd for short-duration seismic loading. The passive pressure is applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Adjacent floor slabs, pavements, or the upper 24-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

We recommend a coefficient of friction of 0.45 be used between cast-in-place concrete and imported crushed rock. Frictional resistance and passive pressure may be used in combination without reduction. The lateral resistance values include a factor of safety of 1.5.

12.1.3 Structural Mat

If the mat cannot be considered rigid, the soil pressure distribution should be computed using a method which models the soil-structure interaction, such as the beam-on-an elastic foundation procedure. The Vertical Modulus of Subgrade Reaction values (K_{V1}) provided in Table 14 may be considered for design of concrete mat and assumes the mat foundation placed over a layer of imported crushed rock and prepared and compacted subgrade.

The modulus value given is for a one-foot square plate and must be corrected for mat shape and size and adjusted for scaling effects using an appropriate formula, such as:

$K_S = K_{V1} (B+1)^2 / (4B^2)$, where B = mat/slab width in feet
where K_S is coefficient of subgrade reaction

12.1.4 Ring Wall

The ring wall should be reinforced circumferentially to resist hoop stress resulting from lateral pressure of soil confined within the ring wall. Tension in the footing and required reinforcing steel may be calculated using equations in Structural Engineers' Handbook (Woznaik) and ACI 318-05.

12.1.5 Pile Foundation Design Recommendations

Auger-Cast Piles

If necessary, augered cast-in-place (AC) piles may be used for support of structures with relatively high loading, uplift and moments. The AC pile derives its capacities from a combination of skin friction and tip bearing. AC piles shall extend a minimum 2 feet into the very dense gravel soils with SPT N-value >50 bpf. The structural designer shall determine the reinforcement requirements based on the structural demands for axial compressive loads, lateral loads, moments, or minimal reinforcement required by design codes shall be satisfied.

Driven piles are not suitable for this site due to vibration restrictions outlined in the lease agreement and subsurface conditions.

The soil strength parameters obtained from exploratory boring BH-32 are generally considered suitable for analysis of pile foundations. Groundwater was encountered at a depth of 38 feet BGS (Elev 353.50 ft) in boring BH-32.

LPile Parameters

Auger cast piles (drilled piles) subjected to lateral loads and/or moments shall be checked by LPile® to ensure the designed piers have sufficient overturning resistance. The following tables present soil profile and estimated soil parameters for use in the LPILE® software:

Boring BH-32

Table 17: LPile Input Parameters

Soil Type	Depth to Bottom of Soil Layer, (feet, BGS)	SPT 'N' Value*	Effective Unit Weight (pcf)	Internal Friction Angle (deg.)	Cohesion (psf)	p-y modulus, k (pci)	†K_a	†K_p
Silty Sand & Silt w/ sand (Loose)	2.5	-	100	28	0	20	0.36	2.77
Gravel w/ silt & sand (Very Dense)	4.5	78	130	36	0	150	0.26	3.85
Sand w/silt & gravel (Medium dense)	15	10-24	115	32	0	70	0.31	3.25
Gravel w/ silt & sand (Dense to Very Dense)	62	50+	135 (AGW) 72.6 (BGW)	38	0	250 (AGW) 175 (BGW)	0.23	4.20

Note: The upper 3 feet BGS shall be ignored for pile design due to frost action and construction disturbance
Groundwater encountered at 38 feet BGS
*Field recorded N-value, not corrected based on hammer efficiency
†K_a = Rankine active earth pressure coefficient; *K_p = Rankine passive earth pressure coefficient,
AGW: above groundwater, BGW: below groundwater

Table 18: LPile® Soil Types for BH-32

Soil Type	LPile® Soil Type (p-y Curve Model)
Silty Sand & Sand w/ silt	API Sand (O'Neill)
Gravels	API Sand (O'Neill)

The above indicated friction angle, lateral modulus and unit weight values have no factor of safety; these values are based on our borings, published values, and our past experience with similar soil types. These values should therefore be considered approximate. If drilled piers are designed using the above parameters, settlements are not anticipated to exceed 1-inch.

Axial Capacities

The parameters provided in tables above were used to calculate vertical compression and tension (uplift) load capacities of AC pile foundation. Based on our analysis using β method, proposed by Reese and O'Neil and specified in FHWA Manual, and considering dense to very dense poorly graded gravels and gravel with silt and sand bearing stratum at depth of 55 feet and extending at least to a depth of 62 feet below ground surface with N_{60}>85, the maximum ultimate compression bearing capacity is 478 kips and 698 kips for pile diameters 18-inch and 24-inch, respectively. Auger cast piles should extend down to very dense gravels and be socketed a minimum 2 feet into the gravel stratum. The maximum ultimate uplift capacities of 238 kips and 355 kips were calculated for pile diameters of 18-inch and 24-inch, respectively. We recommend the following allowable axial capacities for 18- and 24-inch pile diameters:

Table 19: Preliminary AC Pile Capacities

Allowable Compression Capacity*		
Pile Embedment Depth, feet	AC Pile dia.= 18"	AC Pile dia. = 24"
	Capacity (tons)	Capacity (tons)
55	191 kips (~100-ton)	280 kips (~150-ton)

Allowable Uplift Capacity*		
Pile Embedment Depth, feet	AC Pile dia.= 18"	AC Pile dia. = 24"
	Capacity (tons)	Capacity (tons)
55	95 kips (48-ton)	142 kips (71-ton)

*A factor of safety of 2.5 applied to the calculated ultimate capacities

Notes:

1. The depth of embedment is measured from existing ground surface
2. The capacities can be increased by 1/3 during seismic events
3. No reduction in design capacities apply at these depths due to down-drag

A pile cap will be constructed over group of piles and in contact with the ground. For auger cast, bored and jetted piles, group efficiency is generally taken as about 0.67 to 0.9 for a suspended pile cap. If pile cap is in contact with soil, the group efficiency could be close to 1.

Pile Spacing

Group effects: For vertical loading use 3*pile diameter for minimum spacing, anything less needs to consider group effects. For lateral loading 5*pile diameter spacing to avoid reduction from group action. GNN should review the preliminary pile layout plan for pile spacing and configuration.

Based on available case studies, AASHTO 2002 (AASHTO 10.8.3.9.3) for group efficiencies for drilled shafts is most likely conservative for AC plies where the pile cap is in firm contact with the ground and the soils are not loosened by the installation process.

Estimated Settlement

Settlement checks indicate that both 18-inch and 24-inch diameter piles meet the 1-inch maximum load settlement criteria. A more detailed settlement analysis of the pile or pile groups can be performed if requested after an initial pile layout plan is provided to GN Northern. In general, settlement of the piles and pile groups are expected to be less than 1-inch and majority of the settlement will occur during construction.

Pile Load Test

Axial capacities shall be verified through the use of static load testing. We recommend that pile load testing be performed before installation of production piles on this project and shall be conducted on two (2) sacrificial, non-production piles. The load testing shall be conducted in accordance with ASTM D1143 method, "Standard Test Methods for Deep Foundations under Static Axial Compressive Load". The pile load test shall be monitored by a geotechnical representative of GN Northern and the results reviewed by our Geotechnical engineer.

Verification testing should be performed to a minimum of 200% of the design compression load. Increase load to 2 times the designed bearing capacity starting from zero with an increment of 30 kips. The interval for settlement readings are 5, 10, 15, and 30 minutes for each load increment, and then taking readings in every 15 minutes to 1 hour, and then taking readings in every hour.

Lateral Resistance

The auger cast pile foundation and pile cap shall be designed by your structural engineer. A passive earth pressure of 360 pcf may be used for pile cap confined by native gravel soil or granular structural fill. This value has been reduced to account for the required deformation required to engage fill (i.e. ultimate) passive resistance and does not include a factor of safety.

Design Review and Construction Recommendations

GN Northern shall be engaged to review the foundation plans prior to construction to provide any additional comments or recommendations necessary. The pile spacing and reinforcement and attachment to the pile cap should be provided on the plans.

To avoid a reduction in axial compression and lateral capacities caused by variable subsurface conditions, we recommend that drawings instruct the contractor to notify the **GER** if subsurface conditions significantly different than encountered in the test borings are disclosed during pile installation. Under these circumstances, it may be necessary to adjust the overall length of the pile. To facilitate these adjustments and assure that the pile is embedded in suitable materials, a representative of GER should observe construction, the materials penetrated and document the auger cast pile installation on a full-time basis.

The pile contractor should be aware of the subsurface soil and groundwater conditions present at the site and be prepared for cobble- and boulder sized stones and the possibility of heaving sands during installation (if auger plugs are not used).

The presence of groundwater and/or cohesionless sandy and gravelly soils in the exploratory boring indicates casing and/ or dewatering equipment may be required. In no case should concrete be placed in more than 3 inches of water unless the tremie method is used.

Temporary casing may be required during the pile excavation in order to control possible groundwater seepage and support the sides of the excavation in weak soil zones. Care shall be taken so that the sides and bottom of the excavations are not disturbed during construction. The bottom of the pile shall be free of loose soil or debris prior to reinforcing steel and concrete placement.

A concrete slump of at least 6 inches is recommended to facilitate temporary casing removal. It should be possible to remove the casing from a pile excavation during concrete placement provided that the concrete inside the casing is maintained at a sufficient level to resist any earth and hydrostatic pressures outside the casing during the entire casing removal procedure.

The grout for the piles should be pumped under sufficient pressure to ensure a continuous pile without any breaches. We recommend a minimum grout pumping pressure of 150 psi, and a minimum seven (7) foot grout head on the pile as the auger is being retracted from the hole to ensure pile continuity. During grout placement, consistency of the grout should be determined using a flow cone and grout cubes must be taken from each grouted hole and tested to determine their strength. We recommend a minimum grout strength of 4000 psi.

The placement of the auger cast plies shall be staggered to avoid placement adjacent to piles that have not achieved initial set. All grout should be injected through the hollow stem of the auger under adequate pressure (a minimum 150 psi) to ensure maximum adhesion of the pile concrete to the surrounding soil.

12.1.6 Building Pad and Concrete Slab-on-Grade Floors Recommendations

Subgrade Preparation

Based on the existing site grades, we anticipate that mass grading for some building pads will result in pads graded with cut/fill transitions. To provide a uniform bearing support and minimize the potential for differential settlement of the structure resulting from a straddle condition, we recommend limiting the maximum differential of the thickness of fill material within the building pad footprint to 50%; i.e. if the thickest fill section within a given portion of the building pad is 6 feet, then no portion of the building pad shall be constructed with less than 3 feet of fill material across the footprint. This requirement shall apply to all building pads where the proposed thickness of fill exceeds 3 feet and will require delineating building envelopes on the proposed site layout plan. Subgrade preparation, fill placement and compaction shall be completed in accordance with the recommendations of this report.

A minimum 6-inch layer of crushed aggregate fill shall be placed beneath all slabs. The material shall meet the WSDOT Specification 9-03.9 (3), “Crushed Surfacing Top Course”, with less than 5 percent passing the No. 200 sieve (fines). The crushed rock material shall be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D1557 method. Prior to placement of crushed aggregate fill, the subgrade soils shall be prepared in accordance with the recommendations of the EARTHWORK AND GRADING RECOMMENDATIONS section below.

An appropriate vapor retarder (10-mil polyethylene liner) shall be installed (ASTM E1745/E1643) beneath areas receiving moisture sensitive resilient flooring/VCT where prevention of moisture migration through slab is essential. 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.

Flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives and will warrant their product only if a vapor barrier is installed according to their recommendations. Actual selection and design of an appropriate vapor barrier, if needed, should be based on discussions between the owner and members of the design team.

Design Parameters

Load-bearing concrete slabs with forklift traffic shall be designed using a coefficient of subgrade reaction (K_S). Slabs should be reinforced according to their proposed use and loading and per the structural engineer’s recommendations. Slab thickness, reinforcement and joint spacing shall be determined by a licensed structural engineer.

The following Vertical Modulus of Subgrade Reaction (K_{V1}) values are for various thicknesses of crushed rock:

- 6-inch crushed rock, K_{V1} = 110 pounds per cubic inch (pci)
- 12-inch crushed rock, K_{V1} = 150 pci
- 18-inch crushed rock, K_{V1} = 180 pci
- 24-inch crushed rock, K_{V1} = 220 pci

If floor slabs are designed and constructed as noted above, then we anticipate settlements of the slabs will be less than 1 inches over a 50-foot span.

12.1.7 Retaining Wall Design Recommendations

Lateral Earth Pressures

The following may be used for design of below-grade or retaining walls. Lateral earth pressures are provided as equivalent fluid unit weights, in pound per square foot (psf) per foot of depth or pcf. The equivalent fluid pressure values assume free-draining conditions and a drainage system installed and maintained to prevent the build-up of hydrostatic pressures. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of soil over the wall footing. The following lateral earth pressures are presented on Table 18 considering approved select granular backfill material.

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure which is commonly used for design of freestanding cantilever retaining walls. The lateral outward movement required to develop the full active pressure condition ranges from 0.002H to 0.004H for granular soil. If the wall cannot yield under the applied load, the earth pressure will be higher. Such walls should be designed for "at-rest" and include restrained or braced walls such as basement walls, loading dock walls, or other walls restrained at the top. The horizontal resultant force (pressure x H/2 where H is height of buried wall) should be applied at an H/3 distance from the base of the wall.

Table 20: Lateral Earth Pressures

Earth Pressure Condition	Drained Equivalent Fluid Unit Weight (psf/ft) Level Backfill	Drained Equivalent Fluid Unit Weight (psf/ft) 2:1 Sloped Backfill
Active (K_a)	35	55
At-Rest (K_o)	55	70
Passive (K_p)	300	-

psf/ft = pounds per square foot per foot of depth/embedment

Surcharge loading effects (building foundations, vehicles, etc.) should be evaluated by the retaining wall designer. In general, structural loads within a 1H:1V upward projection from the bottom of the proposed basement or retaining wall footing will surcharge the proposed retaining structure. In addition to the recommended earth pressure, retaining walls adjacent to paved areas (roads/streets) should be designed to resist vehicular traffic. Typical vehicle traffic may be estimated as equivalent to 2 to 2.5 feet of compacted fill, a vertical pressure of 240 to 300 psf. A uniform lateral pressure for typical vehicular traffic of 80 psf and 120 psf may be used for the active and at-rest conditions, respectively. Uniform lateral surcharges may be estimated using the applicable coefficient of lateral earth pressure using a rectangular distribution. A factor of 0.45 and 0.3 may be used for at-rest and active conditions, respectively. We recommend that the retaining wall designer should contact GNN for any required geotechnical input in estimating any applicable surcharge loads based upon the actual magnitude and configuration of the applied loads.

For the seismic loading condition, based on the height of wall and the backfill materials, we recommend using the Seed & Whitman method based on the Mononobe-Okabe equation. This method combines the seismic lateral pressure with the static active pressure for the total lateral pressure. If required, use a seismic lateral earth pressure increment of 10 pcf for level backfill conditions. This increment should be applied in addition to the provided static lateral earth pressure using a triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). For the restrained, at-rest condition, the seismic increment may be added to the applicable active lateral earth pressure (in lieu of the at-rest lateral earth pressure) when analyzing short duration seismic loading. Per Section 1803.5.12 of the IBC, the dynamic seismic lateral earth pressure is applicable to structures assigned to Seismic Design Category D through F for foundation and retaining wall structures supporting more than 6 feet of backfill height. The wall footings should be designed in accordance with the "Spread Footing Design Recommendation" section of this report.

Retaining wall structures should be provided with appropriate drainage to avoid build-up of hydrostatic pressures and appropriately waterproofed. Positive drainage for retaining walls should consist of a vertical layer of permeable material (chimney drain), such as drain rock or crushed rock (typically ¼- to ¾-inch crushed), at least 12 inches thick, be placed against the back of retaining wall, extending from the base of the wall to within 6 inches of finished grade. Perforated collector pipes should be embedded at the base of the drain rock. The perforated collector pipes should discharge at an appropriate location away from the base of the wall.

The backfill material placed behind the walls and extending a horizontal distance equal to at least the height of the retaining wall should consist of granular retaining wall backfill material meeting WSDOT Standard Specifications 9-03.12(2) Gravel Backfill for Walls. We recommend placing a nonwoven filter fabric (e.g., Mirafi 140N or equivalent) between the select granular wall backfill material and the general backfill, native soil and/or topsoil to prevent fines from migrating into the select granular wall backfill material. The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density determined by ASTM D 1557. Backfill placed within 5 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (e.g., jumping jack or vibratory plate compactors).

Settlements of up to 1% of the wall height commonly occur immediately adjacent to cantilevered walls as the wall rotates and develops active lateral earth pressures. Consequently, we recommend construction of flat work adjacent to cantilevered retaining walls be postponed at least three (3) weeks after backfilling of the wall, unless site conditions indicate otherwise.

12.1.8 Pavement Design Recommendations

Our structural pavement design recommendations include both Asphaltic Concrete (AC) and Portland Concrete Cement (PCC) pavements. We have prepared pavement design for subgrade preparation to include scarified and re-compacted onsite soil subgrade (cut ground surface) or subgrade receiving less than 2 feet of new structural fill placed over dense compacted subgrade.

The pavement sections were designed using the American Association of State and Highway Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993), 1998 Rigid Pavement Supplement and the 2018 WSDOT Pavement Policy.

Structural Pavement Design Criteria

We made the following assumptions regarding, and used the following parameters for the design of structural pavement sections. Our analysis considers a 20-year design life. If any of these assumptions are incorrect, contact our office for re-analysis of our pavement design recommendations.

Design Traffic

We assumed certain Equivalent Single Axle Loads (ESALs) for flexible AC pavement design. The actual ESALs should be selected by the design team based on traffic levels anticipated as the project design progresses. For the lightly loaded passenger car parking areas, the traffic is assumed to be approximately 30,000 ESALs.

Pavement Subgrade Strength Parameter

Based on the findings of our site investigation pavement subgrades are expected to consist of silty sand (SM) and fine sand with silt (SP). Bulk samples of the near surface soils were collected from test pits TP-02, TP-03, TP-04, and TP-10 for laboratory testing. Subgrade strength was estimated from four (4) laboratory-prepared remolded California Bearing Ratio (CBR) test of the collected bulk sample. Based on the testing results, a CBR value of 7 was selected for the design. If exposed subgrade conditions during site grading differ from the soil conditions described here, we should be contacted to re-evaluate our pavement design recommendations.

The design CBR value was adjusted to determine an effective subgrade modulus design value using an adjustment factor of 0.89 to account for seasonal moisture effects. This adjustment factor for effective subgrade modulus was calculated in general accordance with the procedures given in Section 2.3.1 in the AASHTO Guide using the moduli ratios for subgrade in Eastern Washington as given in Section 2.3.2.5 of the WSDOT Pavement Guide – Volume 2.

Pavement Design Parameters

Pavement design procedures are based on the strength properties of the subgrade soils and paving materials along with the design traffic loading in terms of equivalent single-axle load (ESALs) and climatic conditions of the region. Table 19 summarizes the input parameters used for analysis of the pavement sections:

Table 21: Pavement Design Parameters

Application	Design Values
Pavement Design Life, year	20
Level of Reliability, R (%)	85
Flexible Overall Standard of Deviation, So	0.45
Rigid Overall Standard Deviation, So	0.35
Initial Serviceability Rating, Pi	4.2
Terminal Serviceability Rating, Pt	2.5
Effective Subgrade Resilient Modulus, Mr (psi)	9,345
Modulus of Subgrade Reaction, k-value (psi/in)	125
Asphalt Concrete (AC) Layer Coefficient[1]	0.44
Base Aggregate (BC) Layer Coefficient	0.12
Base Aggregate Resilient Modulus	30,000
Base Aggregate Drainage Coefficient	1
28-day Modulus of Rupture of PCC (psi)	570
Modulus of Elastic of PCC (psi)	3,600,000

Load Transfer Coefficient J[2]	2.8
Compressive Strength of Concrete f’c, (psi)	4,000

1. *New Dense Graded HMAC*
2. *Load transfer coefficient of 2.8 for dowel reinforced concrete joints*

Pavement Design Sections

The pavement sections in the following tables are minimum recommended material thicknesses. Because the proposed project’s infrastructure has not been finalized, we have provided pavement design sections for several traffic loadings considering a properly prepared cut subgrade or subgrade consisting of less than 2 feet of structural fill over dense recompacted subgrade:

Table 22: AC Pavement Design Sections

Traffic Application	Traffic Loading (ESALs)	AC Thickness (inches)	Aggregate Base Course Thickness (inches)
Heavy Duty (Site Entrance/Drive Lanes/Truck Routes)	100,000	3	8
	250,000	4	8
	500,000	4 or 4.5	12 or 10
	1,000,000	5	11
	2,500,000	6	12
	5,000,000	7	11
Light Duty (Car Parking Areas)	~30,000	3	6

Preventive Maintenance

Asphalt (AC) pavements tend to develop thermal and fatigue cracking over time from environmental factors and traffic loads and, as such, periodic maintenance should be anticipated. Asphalt, being a viscoelastic material, weakens from temperature influx. Timely preventative measures for continual flexible maintenance such as crack filling and seal coating at 8-10 year intervals to control the progression of surface cracking and distress to prevent water from infiltrating into the base course and subgrade shall be considered. Performing this intermediate level of maintenance can achieve the required design service life.

PCC Pavement Design Sections

The following recommendations are for plain (unreinforced) PCC thickness with dowelled joints. The PCC should be constructed with a maximum joint spacing of 12 feet. PCC pavement should meet **2024 Washington State Department of Transportation Standard Specification** (**WSS**) provided in division 5-05 – Cement Concrete Pavement.

Table 23: PCC Pavement Design Sections

Traffic Application	Traffic Loading (ESALs)	PCC Thickness (inches)	Aggregate Base Course Thickness (inches)
Heavy Duty	< 500,000	6.5	6
	>500,000 to 5 million	8	6
Standard Duty		5	4

The design recommendations presented above require dowel reinforcement in longitudinal and transverse contraction joints as shown in ACI 330.2R-17. Dowels should be 1 or 1.25 inch in diameter, 18 inches long and be spaced at 12 inches on center. In locations where concrete slabs are used in isolated areas such as dumpster pad and short apron slab approaching building, joint reinforcement is not required. In these locations however, an additional two (2) inches should be added to the thicknesses presented in the table above to alleviate cracking of unsupported edges.

Proper design and detailing of longitudinal and transverse control joints, tie bars and joint dowels will be required. The project civil engineer should prepare the jointing plans and details. If requested GNN can provide more detailed recommendations and to review final jointing plans and details for the project. The following general recommendations are presented for doweled PCC pavements:

Contraction Joints should be reinforced with dowels in accordance with ACI 330.2R-17. Joint cuts should be 1/5 of the depth of the concrete. Time of initial sawing, both in the transverse and longitudinal directions, is critical in preventing uncontrolled shrinkage cracking. It is important that sawing begin as soon as the concrete is strong enough to both support the sawing equipment and to prevent raveling during the sawing operation. All joints shall be sawed within 12 hours of concrete placement. This is particularly critical during hot weather. Once sawing begins, it shall be a continuous operation and shall only be stopped if raveling begins to occur. Joints should have a maximum spacing no greater than 12 feet, as described in ACI 330.2R-17.

Expansion Joints are recommended to isolate fixed objects abutting or within the paved area, such as around light poles and drainage inlet structures. Joints should be full depth and filled with pre-molded materials per ACI 330.2R-17. Pavement edges at expansion joints located in areas that encounter wheel loads should be thickened by two inches wherever practical; the transition in thickness should occur over a minimum distance of five feet. Smooth dowels are the most widely used method of transferring load across expansion joints. Expansion joint dowels are specially fabricated with a cap on one end of each dowel that creates a void in the slab to accommodate the dowel as the adjacent slab closes the expansion joint.

Construction Joints: Dowels should be provided at the same size and spacing as required for Contraction Joints as noted above. For a butt end construction joint, an adequate number of ½ inch diameter (#4 bar) deformed steel tie bars, 30 inches in length and spaced no greater than 36 inches apart, are also required to tie the exterior curb and gutter to the outer concrete pavement edge to keep the outside slab from separating from the curb and gutter.

Pavement Materials

Asphalt Concrete Mix

For heavy duty sections, AC should consist of ¾" dense HMA in conformance with the specifications provided in division 5-04 of the WSS for Asphalt Concrete mix design and construction requirements for a Low RAP/No RAS Classification. The asphalt cement binder should be PG 64H-28 Performance Grade Asphalt Cement according to WSS 9-02.1(4) - Performance Graded Asphalt Binder. For light duty section, 1/2" Dense HMA with PG 64S-28 asphalt cement is considered suitable. The AC should be placed with a minimum lift thickness of 1.5 inches and be compacted to at least 91 percent of Rice Density of the mix, as determined in accordance with ASTM D 2041. (S represent "Standard" traffic loading and H represent "Heavy" traffic loading).

We recommend the HMA for heavy duty AC section shall be designed at 100 gyration level simulating a projected design ESAL of 3 million ESAL over a 20-year period. HMA job-mix formula (JMF) shall be developed in accordance with WSDOT Standard Operating Procedure (SOP) 732 "Volumetric Design for Hot Mix Asphalt (HMA)". The HMA JMF shall be verified in accordance to Section 10 of SOP 732. The PG 64H-28 asphalt binder shall meet Multiple Stress Creep Recovery (MSCR) requirement.

For the 5-inch thick surfacing layer, GNN recommends that the contractor place the HMA in 2 lifts. This is accomplished with a 3" lower lift and a 2" surface lift. Lift thicknesses of less than 2" are not recommended as difficulties often arise with mix stability and compaction in thin asphalt layers.

Base aggregate material shall meet WSS 9-03.9(3), Crushed Surfacing Base Course. Refer to division 9-03 of the WSS for aggregate base course use and construction. Base aggregate shall be placed in 6 inch thick lifts and each lift shall be compacted to at least 95% of the maximum dry density as determined by ASTM D1557.

Portland Cement Concrete

The PCC mix shall have a minimum compressive strength of 4,000 psi and nominal maximum aggregate size of 1.5 inches.

Pavement Subgrade Preparation

Following stripping, prior to fill placement on cut ground surfaces or crushed base aggregate course, remove loose soil and debris. Scarify the native cut soil subgrade a minimum 12 inches deep, moisture-condition the exposed subgrade soils to near optimum moisture, then compact to a minimum in-place dry density of 95 percent of the maximum dry density as determined by ASTM D 1557. The prepared subgrade surface should then be proof-rolled with a fully loaded dump truck (minimum 30-ton tandem axle dump truck) or similar heavy rubber-tire construction equipment to inspect subgrade stability and performance and identify remaining soft or week spots, or pumping areas. A properly prepared and compacted subgrade surface shall not deflect excessively under the load of a loaded truck. A rut depth or deflection of ½" or greater is considered unsatisfactory. A representative of the GER should observe the proof-rolling. Soft or loose zones identified during the field evaluation should be compacted to a dense and non-unyielding surface or be over-excavated and replaced with imported granular structural fill.

All fills used to raise low areas must be compacted suitable fill material placed under engineering control conditions. Structural fill material should be placed in maximum 8-inch thick un-compacted lifts and each lift shall be compacted to a minimum 95 percent of the maximum dry density as determined by ASTM D 1557. The finished surface shall be smooth, uniform and free of localized loose and soft spots. All subgrade deficiency corrections and drainage provisions shall be made prior to placing the aggregate base course. All underground utilities shall be protected prior to grading.

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed pavement sections, an allowance for additional traffic will need to be made in the design pavement section. Additionally, the base rock layer should not be used for construction traffic, as it is not sufficient to protect the subgrade from damage.

Depending on the time of year following wet winter weather, if moist soil conditions make it difficult to properly moisture condition and compact the roadway subgrade, the use of cement amendment may be considered as alternative to moisture conditioning and compaction. A cement stabilized subgrade will allow construction of the pavement sections without disturbing the wet subgrade. If this method is considered, contact GNN's Geotechnical Engineer for additional recommendations and alternative pavement sections.

Pavement Drainage

Pavement design recommendations assume proper drainage is incorporated in the design to avoid prolonged periods of high water content in the base and subgrade. Excess water under the pavement weakens subgrade and unbound base layer, increases the potential for frost heave and can result in pumping with the associated faulting and loss of support.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

The pavement surfacing and adjacent sidewalks should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to these grade-supported slabs, since this could saturate the subgrade and contribute to premature pavement or slab deterioration.

12.1.9 Nonstructural Concrete Flatwork

Nonstructural concrete flatwork such as sidewalks, entryways etc. has a potential for cracking over time due to influx of soil-moisture. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum requirements outlined in Table 22 below. These requirements will reduce the potential for irregular cracking and promote cracking along construction joints, but may not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress. To reduce the potential for flatwork to separate from the building foundations, we recommend the owner may elect to install dowels to tie these two elements together. Note that these sections are not to be used for areas that will receive regular vehicular traffic. Non-structural PCC for flatwork (sidewalks) can consist of use of WSS 6-02.3(2)B - Commercial Concrete.

Table 24: Nonstructural Concrete Flatwork Sections

	Sidewalks	Entryways
PCC Thickness (in)	4 (nominal)	4 (full)
Presoaking	Wet down prior to placing	Wet down prior to placing
Reinforcement	--	No. 4 at 24 inches o/c
Thickened Edge (in.)	--	--
Crack Control Joints	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a min of 1/3 the concrete thickness
Max. Joint Spacing	5 feet	6 feet
Aggregate Base Thickness (inches)	4	4
Subgrade Preparation	Scarify subgrade to a minimum depth of 12 inches, moisture-condition, compact to minimum 95% of the maximum dry density per ASTM D1557. Soft spots detected during compaction shall be over-excavated an additional 12 inches, backfilled with granular structural fill.	

12.1.10 Aggregate-Surfaced Pavement Section

The design thickness of aggregate-surfaced pavements is determined from estimated traffic loading and a California Bearing Ratio (CBR) value of roadbed (subgrade) soils. The CBR value was determined in accordance with The Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures which provides empirical correlations between the soil index properties (D_{60} and percent passing the #200 sieve screen) and the CBR of subgrade materials. A CBR value of 7% was used in the design for onsite silty sand (SM) subgrade soils based on the results of laboratory testing. Utilizing Tensar® International's SpectraPave4-PRO roadway improvement system software using the Giroud-Han (G-H) iterative equation, thicknesses of aggregate sections, with and without geogrid reinforcement, were calculated. The determination of the design minimum aggregate-surfaced thickness for the gravel surfaced drive aisles is based on the following design parameters:

Table 25: Gravel Road Analysis Parameters

Parameter	Parameter Description	Value
h	required thickness (inches)	
CF	calibration factor for the geosynthetic used in design	
P	axle load	33 kips
r	tire pressure	80 psi
N	total number of axle passes	500,000
RE	limited modulus ratio of compacted aggregate to subgrade soil	3
CBRsg	Subgrade CBR	7% (considers freeze - thaw effects)
CBRbc	Aggregate Base Course CBR	30%
s	Allowable rut depth	1.5 inches
fs	Reference rut depth	1.5 inches
Nc	Bearing capacity factor	3.14 for unreinforced; 5.14 for geogrid reinforced
fc	Factor relating CBR of subgrade to equivalent cu value	30
***P/πr*2**	tire contact pressure (kPa), equivalent to tire pressure (p)	

We recommend the gravel surfacing should be re-graded regularly and no less than each year. Based on the results of our analysis, the recommended minimum aggregate-surfaced sections for drive aisles are as follows:

Table 26: Aggregate-Surface Section for Drive Aisles

Unreinforced Gravel Section*	Gravel Section over Geogrid *
Place **5-inch** of ¾” minus crushed aggregate over **10-inch** of 1¼” minus crushed aggregate	Place **4-inch** of ¾” minus crushed aggregate over **8 inches** of 1¼” minus crushed aggregate
Scarify, then moisture condition and compact subgrade to minimum 95% of modified proctor relative density	**Place geogrid at the bottom of the aggregate base and directly over the compacted sandy subgrade soils
	Scarify, then moisture condition and compact subgrade to minimum 95% of modified proctor relative density

*Compacted thickness
** Aggregate base reinforced with 1 layer of Tensar TX160 geogrid or an equivalent located at the bottom of the aggregate base. No substitution of geogrid allowed without the approval of the GER. Geogrid shall be placed in conformance with the manufacturer’s specification with a minimum 12 inches of overlap and stretched tight over the subgrade.

For parking areas the gavel section shall consist of 3-inch of ¾” minus crushed aggregate over 5-inch of 1¼” minus crushed aggregate.

12.1.11 Subgrade Stabilization using Portland Cement

As an alternative to the use of imported crushed rock for structural fill, an experienced contractor may be able to amend the on-site sandy soils with Portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Specific recommendations for soil amending, based upon exposed site conditions, can be provided if necessary. Cement amendment soil stabilization shall not be used under any structural/building foundation areas.

Portland cement-amended soils are hard and have low permeability. These soils do not drain well, nor are they suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Cement amendment should not be used if runoff during construction cannot be directed away from work areas.

Treatment depths for subgrades, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. We recommended a 7-day unconfined compressive strength of at least 200 pounds per square inch (psi). To protect the cement-treated surfaces from abrasion or damage, the finished surface should be covered with 6 inches of imported crushed rock. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas.

For preliminary planning purposes, we estimate that 5 to 6 percent cement (by dry weight) will be required for amending of general structural fill. However, where amended soils will be used in the upper 12 to 18 inches of roadway subgrades, haul roads, or staging areas, we estimate the cement will need to be increased to 6 to 7 percent. Actual percentages of cement will need to be based on in-situ soil moisture contents and other field conditions at the time of amendment. The contractor should assume an in-situ soil unit weight of 110 to 115 pounds per cubic foot (pcf) when estimating cement volumes.

Cement type shall be Type I or Type I/II. The water should meet the requirements of ASTM C1602. An optimum moisture content and maximum dry density of the soil-cement mixture shall be determined according to AASHTO T 134. Mix specimens for the design cement content should be casted and tested in accordance with ASTM D1633, Standard Test Methods for Compressive Strength of Molded Soil Cement Cylinders, Method A.

The actual thickness of the amended material and imported crushed rock will depend on the anticipated traffic, as well as the contractor's means and methods, and accordingly, should be the contractor's responsibility.

It is not possible to amend soils during heavy or continuous rainfall and during winter freeze periods. Work should be completed during suitable weather conditions. To prevent strength loss during curing, cement-amended soil should be allowed to cure for a minimum of 4 days prior to access by construction traffic.

12.1.12 Surface Drainage Design Recommendations

With respect to surface water drainage, we recommend that the ground surface be sloped to drain away from future structures. Final exterior site grades shall promote free and positive drainage from the building areas. Water shall not be allowed to pond or to collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 5% for a minimum distance of 10 feet from the building perimeter be provided, except in paved locations. In paved areas, a minimum gradient of 1% should be provided unless provisions are included for collection/disposal of surface water adjacent to the structure. Catch basins, drainage swales, or other drainage facilities should be aptly located. All surface water such as that coming from roof downspouts and catch basins be collected in tight drain lines and carried to a suitable discharge point, such as a storm drain system. Surface water and downspout water should not discharge into a perforated or slotted subdrain, nor should such water discharge onto the ground surface adjacent to the building. Cleanouts should be provided at convenient locations along all drain lines.

12.1.13 Utility Trench - External Loads and Pipe Support

External loads caused by the trench backfill, surface restoration and live loads are supported by the combination of pipe strength (pipe stiffness) and the strength of the pipe zone material.

For rigid pipe design, a backfill unit weight of 120 pcf should be used for native onsite sandy material. A trench width of pipe diameter plus 36 inches minimum is recommended.

In a flexible "pipe-soil" system, the pipe deflection is the same as the soil deflection under the load of the trench backfill material and surface loads. Compressibility of the soil envelope (pipe base plus pipe zone) is measured by the soil modulus, E', which is the ratio of soil pressure to soil deflection at a given soil compaction density. On the basis of correlations with the SPT blow counts in sandy soils, GNN recommends that E' value for soils in Table 5 be used for pipeline design.

Table 27: Recommended Values of (E') for Pipeline Design

Material	E' (psi)	Condition
Native soil (SP-SM)	3,000	In situ (trench wall)
Native soil (SP-SM)	1,000	Compacted pipe zone
Imported, clean, well-graded sand or gravel	2,000	Compacted pipe zone
Imported, clean, compacted crushed rock	6,000	Compacted pipe zone

Thrust Restraint

Pressure pipelines are subject to hydraulic forces whenever they abruptly change direction, change diameter, or reach a plug or a valve. Horizontal thrust may be resisted by concrete thrust blocks or by mobilizing frictional resistance between pipe and the pipe zone material using restrained joint pipe. A nominal horizontal bearing resistance of 1,000 psf can be assumed for preliminary sizing of thrust blocks, if they are required.

12.1.14 Ground Rod Installation (HV Substation)

Due to the presence of dense to very dense gravels with cobbles and boulders extending several feet below existing grade, installation of ¾" ground rods will require pre-drilling in order to reach the full design depth.

12.2 EARTHWORK AND GRADING RECOMMENDATIONS

The applicability of our recommendations is contingent upon good construction practices. Poor construction techniques may alter conditions from those on which our recommendations are based and, therefore, result in reduced foundation capacity and additional settlement, as appropriate.

12.2.1 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture conditioning and processing of fills, compacting fills and protection of prepared/graded areas. The Contractor shall review and accept the grading and drainage plans, the geotechnical report, and specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the design team and the GER a work plan that indicates the sequence of earthwork grading for review and approval. The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable building codes, specifications, grading plans, and the recommendations of this geotechnical report. If, in the opinion of the GER, unsatisfactory conditions, such as unsuitable or unsatisfactory soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in the specifications, the Contractor shall review and rectify the deficiencies immediately.

12.2.2 Site Preparation

Clearing and Grubbing

At the start of grading, existing vegetation, roots, non-engineered/artificial fill, any encountered construction debris, trash, and any abandoned underground utilities shall be **fully removed** from the proposed building, structural, and pavement areas. Surface vegetation, topsoil, and any other deleterious materials must be stripped from within and extend a minimum 5 feet beyond proposed building footprints. Based on our explorations, the upper topsoil layer was typically fairly thin on the order of 2 to 3 inches. The upper soils did include root zones with the overlying brush and grass. We estimate approximately 8 to 12 inches of material must be stripped from development footprints; deeper and possibly shallower stripping depths may be necessary as identified by GNN's representative with real-time onsite observations of sufficient removals during grading. The strippings are not suitable for use in engineered fill. Strippings may be stockpiled on-site separately for use in landscaped areas or disposed off-site. Nesting of the organic materials shall not be allowed. We recommend topsoil analysis of the strippings for physical properties and nutrient levels to determine suitability for use in landscape areas. Areas disturbed during clearing shall be properly backfilled and compacted as described in this report.

Site grading shall incorporate the requirements of International Building Code (IBC) 2018 Appendix J. Do not commence site clearing and grading operations until temporary erosion and sedimentation control measures are in place in compliance with Washington State Department of Ecology, Construction Stormwater General Permit (CSWGP), Stormwater Pollution Prevention Plan (SWPPP). The contractor should implement necessary Best Management Practices (BMP) measures and protect the subgrade from exposure to flowing water. A representative of the GER should observe site clearing, grading, and the bottoms of excavations before placing fills. Prior to backfilling with suitable fill material, over-excavation, moisture conditioning and recompaction of loose soils as engineered fill is required to construct stable subgrades for the support of building pad/foundations and infrastructure. Local variations in soil conditions across the site may warrant increasing the depth of over-excavation to a competent bearing stratum and recompaction.

In addition to removals and over-excavations, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by a representative of the GER during grading.

Based on our site reconnaissance and review of historic aerial photos, surficial ground conditions across portions of the project site appear to have been altered somewhat from historic site activities. Although not observed within the selected points of exploration, any undocumented fill materials encountered during grading shall be chased, removed and replaced with suitable onsite sourced soils or imported fill soils placed as engineered structural fill.

Haul Roads and Staging Areas

The use of haul roads and staging areas are recommended to reduce disturbance to the subgrade soils. The amount of staging and haul road areas as well as the required thickness of granular material will vary with the contractor's sequencing, type of construction equipment and the amount and type of construction traffic. A 12- to 18-inch-thick mat of imported granular material is sufficient for light staging areas. The granular mat for haul roads and areas with repeated heavy-construction traffic typically needs to be increased to between 18- to 24-inches. The actual thickness of haul roads and staging areas should be based on the contractor's means and methods and should be the contractor's responsibility. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller to a dense and unyielding surface. Additionally, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material should be 4- to 6-inch minus pit run rock with less than 5% passing a US Standard #200 sieve or quarry spalls meeting WSDOT SS 9-13.1(5) with no more than 10% passing the ¾” minus sieve size.

12.2.3 Grading and Subgrade Preparation

Finished grades were not provided at the time of this report. We anticipate mass grading will include cutting and filling. The upper silty fine sand (SM) and fine sand with silt (SP-SM) soil will requires over-excavation, moisture conditioning and re-compaction as engineered fill. Dune sand areas are not suitable for direct support of building pad, foundation and infrastructure. As part of mass grading (cutting and filling) the dune sandy soils shall be overexcavated and removed or can be blended with onsite sourced silty fine sand (SM), fine sand with silt (SP-SM) and gravelly soils. Large boulder size stones, 1 to 3 feet in nominal size, will be encountered in the upper 10 to 15 feet of the onsite material. These large boulders are embedded in the matrix of poorly- to gap-graded gravels with sand, silt and cobbles.

Do not place backfill or fill soil material on surfaces that are saturated, muddy, frozen, or contain frost, snow, or ice. To prevent potential pumping and unstable ground conditions and improve compaction efforts, we recommend performing site grading during dryer periods of the year. Site grading and excavations should be avoided, if possible, during winter and wet weather periods of the year. If the GER determines that unsatisfactory soil is present, or that subgrade does not meet requirements specified herein, continue excavation and replace with suitable compacted granular backfill or fill material as directed.

Following stripping and prior to fill placement on cut ground surfaces, remove loose soils and debris. Scarify the cut and/or stripped soil subgrade a minimum 12 inches, however, the depth of scarification and recompaction may be increased in real-time based on the exposed conditions at the discretion of the GER. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction. Moisture-condition the exposed subgrade soils to within 2 to 3 percent of optimum moisture, then compact to a minimum in-place dry density of 95 percent of the modified proctor maximum dry density as determined by ASTM D 1557. The envelope for scarification and recompaction should extend laterally a minimum distance of 5 feet beyond the edges of the proposed construction. The subgrade should be proof-compacted with a heavy double-drum steel roller and then proof-rolled with fully-loaded tandem-axle dump truck (minimum 30,000 tons) or similar heavy rubber-tired construction equipment to identify any remaining soft, loose, or unsuitable areas. The proofrolling should be performed under the observation of a representative of the GER to verify the prepared subgrade is dense and non-yielding. Cobble- and boulder-sized stones protruding at the surface or present within the upper 2 feet of the planned subgrade elevation should be removed and voids backfilled with suitable onsite sourced fill soils placed as engineered structural fill. Areas excessively deflecting or pumping under the proofroll should be delineated and repaired as directed by the GER. Specific to tank pads and other heavily loaded structures, after a proofroll, we recommend that the geotechnical inspector probe the subgrade surface with a ½ inch diameter steel T-probe. If the T-probe penetrates the placed fill material, it indicates unsatisfactory compaction. In addition, elastic movement in excess of ¾" inch with substantial cracking or substantial lateral movement during proof-rolling should also be considered a sign of unsatisfactory compaction.

Excessively wet or dry material should either be removed or moisture conditioned and recompacted. We recommend the use of kneading-type compactors such as sheepsfoot roller for compaction of silty fine sand/fine sand with silt subgrade.

Uniformly grade areas to a relatively smooth and level surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated on design plans. Provide a smooth transition between adjacent existing grades and new grades. Use smooth bladed equipment to create undisturbed subgrades. Place backfill evenly adjacent to structures, piping, or conduit to required elevations. Wedging action shall be prevented of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

On-site sourced fill materials shall be watered, blended, and/or mixed, as necessary to attain a relatively uniform moisture content. Subgrade and each subsequent fill or backfill soil layer shall be uniformly moisten before compaction to near-optimum moisture content, unless indicated otherwise. For onsite sandy soils, assume ±2 percent limit unless compaction efforts prove a higher tolerance is acceptable to meet compaction requirements. Remove and replace, or scarify and air dry, otherwise suitable onsite soil material that exceeds near-optimum moisture content and is too wet to compact to specified dry density.

Near surface fine-grained silty sand/sand with silt soils may deteriorate under construction traffic if exposed to inclement weather. Accordingly, we recommend that construction equipment, to the degree possible, be prohibited from traversing prepared subgrade areas during and subsequent to wet weather period. Floor slab and pavement subgrade areas that are prepared before inclement weather should be re-inspected to identify areas requiring repair. Any such areas should be re-compacted or overexcavated and backfilled with granular structural fill in accordance with the recommendations of this report.

It is our opinion conventional earthmoving equipment should be capable of making necessary excavations to the depths anticipated for the proposed development. Excavations extending into the underlying gravels will encounter cobbles and boulders that are embedded in the gravel soil matrix, large size stones may present some difficulties during excavation. Large boulders shall be selectively removed and may need to be broken up to more manageable sizes. For excavations into clean sandy and gravelly soils, caving or sloughing conditions should be anticipated by the earthwork contractor. The use of temporary shoring measures or flattened slopes may be required in such unstable excavations.

Soil conditions shall be evaluated by in-place density testing, visual evaluation, probing, and proof-rolling of the fill soils and re-compacted onsite native soils as it is prepared to check for compliance with recommendations of this report. A moisture-density curve shall be established in accordance with the ASTM D1557 method for onsite soils and imported fill materials used as structural fill.

A representative of the GER should observe all construction cuts to inspect for adverse geologic conditions and make appropriate recommendations in real time based on the exposed conditions. Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the GER. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the GER. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill. Placement of backfill soils shall ensure a good bond between the onsite soils (surrounding sloping grade) and new backfill to eliminate a plane of weakness at the interface.

Each test pit was loosely backfilled during our site investigation. During site development, the earthwork contractor is required to re-excavate the test pits and backfill the excavations with suitable onsite sourced fill material and compact as appropriate for the location within the building/structure pads.

Compaction of Fill Slopes

Compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the GER. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 95 percent of maximum dry density per ASTM D1557.

Subgrade Inspection and Compaction Verification

Allow a representative of the GER to observe earth moving processes, to inspect and test subgrades and each fill or backfill layer, and to observe completed work. Proceed with subsequent earthmoving only after inspections confirm previously completed work complies with requirements. Inspections and tests include:

1. Determine prior to placement of fill that subgrade has been prepared in compliance with requirements of the Geotechnical Report and project specifications.
2. Determine that fill material classification and maximum lift thickness comply with requirements of the Geotechnical Report.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements of the Geotechnical Report and project specifications.

Soil Moisture Conditioning

The onsite soils are dry and will require continuous water source for dust control and general site constructability. Appropriate moisture conditioning of scarified sandy subgrade and onsite sourced suitable fill soils will be required to achieve the required degree of compaction. Place fill at a moisture content within approximately 2 to 3 percent of the soil's laboratory optimum moisture content unless compaction efforts prove a wider tolerance from optimum moisture content is acceptable to meet compaction requirements. Uniformly moisten subgrade and fill soils before compaction within the specified range. A laboratory proctor test to determine optimum moisture content per ASTM D1557 is required prior to field compaction testing. Remove and replace, or scarify and air dry, otherwise satisfactory soil materials that exceed near-optimum moisture content and is too wet to compact to specified dry density.

Shrinkage Factors

The shrinkage factor for earthwork is expected to range from approximately 15% to 30% for the upper excavated or scarified onsite sandy/gravelly soils. This estimate is based on compactive effort to achieve a minimum relative compaction of 95% and may vary with contractor methods. It should be stressed that these values are only estimates and that an actual shrinkage factor would be extremely difficult to predetermine. These values exclude losses due to removal of surficial vegetation or debris. The effective shrinkage of onsite soils will depend primarily on the type of compaction equipment, method of compaction and moisture conditioning used onsite by the earthwork contractor and accuracy of the topographic survey.

12.2.4 Suitability of the Onsite Soils as Engineered Fill

The onsite soil, screened and processed, as necessary, to be free of organics, deleterious materials, stones greater than 4-inch in maximum dimension, and any trash & debris, is generally suitable for use as engineered structural fill, general fill and utility trench backfill. The onsite gravel soils will require screening and processing to remove stones/rocks greater than 4 inches. Engineered fill should be placed in maximum 8-inch-thick loose lifts and each lift compacted to at least 95% of the Modified Proctor maximum dry density, as determined by ASTM D1557 near optimum moisture content.

Large cobbles and boulders can be stockpiled separately. Depending on the quantity of large rocks from excavations it might be cost effective to crush the rocks onsite to make suitable aggregate fill material. If owner elects to explore this options we recommend additional test pit exploration and to contact a local crushing contractor to set up a crusher onsite.

12.2.5 Oversize Material

Oversize material defined as rocks, or other irreducible material with a maximum dimension greater than 4 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the GER. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted and embedded in densified fill material. Oversize material shall not be placed within 6 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

12.2.6 Imported Fill Soils

If required, imported fill soils should be sand and gravel mixture with a maximum rock size of 4 inches, 50-65% passing the No. 4 sieve, and 5 to 15% passing the No. 200 sieve. Alternatively, soil from locally available quarry material consisting of clean, non-plastic, freely-draining sand and gravel, which is free of organic matter or other deleterious materials may be considered acceptable. Such materials should contain particles no larger than 4 inches in maximum dimension, with less than 7 percent fines (based on the ¾-inch fraction) as described in Section 9-03.14(1) of the 2024 Washington State Department of Transportation Standard Specification (WSS). The GER should evaluate and approve the import fill soils before hauling to the site. The imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 95% of the maximum dry density as determined by ASTM D1557 near optimum moisture content.

12.2.7 Imported Crushed Rock Structural Fill

Imported structural fill shall consist of well-graded, crushed aggregate material meeting the grading requirements of WSS 9-03.9(3) (1¼ inch minus Base Course Material) presented here:

Table 28: WSDOT Standard Spec. 9-03.9(3)

Sieve Size	Percent Passing (by Weight)
1¼ Inch Square	99 - 100
1 Inch Square	80 - 100
5/8 Inch Square	50 – 80
U.S. No. 4	25 - 45
U.S. No. 40	3 – 18
U.S. No. 200	Less than 7.5

A fifty (50) pound sample of each imported fill material shall be collected by GNN personnel prior to placement to ensure proper gradation and establish a moisture-density relationship (proctor curve).

12.2.8 Compaction Requirements for Structural/ Engineered Fill

All fill or backfill shall be approved by a representative of the GER, placed in uniform lifts, and compacted to a minimum 95% of the maximum dry density as determined by ASTM D1557. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout. The compaction effort shall be verified in the field using a nuclear density gauge in accordance with ASTM D6938 with the exception of materials with oversize fraction.

The thickness of the loose, non-compacted, lift of structural fill shall not exceed 8 inches for heavy-duty self-propelled compaction equipment and 4 inches for hand guided equipment (i.e. jumping jack or plate compactor). The GER may accept thicker layers if compaction testing indicates the grading procedures and compaction equipment utilized can adequately compact the thicker layers.

During structural fill placement and compaction, a sufficient number of in-place density tests should be completed by a representative of GER to verify that the specified degree of compaction is being achieved. Location and frequency of tests shall be at the GER's discretion based on field conditions encountered. The following table presents fill compaction criteria:

Table 29: Fill Compaction Criteria*

Material / Area	% Compaction
Onsite Sourced Fill Material	95
Imported Granular Fill Materials	95
Aggregate Base	95
Pipe Bedding and Pipe Zone Backfill	90
Utility Trench Backfill	95
Nonstructural Trench Backfill	92
Non-structural/ landscaping Areas	90

*Percent of Maximum Dry Density Determined by ASTM D1557, Laboratory Compaction Characteristics of Soil Using Modified Effort.

12.2.9 Proof-Compaction Alternative

Material containing oversize fraction (i.e. more than 30% material retained on the 3/4-inch sieve) is non-proctor testable per ASTM D1557 method and density testing using a nuclear density gauge is not applicable to verify field compaction. If excessive oversize material is present within the structural fill material, compact oversized material using method specification. Visual observation and probing using a ½ inch diameter steel T-probe during proof-rolling is an acceptable alterative to verify compaction of the subgrade soils. Full-time geotechnical inspections shall be performed to ensure the placement is uniform, prevent nesting and excessive void spaces and that the specified compaction procedures are followed.

1. Proof-roll such soils to a dense and unyielding surface using a loaded, 30-ton, tandem-axle dump truck. Using heavy kneading and/or vibratory-type equipment, compact subgrade and each lift with steady, uniform passes until a non-yielding state is achieved. Sufficient number of compaction coverages or roller passes shall be performed. Acceptance criteria for proofroll shall include no rutting greater than ½-inch and no “pumping” of the soil behind the wheels.

2. For narrow trenches, use a single- or double-drum tandem vibratory roller with a minimum operating weight of 4 to 4-1/2 tons or a 18,000 lbs. excavator and hoe-pack with minimum 5,500 lbs. of impulse force at 2,000 cycles per minute. Compact each lift by applying steady and uniform pressure until achieving a dense and unyielding condition.

3. Adjust lift thickness and moisture content, as recommended by the GER, until the place fill layer exhibits firm, unyielding conditions.

4. Method compaction shall be observed on a full-time basis by a representative of the GER and shall achieve a dense, unyielding, and interlocking fill surface.

5. Over-excavate and recompact areas displaying pumping during proof-compaction, as direct by the GER.

12.2.10 Temporary Excavations/Cut Slopes

It shall be the responsibility of the contractor to maintain safe temporary slope configurations since the contractor is at the job site, able to observe the nature and conditions of the slopes, and able to monitor the encountered subsurface conditions.

All temporary soil cuts for site excavations that are greater than 4 feet deep should be adequately sloped back or supported to prevent sloughing and collapse in accordance with Washington Department of Occupational Safety and Health (DOSH) guidelines. We recommend to limit the maximum duration of the open excavation to the shortest time period possible. Prolonged exposure of temporary excavations may result in some localized instability. The contractor and subcontractors shall be aware of, and familiar with, applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with applicable local, and/or state regulations.

It is our opinion that the soil encountered at the site is classified as Type C soils. For excavation planning purposes, we recommend that temporary, unsupported, open cut slopes shall be no steeper than 1.5 feet horizontal to 1.0 feet vertical (1.5H:1V) in Type C soils. No heavy equipment or material stockpiling should be allowed within 10 feet near the top of temporary cut slopes or to a 1.5:1 projection from the bottom of the excavation unless the cut slopes are adequately braced. Surcharged slopes should be evaluated by the GER based on the contractor’s proposed construction site layout. Final (permanent) fill slopes should be graded to an angle of 2H:1V or flatter. We recommend that permanent slopes be hydroseeded and/or planted with vegetation after construction. Where unstable soils are encountered, flatter slopes may be required. We recommend protecting slopes with waterproof covering during periods of wet weather to reduce sloughing and erosion.

The onsite clean sandy and gravelly soils are prone to caving and sloughing in open excavations. Excavation stability may be achieved by sloping excavation banks or widening shallow excavations in the anticipation of caving. If temporary sloping is not feasible because of site spatial or other constraints, the excavation should be supported by a shoring system in accordance with DOSH guidelines.

12.2.11 Utility Excavation, Pipe Bedding and Trench Backfill

Utility trenching should be accomplished in accordance with applicable WSDOT, American Public Works Association (APWA) and American Water Works Association (AWWA) Standard

Specifications. Refer to Benton County Standard Plans for certain trenching details that may apply to this project.

All trenches should be wide enough to allow for compaction around the haunches of round bottomed utility structures. The earthwork contractor should expect encountering cobbles and boulder size stones within the trench sidewalls that may affect stability. Nested cobble- and boulder-size stones that are loosened during trenching could results in sidewall sloughing or caving. Widening or excavations and or temporary shoring may be needed for excavation stability.

To provide appropriate support and bedding for the pipe, utilities shall be founded on suitable bedding material consisting of clean sand and/or sand & gravel mixture. Pipe bedding should provide a firm uniform cradle for support of the pipes. A minimum 4-inch thickness of bedding material beneath the pipe should be provided. Prior to installation of the pipe, the pipe bedding should be shaped to fit the lower part of the pipe exterior with reasonable closeness to provide uniform support along the pipe. To protect the pipe, bedding material should extend at least 12 inches above the top of the pipes to protect utilities from damage by compacting equipment and rock fragments greater than 1 inch in maximum dimension should be excluded from backfill placed within the first 12 inches above utility lines. Light, hand-operated compaction equipment in conjunction with thinner fill lift thicknesses may be utilized on backfill placed directly above utilities. Sufficient backfill should be placed over the utility before compacting with heavy compactors to prevent damage.

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well graded granular material with a maximum particle size of 1 inch and should meet the specifications provided in WSS 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding. The pipe zone backfill should be compacted to at least 90% of the maximum dry density, as determined by ASTM D 1557 as required by the local building department.

Within roadway alignments (pavements) and beneath building pads (slab subgrades), the remainder of the trench backfill material up to the subgrade elevation can consist of the above 1-inch material or granular material with a maximum particle size of 2.5 inches, less than 10 percent by dry weight passing the U.S. Standard No. 200 Sieve, and meeting the specifications provided in WSS 9-03.19 – Bank Run Gravel for Trench Backfill. The trench backfill should be compacted to at least 95% of the maximum dry density as determined by ASTM D 1557.

Onsite soils can be considered suitable for trench backfill above the pipe zone provided they are free of organic matter and oversize material, and can be adequately compacted. Compaction of backfill material should be performed within ±2 percent of optimum moisture. Backfill operations shall be observed and tested to monitor compliance with these recommendations.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, typically sand-cement slurry may be substituted for compacted backfill. The slurry should contain about one and one-half (1.5) sack of cement per cubic yard. When set, such a mix typically has the consistency of compacted soil. Sand cement slurry placed near the surface within landscape areas should be evaluated for potential impacts on planned improvements.

12.2.12 Subgrade Protection and Protecting Graded Areas

The degree to which construction grading problems develop is expected to be dependent, in part, on the time of year that construction proceeds and the precautions which are taken by the Contractor to protect the subgrades.

The onsite fine-grained surficial soils are susceptible to wind and water erosion. In anticipation of wet weather, the surficial soils should be mechanically stabilized with a coarse aggregate cover or other suitable means to minimize the potential of erosion into the foundation excavations. The site shall be graded to prevent water from ponding within construction areas and/or flowing into excavations. Accumulated water must be removed immediately along with any unstable soil.

It is the responsibility of the Contractor to project newly graded areas from traffic, water accumulation, softening, freezing, and erosion. The following applies for protecting graded areas:

1. Protect subgrades from damage and degradation from construction activities, weather, run-off or run-on, and other environmental or construction conditions.
2. Protect subgrades from disturbance due to construction traffic. Rubber-tired vehicles should not access prepared subgrades unless the subgrade is sufficiently dense to allow construction traffic without disturbance.

3. Maintain all subgrades for foundation, slab, pavement, and hardscape free of loose soil and debris.
4. Protect subgrades from softening and damage by rain or water accumulation.
5. Repair subgrades that are disturbed, soft, or otherwise do not meet the stability and bearing requirements stated in this report due to the contractor's means and methods.
6. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. If a subgrade freezes, it must be re-compacted and retested prior to acceptance.
7. Scarify or remove and replace soil material to depth as directed by GER; reshape and recompact at optimum moisture content to the required density.

12.2.13 Wet Weather and Wet Soil Conditions

Trafficability on near-surface fine grained soils that are excessively moist or wet may be difficult during and after extended wet periods, track-mounted excavating equipment may be required during wet weather. Earthwork activities performed immediately after a prolong rainfall and to allow construction traffic could damage the prepared subgrades. If earthwork takes place in wet weather or wet conditions, the following recommendations should be followed:

1. All subgrade areas prepared before the inclement weather conditions shall be inspected. Soils which have been disturbed during site-preparation, or soft or loose zones identified during probing or proof-rolling, should be removed, and replaced with compacted granular structural fill.
2. Maintain the subgrade in a compacted condition and protect subgrades from construction traffic disturbance after they have been prepared and meet compaction requirements. Consequently, do not operate construction equipment or vehicles on prepared subgrade areas during wet weather conditions.
3. Carefully stage equipment and/or stockpiles, route construction equipment away from subgrades, and implement site drainage procedures to help reduce saturating subgrades during wet weather conditions.

4. Work areas and stockpiles should be covered with plastic. Straw bales, straw wattles, geotextile silt fences, and/or other measures should be used as appropriate to control soil erosion.
5. Equipment with large tracks, lugs, or having toothed buckets has a significant potential to disturb the site soils prior to or following compaction. Rubber-tired vehicles should not access prepared subgrades unless the subgrade is sufficiently dense to allow construction traffic without disturbance.
6. For soils exhibiting pumping, rutting, weaving, or otherwise exhibiting unstable performance, moisture-condition (typically dry) and re-compact the soil to fill requirements, or remove and replace the unstable soils with granular structural fill.
7. Prior to a rain event, stabilize surficial fine grained soils to minimize potential for erosion into adjacent excavations.
8. Excavation and fill placement should be observed on a full-time basis by a representative of GER to determine that unsuitable materials are removed and that suitable compaction and site drainage is achieved.

13.0 CONTINUING GEOTECHNICAL SERVICES

GNN recommends that the Client should maintain an adequate program of geotechnical consultation, construction monitoring, and soils testing during the final design and construction phases to monitor compliance with GNN's geotechnical recommendations. ***Maintaining GNN as the geotechnical consultant from beginning to end of the project will provide continuity of services.*** If GN Northern, Inc. is not retained by the owner/developer and/or the contractor to provide the recommended geotechnical inspections/observations and testing services, the geotechnical engineering firm or testing/inspection firm providing tests and observations shall assume the role and responsibilities of Geotechnical Engineer-of-Record.

GNN can provide construction monitoring and testing as additional services. The costs of these services are not included in our present fee arrangement, but can be obtained from our office. The recommended construction monitoring and testing includes, but is not necessarily limited to, the following:

- Consultation during the design stages of the project.
- Review of the grading and drainage plans to monitor compliance and proper implementation of the recommendations in GNN's Report.
- Observation and quality control testing during site preparation, grading, and placement of engineered fill as required by the local building ordinances.
- Geotechnical engineering consultation as needed during construction

14.0 LIMITATIONS OF THE GEOTECHNICAL EVALUATION REPORT

This GEOTECHNICAL SIET INVESTIGATION REPORT ("Report") was prepared for the exclusive use of **TECNICAS REUNIDAS**. GN Northern, Inc.'s (GNN) findings, conclusions and recommendations in this Report are based on selected points of field exploration, laboratory testing, and GNN's understanding of the proposed project at the time the Report is prepared. Furthermore, GNN's findings and recommendations are based on the assumption that soil, rock and/or groundwater conditions do not vary significantly from those found at specific exploratory locations. Variations in soil, bedrock and/or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until during or after construction. Variations in soil, bedrock and groundwater may require additional studies, consultation, and revisions to GNN's recommendations in the Report.

This Report's findings are valid as of the issued date of this Report. However, changes in conditions of the subject property or adjoining properties can occur due to passage of time, natural processes, or works of man. In addition, applicable building standards/codes may change over time. Accordingly, findings, conclusions, and recommendations of this Report may be invalidated, wholly or partially, by changes outside of GNN's control. Provided that the site conditions are not disturbed or altered after the planned grading is completed, the report will be valid for a period of **5 years** from the issued date of the Report.

In the event that any changes in the nature, design, or location of structures are planned, the findings, conclusions and recommendations contained in this Report shall not be considered valid unless the changes are reviewed by GNN and the findings, conclusions, and recommendations of this Report are modified or verified in writing.

This Report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the findings, conclusions, and recommendations contained herein to the attention of the architect and design professional(s) for the project so that they are incorporated into the plans and construction specifications, and any follow-up addendum for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations during construction. It is further understood that the owner or the owner's representative is responsible for submittal of this Report to the appropriate governing agencies. The foregoing notwithstanding, no party other than the Client shall have any right to rely on this Report and GNN shall have no liability to any third party who claims injury due to reliance upon this Report, which is prepared exclusively for Client's use and reliance.

GNN has provided geotechnical services in accordance with generally accepted geotechnical engineering practices in this locality at this time. GNN expressly disclaims all warranties and guarantees, express or implied.

Client shall provide GNN an opportunity to review the final design and specifications so that earthwork, drainage and foundation recommendations may be properly interpreted and implemented in the design and specifications. If GNN is not accorded the review opportunity, GNN shall have no responsibility for misinterpretation of GNN's recommendations.

Although GNN can provide environmental assessment and investigation services for an additional cost, the current scope of GNN's services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

15. 0 REFERENCES

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APPENDICES

Appendix I

<u>Vicinity Map (Figure 1)</u>

<u>Site Exploration Maps (Figure**s** 2, **&** 2**A**)</u>

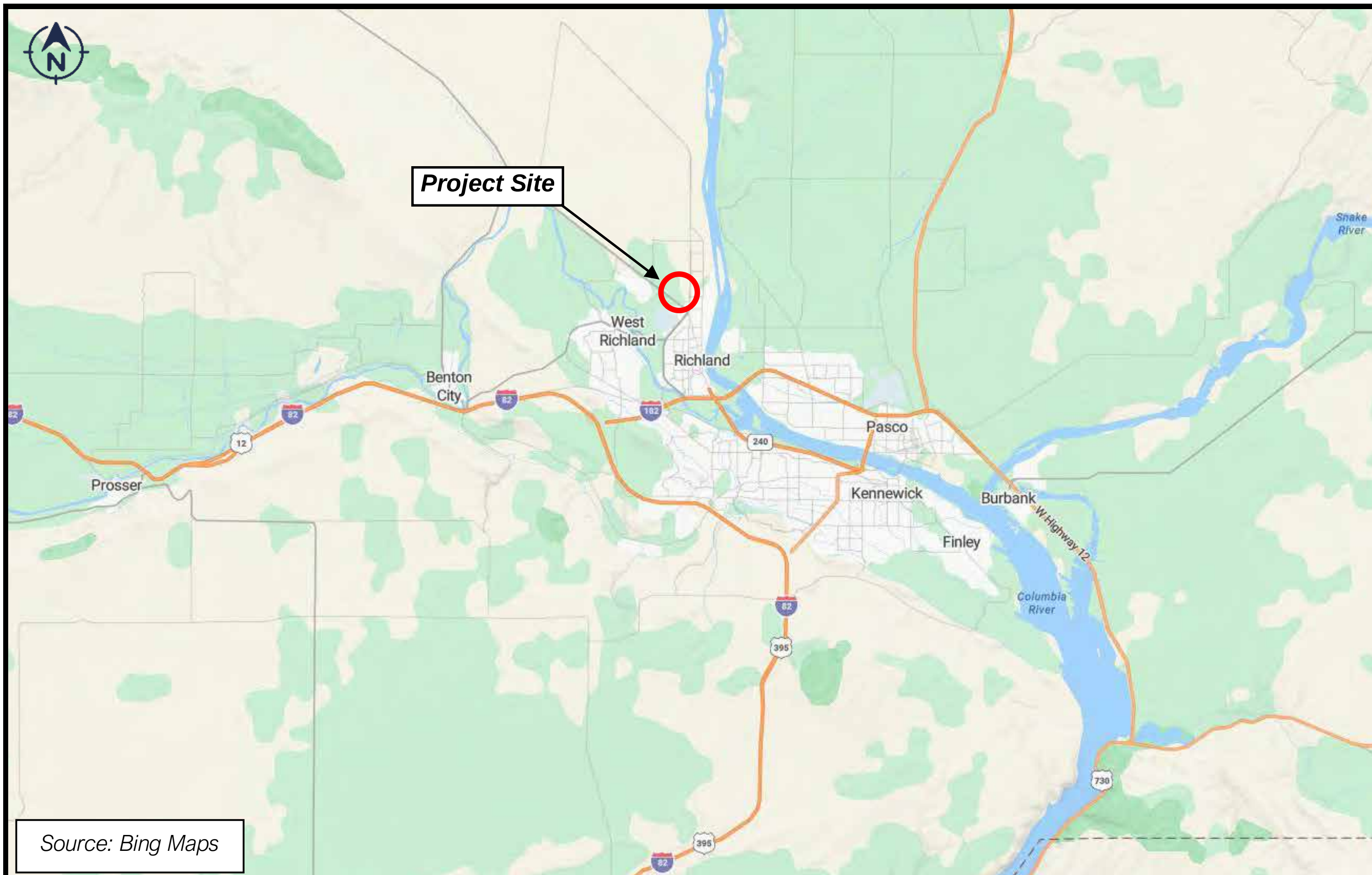


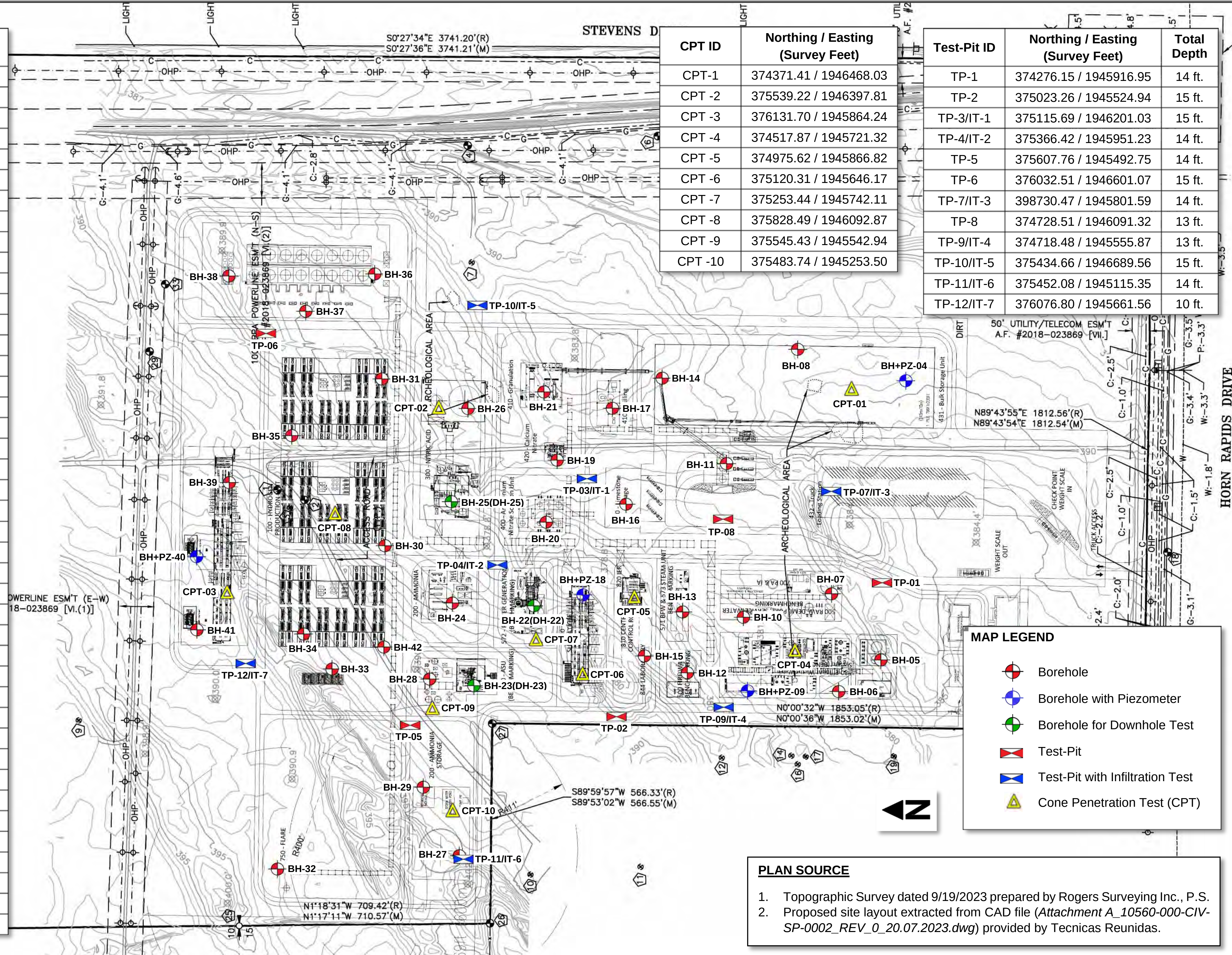
FIGURE 1: VICINITY MAP

PROJECT NO. 223-1672

Boring ID	Northing / Easting (Survey Feet)	Total Depth
BH-01	373779.94 / 1946069.52	*not drilled*
BH-02	374036.21 / 1945633.50	*not drilled*
BH-03	374038.60 / 1945789.78	*not drilled*
BH-04+PZ	374218.62 / 1946492.60	61.5 ft.
BH-05	374274.97 / 1945697.26	41 ft.
BH-06	374392.45 / 1945605.06	41 ft.
BH-07	374417.87 / 1945883.46	30.5 ft.
BH-08	374526.64 / 1946577.26	30.25 ft.
BH-09+PZ	374651.74 / 1945603.61	46.5 ft.
BH-10	374666.25 / 1945812.73	25.5 ft.
BH-11	374721.83 / 1946249.76	35.25 ft.
BH-12	374822.44 / 1945652.26	43 ft.
BH-13	374839.32 / 1945825.48	21 ft.
BH-14	374907.87 / 1946490.08	42 ft.
BH-15	374944.95 / 1945698.36	21 ft.
BH-16	375004.46 / 1946130.02	27.5 ft.
BH-17	375047.67 / 1946402.58	46.5 ft.
BH-18+PZ	375121.55 / 1945869.89	35.5 ft.
BH-19	375202.19 / 1946252.48	31.5 ft.
BH-20	375229.74 / 1946075.55	21 ft.
BH-21	375242.36 / 1946446.05	20.5 ft.
BH-22(DH-22)	375261.09 / 1945836.69	80 ft.
BH-23(DH-23)	375428.99 / 1945607.61	60 ft.
BH-24	375492.75 / 1945841.47	30.5 ft.
BH-25(DH-25)	375499.73 / 1946129.99	80 ft.
BH-26	375457.13 / 1946395.79	21 ft.
BH-27	375464.26 / 1945124.76	27 ft.
BH-28	375554.71 / 1945624.62	17 ft.
BH-29	375568.60 / 1945317.35	23 ft.
BH-30	375686.32 / 1946001.88	24.25 ft.
BH-31	375702.00 / 1946476.62	16.5 ft.
BH-32	375978.16 / 1945078.77	62 ft.
BH-33	375831.90 / 1945649.66	26 ft.
BH-34	375913.64 / 1945747.90	28 ft.
BH-35	375955.48 / 1946311.36	26 ft.
BH-36	375727.00 / 1946774.70	33 ft.
BH-37	375920.81 / 1946665.92	26.5 ft.
BH-38	376140.40 / 1946762.79	15 ft.
BH-39	376119.56 / 1946261.12	20.5 ft.
BH-40+PZ	376220.38 / 1945963.13	66.5 ft.
BH-41	376216.10 / 1945755.13	16.5 ft.
BH-42	375685.91 / 1945714.02	32 ft.

CPT ID	Northing / Easting (Survey Feet)
CPT-1	374371.41 / 1946468.03
CPT -2	375539.22 / 1946397.81
CPT -3	376131.70 / 1945864.24
CPT -4	374517.87 / 1945721.32
CPT -5	374975.62 / 1945866.82
CPT -6	375120.31 / 1945646.17
CPT -7	375253.44 / 1945742.11
CPT -8	375828.49 / 1946092.87
CPT -9	375545.43 / 1945542.94
CPT -10	375483.74 / 1945253.50

Test-Pit ID	Northing / Easting (Survey Feet)	Total Depth
TP-1	374276.15 / 1945916.95	14 ft.
TP-2	375023.26 / 1945524.94	15 ft.
TP-3/IT-1	375115.69 / 1946201.03	15 ft.
TP-4/IT-2	375366.42 / 1945951.23	14 ft.
TP-5	375607.76 / 1945492.75	14 ft.
TP-6	376032.51 / 1946601.07	15 ft.
TP-7/IT-3	398730.47 / 1945801.59	14 ft.
TP-8	374728.51 / 1946091.32	13 ft.
TP-9/IT-4	374718.48 / 1945555.87	13 ft.
TP-10/IT-5	375434.66 / 1946689.56	15 ft.
TP-11/IT-6	375452.08 / 1945115.35	14 ft.
TP-12/IT-7	376076.80 / 1945661.56	10 ft.



PLAN SOURCE

1. Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.
2. Proposed site layout extracted from CAD file (*Attachment A_10560-000-CIV-SP-0002_REV_0_20.07.2023.dwg*) provided by Tecnicas Reunidas.

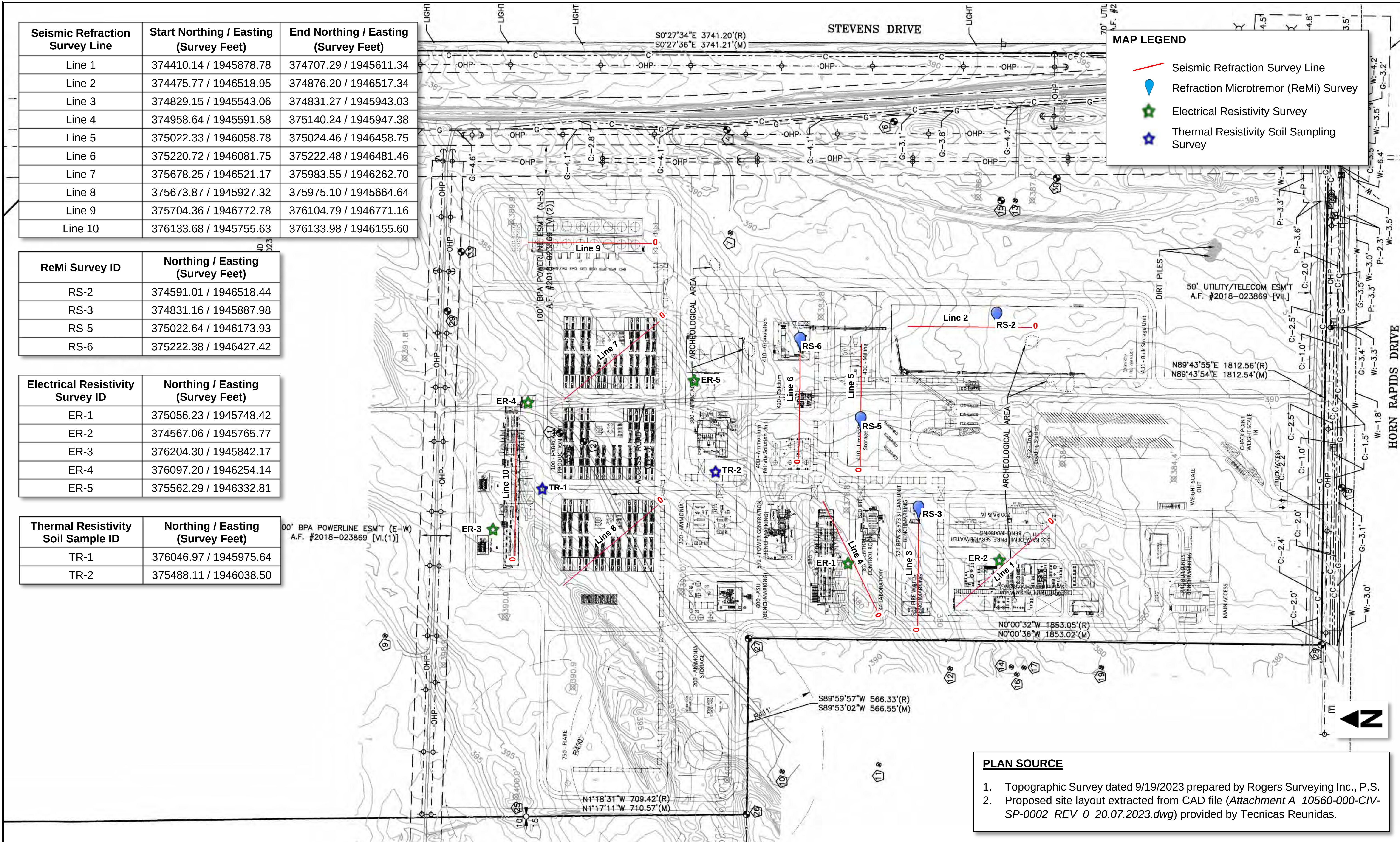
FIGURE 2: SITE EXPLORATION MAP **PROJECT NO. 223-1672**

Seismic Refraction Survey Line	Start Northing / Easting (Survey Feet)	End Northing / Easting (Survey Feet)
Line 1	374410.14 / 1945878.78	374707.29 / 1945611.34
Line 2	374475.77 / 1946518.95	374876.20 / 1946517.34
Line 3	374829.15 / 1945543.06	374831.27 / 1945943.03
Line 4	374958.64 / 1945591.58	375140.24 / 1945947.38
Line 5	375022.33 / 1946058.78	375024.46 / 1946458.75
Line 6	375220.72 / 1946081.75	375222.48 / 1946481.46
Line 7	375678.25 / 1946521.17	375983.55 / 1946262.70
Line 8	375673.87 / 1945927.32	375975.10 / 1945664.64
Line 9	375704.36 / 1946772.78	376104.79 / 1946771.16
Line 10	376133.68 / 1945755.63	376133.98 / 1946155.60

ReMi Survey ID	Northing / Easting (Survey Feet)
RS-2	374591.01 / 1946518.44
RS-3	374831.16 / 1945887.98
RS-5	375022.64 / 1946173.93
RS-6	375222.38 / 1946427.42

Electrical Resistivity Survey ID	Northing / Easting (Survey Feet)
ER-1	375056.23 / 1945748.42
ER-2	374567.06 / 1945765.77
ER-3	376204.30 / 1945842.17
ER-4	376097.20 / 1946254.14
ER-5	375562.29 / 1946332.81

Thermal Resistivity Soil Sample ID	Northing / Easting (Survey Feet)
TR-1	376046.97 / 1945975.64
TR-2	375488.11 / 1946038.50



Appendix II

Geologic Map (Figure 3)
Liquefaction Susceptibility Map (Figure 4)
USGS **Quaternary** Fault Map (Figure 5)
Cascadia Earthquake Hazard Map (Figure 6)
USGS Landslide **Inventory** Map (Figure 7)
FEMA Flood Map (Figure 8)

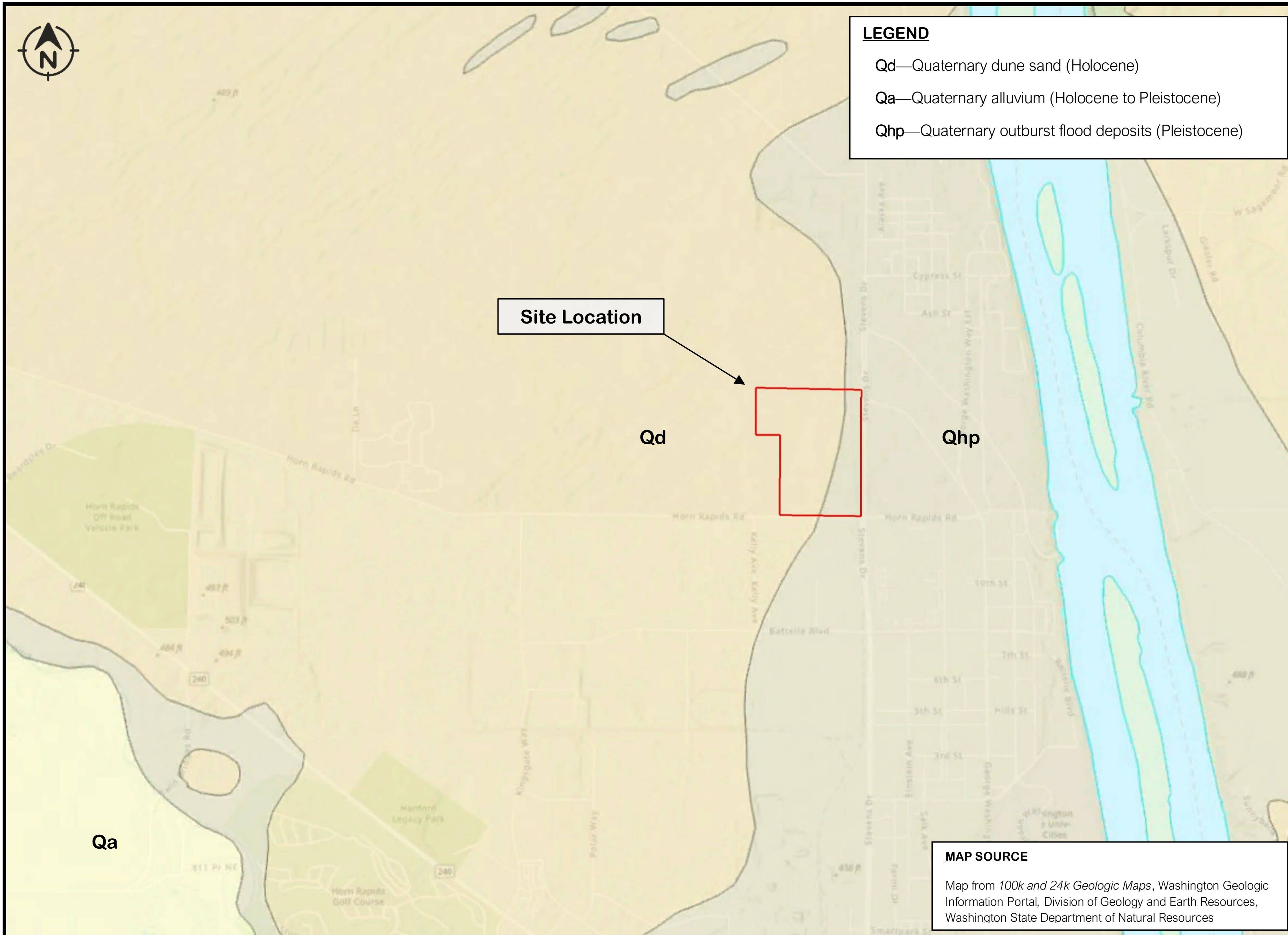


FIGURE 3: GEOLOGIC MAP

PROJECT NO. 223-1672

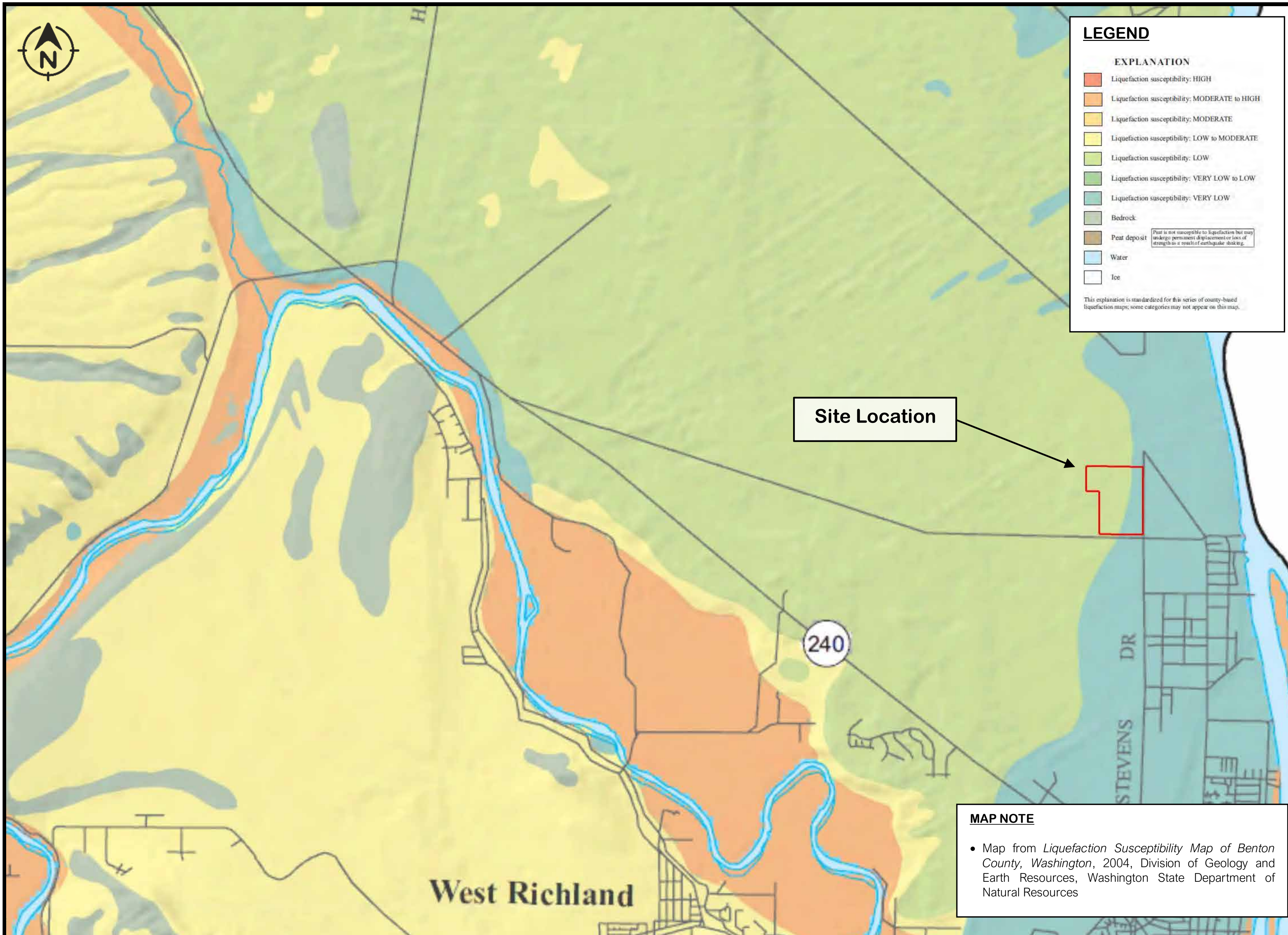


FIGURE 4: LIQUEFACTION SUSCEPTIBILITY MAP

PROJECT NO. 223-1672

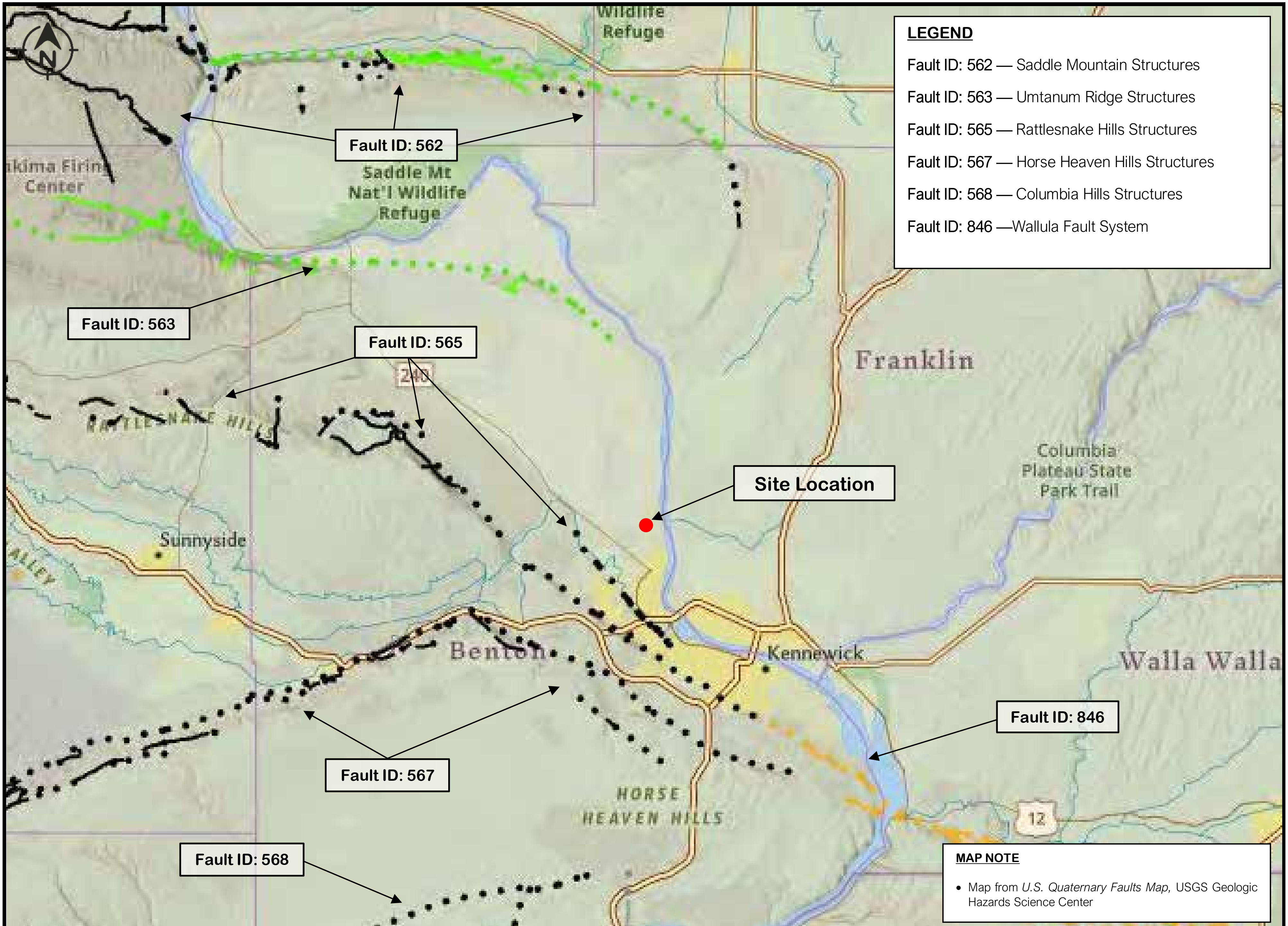


FIGURE 5: USGS QUATERNARY FAULT MAP PROJECT NO. 223-1672

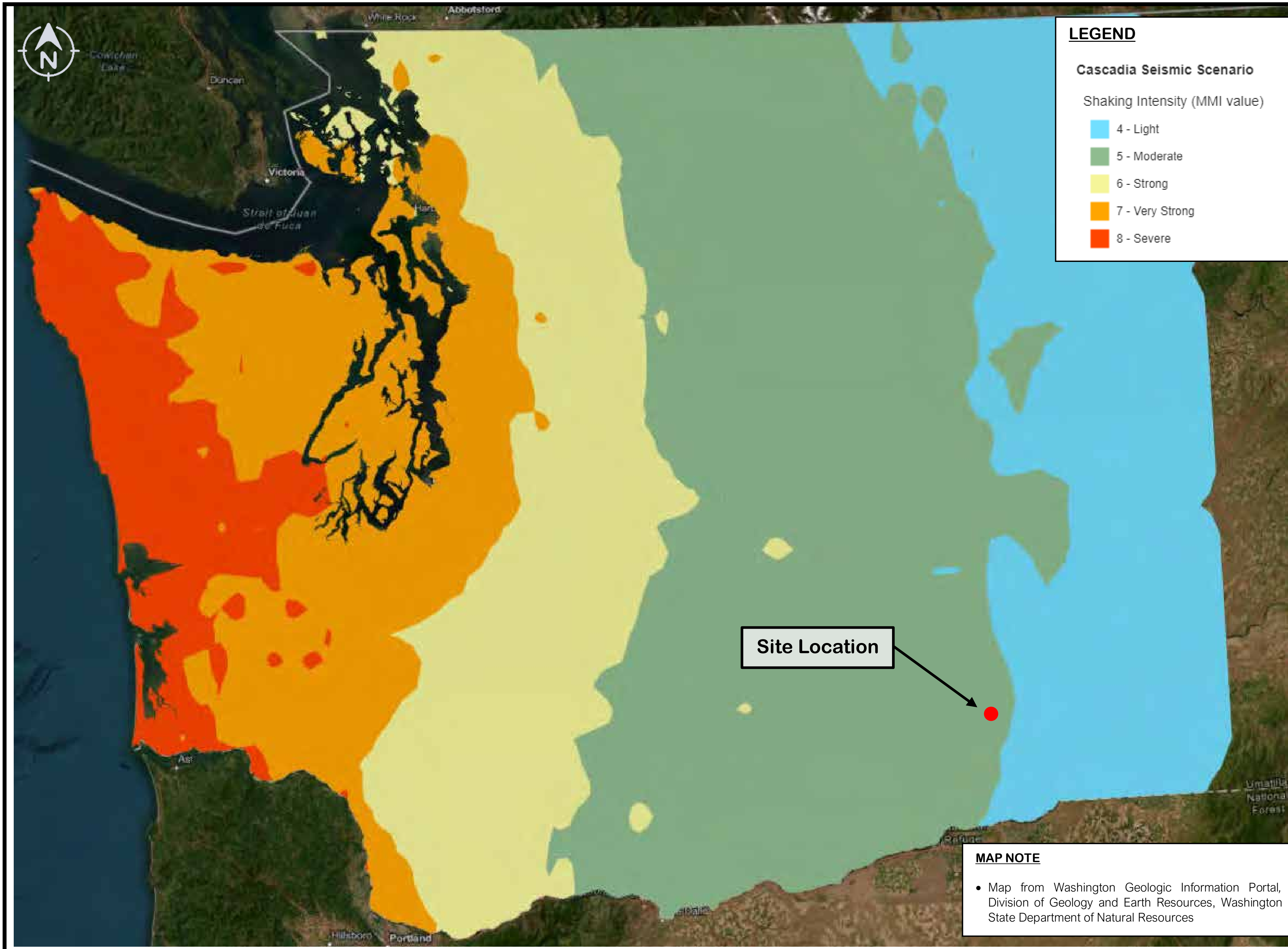
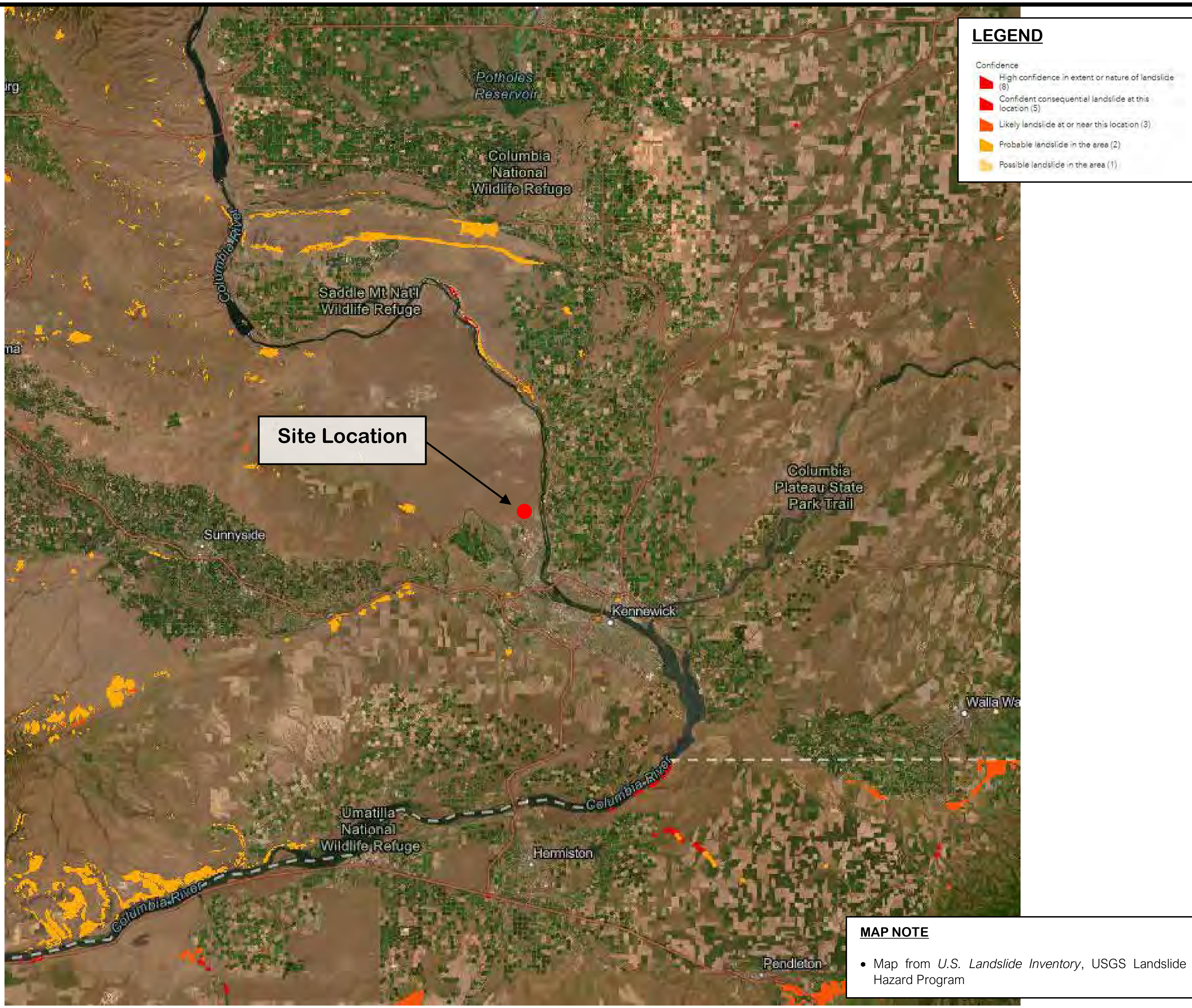


FIGURE 6: CASCADIA EARTHQUAKE HAZARD MAP

PROJECT NO. 223-1672



MAP NOTE

- Map from *U.S. Landslide Inventory*, USGS Landslide Hazard Program

FIGURE 7: LANDSLIDE INVENTORY MAP

PROJECT NO. 223-1623

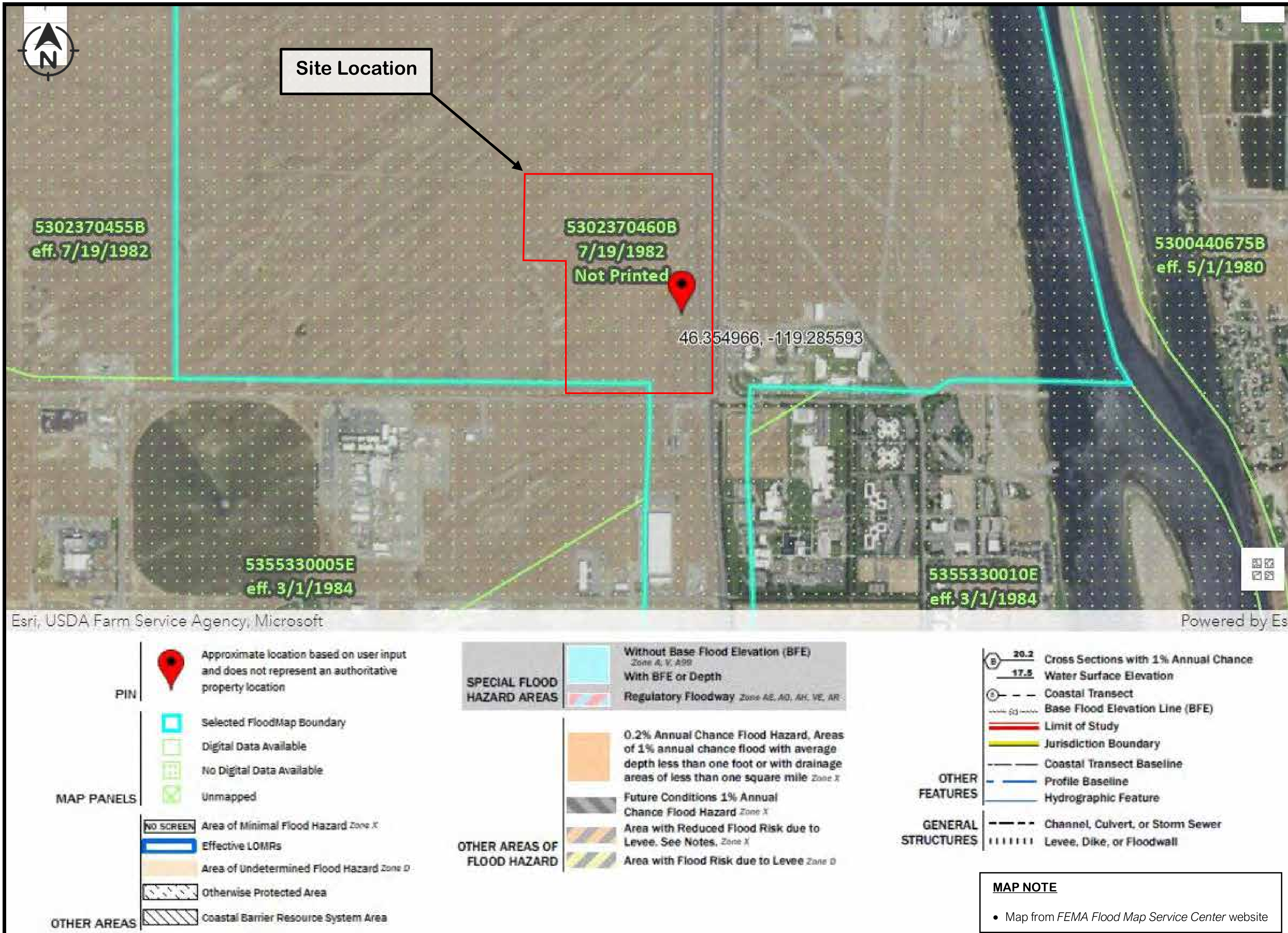


FIGURE 8: FEMA FLOOD MAP

PROJECT NO. 223-1672

Appendix III

Historic Aerial Photographs

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**2021** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**2017** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**2013** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize
NW corner of Horn Rapids Rd and Ste
Richland, WA

N

2009

HIG Project # 2077331
Client Project # 223-1672
Approximate Scale 1: 6,000 (1"=500')
www.historicalinfo.com

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**2006** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1996** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1988** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize
NW corner of Horn Rapids Rd and Ste
Richland, WA

N

1982

HIG Project # 2077331
Client Project # 223-1672
Approximate Scale 1: 6,000 (1"=500')
www.historicalinfo.com

HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize
NW corner of Horn Rapids Rd and Ste
Richland, WA

N

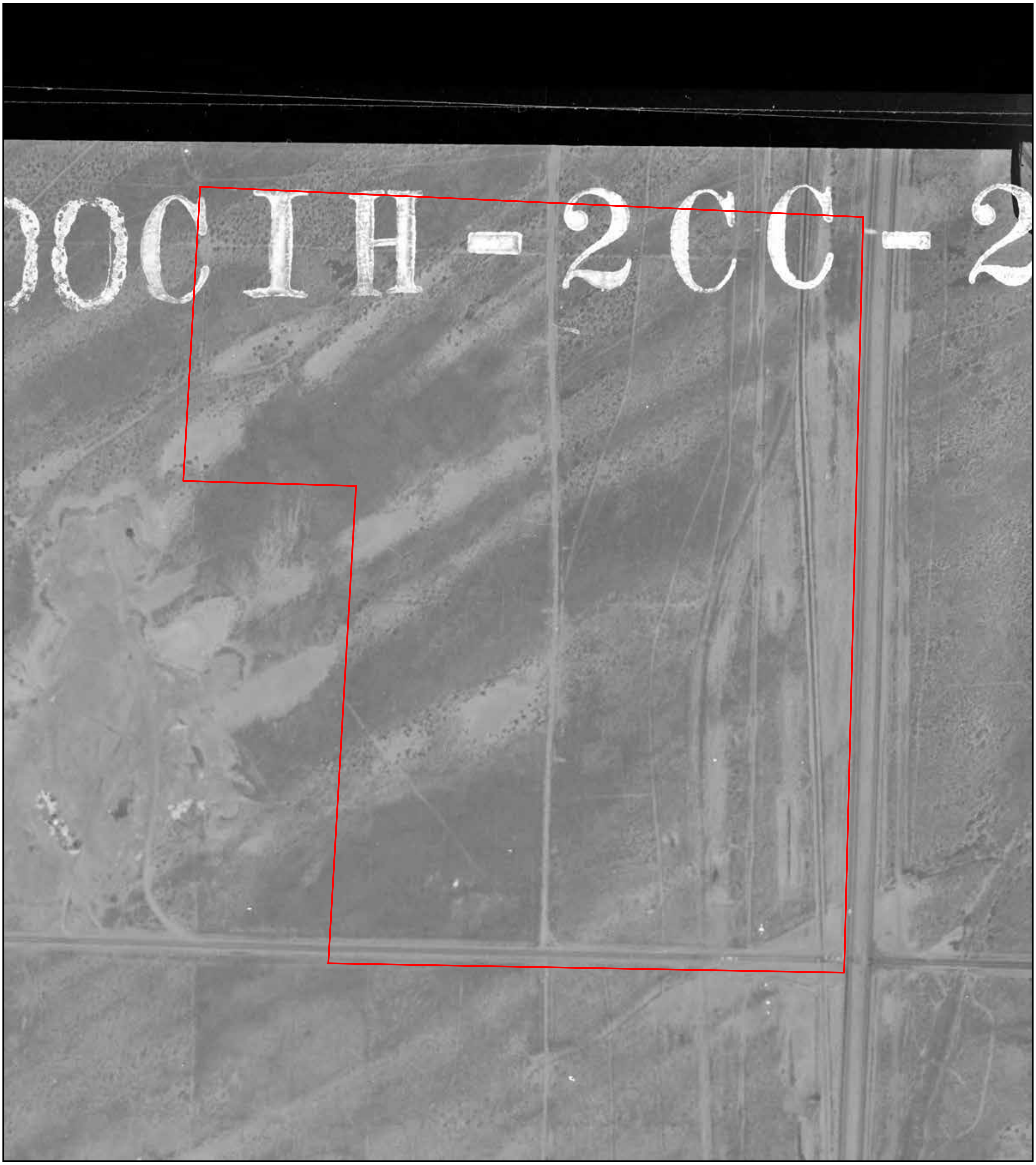
1973

HIG Project # 2077331
Client Project # 223-1672
Approximate Scale 1: 6,000 (1"=500')
www.historicalinfo.com

HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1964** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

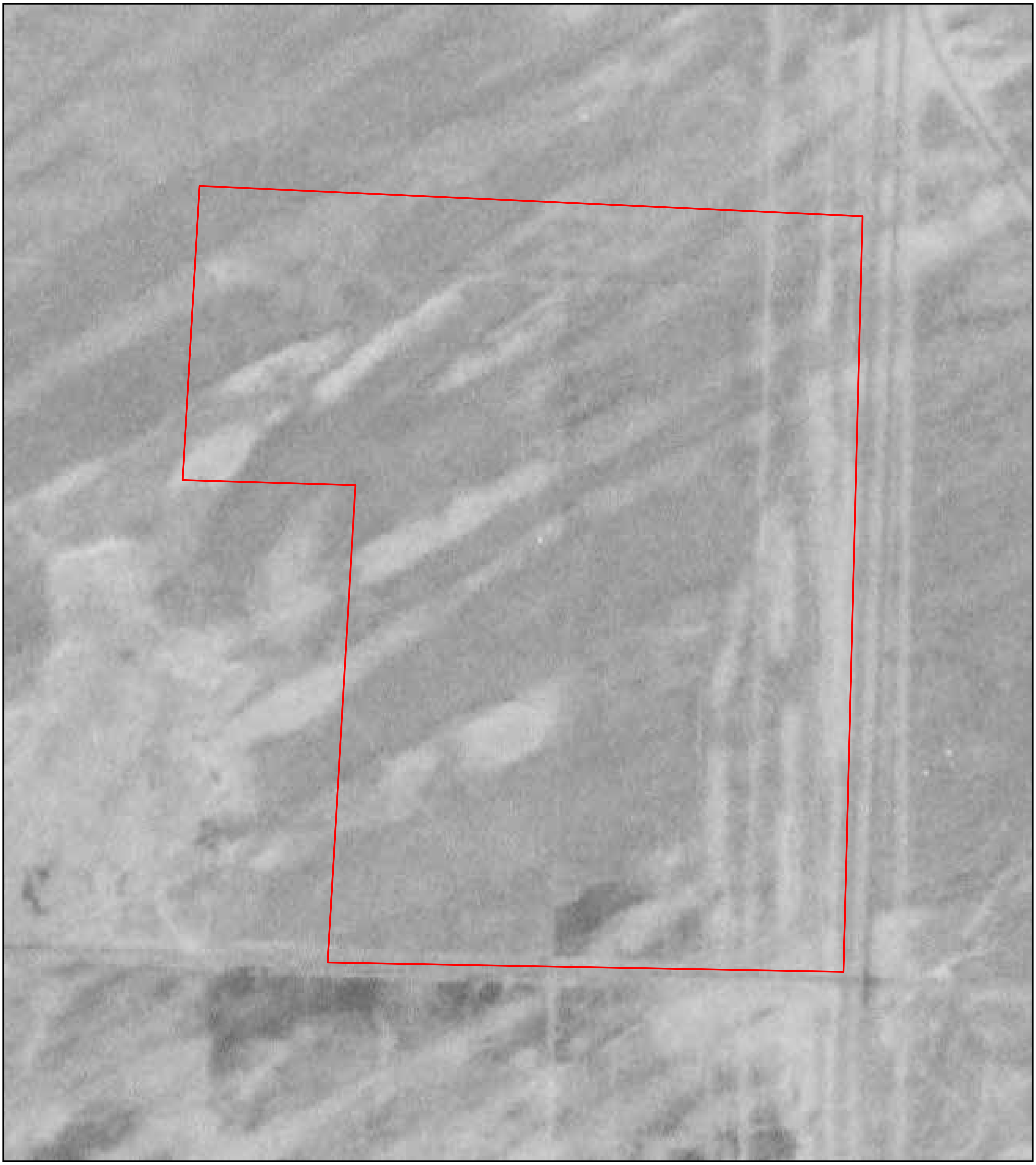


Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1962** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1957** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG



Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1952** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com	HIG

Site boundaries shown in red are approximate

Atlas Agro- Pacific Green Fertilize NW corner of Horn Rapids Rd and Ste Richland, WA	N	**1948** HIG Project # 2077331 Client Project # 223-1672 Approximate Scale 1: 6,000 (1"=500') www.historicalinfo.com

HIG

Appendix IV

Exploratory Boring Logs
Exploratory Test-Pit Logs
Key Chart (for Soil Classification)

GN Northern, Inc
722 N. 16th Ave Suite 31
Yakima, WA 99802
Telephone: (509) 248-9798

BORING NUMBER BH-04

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/14/23 **COMPLETED** 8/14/23
GROUND ELEVATION 391 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING 42.00 ft / Elev 349.00 ft
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING 41.10 ft / Elev 349.90 ft
NOTES Bulk Storage Unit area, 1946492.60 E, 374218.62 N
AFTER DRILLING 41.10 ft / Elev 349.90 ft

SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS
GB		MC = 1% Fines = 20% OC = 2.4%
SPT	18-26-50/6"	
SPT	11-16-11 (27)	
SPT	15-15-14 (29)	
SPT	16-17-14 (31)	MC = 5% DD = 116 pcf
SPT	7-7-6 (13)	MC = 5% DD = 106 pcf SG = 2.68
SPT	7-7-16 (23)	
SPT	20-21-50/5"	
SPT	21-20-43 (63)	MC = 6% DD = 123 pcf SG = 2.67
SPT	9-11-11 (22)	MC = 5% DD = 113 pcf
SPT	13-19-25 (44)	
SPT	17-24-34 (58)	
SPT	37-50/5"	
SPT	25-30-34 (64)	
SPT	50/6"	
SPT	4-14-32 (46)	

DEPTH (ft)	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0–2.0	SM	SILTY SAND, (SM) gray, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	389.0
2.0–12.0	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense; 1st drilling attempt met with auger refusal at ~4' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed medium dense, some Poorly Graded Sand with Gravel (SP); damp; medium dense to dense	379.0
12.0–14.5	SW	WELL GRADED SAND WITH GRAVEL, (SW) gray, fine to coarse grained, damp, medium dense	376.5
14.5–18.5	GP	POORLY GRADED GRAVEL, (GP) gray, damp, medium dense, partial recovery	372.5
18.5–29.0	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, damp, very dense; damp to moist	362.0
29.0–38.5	SW	WELL GRADED SAND WITH GRAVEL, (SW) dark gray, fine to coarse grained, damp to moist, medium dense; dense	352.5
38.5–49.0	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, wet, very dense; interbedded with Well Graded Sand with Gravel (SW)	342.0
49.0–53.5	GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray, very dense, interbedded with fine grained Poorly Graded Sand (SP)	337.5
53.5–58.5	SP	POORLY GRADED SAND, (SP) gray, fine grained, very dense, trace gravel	332.5
58.5–61.5	ML	SILT / SILT WITH SAND, (ML) tan to olive brown, dense	329.5

- Piezometer installed
- Groundwater encountered at ~42' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 61.5 feet.

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BORING NUMBER BH-05

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/14/23 **COMPLETED** 8/14/23
GROUND ELEVATION 384 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING 33.00 ft / Elev 351.00 ft
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Effluent Waste Water System area, 1945697.26 E, 374274.97 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0	GB		OC = 2.1%	SM	SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	
3.0						381.0
5	SPT	50/1"		GP	POORLY GRADED GRAVEL, (GP) gray, dry, very dense, 1st drilling attempt met with auger refusal at ~3' BGS indicating very dense (representative of SPT blow count >50/<6"), moved few feet and drilling resumed no recovery	
10	SPT	50/4"		GP	poor recovery	
15	SPT	28-50/4"		GP	poor recovery	
18.0						366.0
20	SPT	9-12-12 (24)	MC = 6% DD = 122 pcf Fines = 8% SG = 2.66	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, coarse grained, damp to moist, medium dense	
25	SPT	8-12-14 (26)		GP-GM		
30	SPT	4-9-15 (24)		GP-GM	fine grained sand, saturated, medium dense	
33.5 ▽						350.5
35	SPT	19-50/6"		SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) brown to gray brown, coarse grained, very dense, with gravel	
40	SPT	21-50/6"		SP-SM	gravelly sand	
41.0						343.0

- Drilling terminated at ~41' BGS due to auger refusal
- Groundwater encountered at ~33' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 41.0 feet.

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BORING NUMBER BH-06

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/14/23 **COMPLETED** 8/14/23
GROUND ELEVATION 380 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING 29.00 ft / Elev 351.00 ft
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Effluent Waste Water System area, 1945605.06 E, 374392.45 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0–2.0				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears medium dense, with grass and weeds on surface	378.0
2.0–4.8	SPT	33-50/6"	MC = 1% Fines = 14%			SILTY GRAVEL WITH SAND, gray brown, dry, very dense 1st and 2nd drilling attempts met with auger refusal at ~2' & 3.5' BGS respectively, indicating very dense (representative of SPT blow count >50/<6"), moved a few feet after each refusal and drilling resumed	375.3
4.8–9.5	SPT SPT	5-6-7 (13) 50/3"	Fines = 6%	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, very dense, with cobbles and large boulders, (sandy gravel with silt) medium dense, poor recovery very dense, no recovery	370.5
9.5–12.0	SPT	40-50/3"	MC = 2% DD = 127 pcf SG = 2.66	GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, very dense	368.0
12.0–18.5	SPT SPT	30-31-28 (59) 21-26-30 (56)	 MC = 5% DD = 121 pcf	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense dark gray to black, damp to moist	361.5
18.5–38.0	SPT SPT SPT SPT	17-16-14 (30) 6-11-12 (23) 4-5-5 (10) 3-5-6 (11)	 MC = 7% Fines = 1%	GP		POORLY GRADED GRAVEL, (GP) dark gray, moist, medium dense to dense, trace Poorly Graded Sand with Silt (SP-SM) medium dense, trace sand loose to medium dense, with silt medium dense	342.0
38.0–41.0	SPT	50/6"		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, very dense	339.0

- Drilling terminated at ~41' BGS due to auger refusal
- Groundwater encountered at ~29' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 41.0 feet.

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BORING NUMBER BH-07

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/15/23 **COMPLETED** 8/15/23

GROUND ELEVATION 384 ft **HOLE SIZE** 7 inches

DRILLING CONTRACTOR Geologic Drill Partners, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA

AT TIME OF DRILLING ---

LOGGED BY ABC **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Raw, Demi, Pure, Service Water area, 1945883.46 E, 374417.87 N

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose to medium dense, with gravel, with grass and weeds on surface	
2.0				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears dense to very dense, with cobbles, trace boulders	382.0
						digging conditions indicate very dense (representative of SPT blow count >50/<6"), interbedded with Poorly Graded Sand (SP)	
						excavated to ~8' BGS then began drilling	
10	SPT	17-13-50/2"				very dense	
						1st attempt met with auger refusal at ~12' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed	
15	SPT	28-50/6"	MC = 3% DD = 125 pcf SG = 2.66			with interbedded Poorly Graded Sand (SP)	
20	SPT	23-50/6"					
23.5				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) light brown to tan, fine to medium grained, dry, very dense, trace gravel	360.5
25	SPT	10-17-35 (52)					
30	SPT	50/5"				with gravel	
30.5							353.5

- Drilling terminated at ~30.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 30.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/15/23 16:16 - C:\USERS\KHARM\ONEDRIVE\PUBLIC\ACTIVE PROJECTS\1 - CURRENT PROJECTS\223-1672 ATLAS AGRO\223-1672 LOGS.GPJ

BORING NUMBER BH-08

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Yakima, WA 99802
Telephone: (509) 248-9798

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/14/23 **COMPLETED** 8/14/23
GROUND ELEVATION 393 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Bulk Storage Unit area, 1946577.26 E, 374526.64 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0				SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	
2.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, very dense, with cobbles, trace boulders	390.5
5	SPT	28-50/2"					
10	SPT	9-11-10 (21)	MC = 2%			medium dense	
14.5				SW		WELL GRADED SAND WITH GRAVEL, (SW) gray brown, fine to coarse grained, damp, dense gravelly sand with silt	378.5
15	SPT	22-21-16 (37)	MC = 5% DD = 123 pcf Fines = 4% SG = 2.68				
18.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, very dense, with cobbles, trace boulders	374.5
20	SPT	28-50/6"					
23.5				SP		POORLY GRADED SAND WITH GRAVEL, (SP) gray, fine to coarse grained, moist, dense, trace coarse grained sand (gravelly sand)	369.5
25	SPT	7-14-18 (32)	MC = 6% Fines = 4%				
30	SPT	50/2"				very dense, no recovery	
30.3							362.8

- Drilling terminated at ~30.25' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 30.3 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/15/23 16:16 - C:\USERS\KHARMON\ONEDRIVE\PUBLIC\ACTIVE PROJECTS\1 - CURRENT PROJECTS\223-1672 ATLAS AGRO\223-1672 LOGS.GPJ

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BORING NUMBER BH-09+PZ

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/15/23 **COMPLETED** 8/16/23

GROUND ELEVATION 382 ft **HOLE SIZE** 7 inches

DRILLING CONTRACTOR Geologic Drill Partners, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA

AT TIME OF DRILLING 29.50 ft / Elev 352.50 ft

LOGGED BY ABC **CHECKED BY** IM

AT END OF DRILLING 30.50 ft / Elev 351.50 ft

NOTES Effluent Waste Water Systerm area, 1945603.61 E, 374651.74 N

AFTER DRILLING 29.50 ft / Elev 352.50 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	GB		OC = 1.8%	SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) tan to light brown, fine to medium grained, dry, appears loose to medium dense, with grass and weeds on surface
3.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry to damp, appears very dense, with cobbles and large boulders, cemented to ~6' BGS digging conditions indicate very dense (representative of SPT blow count >50/<6") (378.5)
6.0				SP		POORLY GRADED SAND WITH GRAVEL, (SP) gray brown, fine to coarse grained, dry to damp, appears very dense, with cobbles and boulders excavated to ~9' BGS then began drilling (376.0)
9.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, damp to moist, dense (372.5)
10	SPT	8-35-40 (75)				
	SPT	9-23-10 (33)	MC = 4%			
20	SPT	30-50/6"				very dense, no recovery
	SPT	17-24-13 (37)	MC = 8% Fines = 7%			damp to moist, dense
30	SPT	9-17-9 (26)				medium dense, poor recovery
	SPT	10-8-8 (16)	Fines = 6%			some Poorly Graded Gravel with Silt and Sand (GP-GM)
38.0				SP		POORLY GRADED SAND, (SP) tan, fine to medium grained, dense (344.0)
40	SPT	8-23-20 (43)				with gravel
43.5				SP		POORLY GRADED SAND WITH GRAVEL, (SP) tan, fine to coarse grained, dense (338.5)
	SPT	8-20-25 (45)				
46.5						(335.5)

- Piezometer installed
- Drilling terminated at ~46.5' BGS due to auger refusal
- Groundwater encountered at ~29.5' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 46.5 feet.

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BORING NUMBER BH-10

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/15/23 **COMPLETED** 8/15/23
GROUND ELEVATION 381 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Raw, Demi, Pure, Service Water area, 1945812.73 E, 374666.25 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0 – 2.0				ML		SILT WITH SAND, (ML) brown, dry, appears loose to medium dense, with gravel, with grass and weeds on surface	379.0
2.0 – 9.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) black to dark gray, dry, appears dense to very dense, with cobbles and large boulders, cemented to ~5' BGS digging conditions indicate very dense (representative of SPT blow count >50/<6") excavated to ~9' BGS then began drilling	371.5
9.5 – 13.0	SPT (10–11.5)	6-7-6 (13)	MC = 3% Fines = 10%	SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL, (SW-SM) gray brown, fine to coarse grained, dry, medium dense 1st drilling attempt met with auger refusal at ~12' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed	368.0
13.0 – 25.5	SPT (15–16.5)	21-26-25 (51)	MC = 3%	GP		POORLY GRADED GRAVEL, (GP) gray, dry, very dense	
	SPT (20–21.5)	36-19-16 (35)				gray, dense, with some Poorly Graded Sand (SP)	
	SPT (25–25.5)	50/6"				very, dense, trace sand	355.5

- Drilling terminated at ~25.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 25.5 feet.

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BORING NUMBER BH-11

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/15/23 **COMPLETED** 8/15/23
GROUND ELEVATION 386.5 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES North of Truck Loading Station, 1946249.76 E, 374721.83 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elevation
0						
	GB		OC = 1.9%	SM	SILTY SAND (SM) / SANDY SILT, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	
2.0						384.5
				GM	SILTY GRAVEL, (GM) brown, dry, appears dense to very dense, with cobbles and boulders	
4.0						382.5
5				GP	POORLY GRADED GRAVEL, (GP) gray, dry, appears very dense, with black Poorly Graded Sand (SP) digging conditions indicate very dense (representative of SPT blow count >50/<6")	
					excavated to ~9' BGS then began drilling	
10	SPT	21-39-42 (81)			very dense, no recovery	
13.0						373.5
				GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, very dense	
15	SPT	18-32-50/6"				
20	SPT	50/6"	MC = 2%			
25	SPT	50-50/3"			no recovery	
30	SPT	50/5"			partial recovery	
35	SPT	50/3"			partial recovery	
35.3						351.3

- Drilling terminated at ~35.25' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 35.3 feet.

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BORING NUMBER BH-12

CLIENT	Tecnicas Reunidas	**PROJECT NAME**	Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER	223-1672	**PROJECT LOCATION**	Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED	8/16/23 **COMPLETED** 8/16/23	**GROUND ELEVATION**	379 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR	Geologic Drill Partners, Inc.	**GROUND WATER LEVELS:**	
DRILLING METHOD	Acker Recon Track Mounted Drill Rig w/HSA	∇ **AT TIME OF DRILLING**	28.00 ft / Elev 351.00 ft
LOGGED BY	ABC **CHECKED BY** IM	**AT END OF DRILLING**	---
NOTES	Fire Water area, 1945652.26 E, 374822.44 N	**AFTER DRILLING**	---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0 – 2.0				SM	SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) light brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	377.0
2.0 – 9.5				GP	POORLY GRADED GRAVEL WITH SAND, (GP) light brown to gray, dry, appears dense to very dense, with cobbles and large boulders cemented to ~6.5' BGS digging conditions indicate very dense (representative of SPT blow count >50/<6") .	369.5
10	SPT	16-23-50/4"	MC = 2%	SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) light brown to tan, fine grained, dry, very dense, some gavel	
14.5						364.5
15	SPT	50/6"	MC = 1%	GP	POORLY GRADED GRAVEL, (GP) gray, dry, very dense, poor recovery	
20	SPT	25-37-50/6"		GP	no recovery	
23.5						355.5
25	SPT	23-37-38 (75)		GP	POORLY GRADED GRAVEL WITH SAND, (GP) tan to gray, coarse grained, moist to wet, very dense, with gravel	
28 ∇						
29.5						349.5
30	SPT	5-12-19 (31)	DD = 111 pcf Fines = 12%	SW-SM	WELL GRADED SAND WITH SILT, (SW-SM) brown, fine grained, dense, some Silty Sand (SM)	
34.0						345.0
35	SPT	3-11-24 (35)	DD = 119 pcf Fines = 10%	SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dense, with gravel	
40	SPT	6-9-30 (39)		SP-SM		
43.0						336.0

- Drilling terminated at ~43' BGS due to auger refusal
- Groundwater encountered at ~28' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 43.0 feet.

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BORING NUMBER BH-13

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/15/23 **COMPLETED** 8/15/23
GROUND ELEVATION 383 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES BFW & Steam Unit area, 1945825.48 E, 374839.32 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				SM		SILTY SAND, (SM) light brown, fine grained, damp, appears loose, with grass and weeds on surface	
	BULK		MC = 4% Fines = 12% NON-PLASTIC				
4.0				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, appears very dense, trace cobbles, slightly cemented	379.0
5	SPT	50/5"				very dense	
6.0				SP		POORLY GRADED SAND WITH GRAVEL, (SP) black, fine to coarse grained, dry, appears dense	377.0
9.0				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	374.0
10	SPT	18-33-50/4"	MC = 3%				
13.5				GP		POORLY GRADED GRAVEL, (GP) gray, dry, very dense	369.5
15	SPT	45-50/6"	MC = 2%				
20	SPT	50/3"				no recovery	
21.0							362.0

- Drilling terminated at ~21' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 21.0 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 10/15/23 16:16 - C:\USERS\KHARMON\ONEDRIVE\PUBLIC\ACTIVE PROJECTS\1 - CURRENT PROJECTS\223-1672 ATLAS AGRO\223-1672 LOGS.GPJ

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BORING NUMBER BH-14

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/15/23 **COMPLETED** 8/15/23

GROUND ELEVATION 387.5 ft **HOLE SIZE** 7 inches

DRILLING CONTRACTOR Geowest Drilling Inc

GROUND WATER LEVELS:

DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA

∇ **AT TIME OF DRILLING** 40.00 ft / Elev 347.50 ft

LOGGED BY GR **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Bulk Storage Unit area, 1946490.08 E, 374907.87 N

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0				SM	SILTY SAND (SM) / SANDY SILT, (SM) light brown, fine grained, dry, appears loose, with grass and weeds on surface	
1.5				GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray to tan, dry, appears very dense, with cobbles, trace boulders	386.0
5					digging conditions indicate very dense (representative of SPT blow count >50/<6")	
10	SPT	11-20-17 (37)	MC = 3% DD = 123 pcf Fines = 9% SG = 2.66		. gray, dense	
15	SPT	12-42-35 (77)			very dense	
20	SPT	19-29-50/5"	MC = 3%		dry to damp	
25	SPT	34-44-50/5"			gray brown, dry	
30	SPT	17-42-35 (77)	MC = 3%			
35	SPT	38-29-34 (63)				
40	SPT	6-7-50/5"			∇ brown	
42.0						345.5

- Drilling terminated at ~42' BGS due to auger refusal
- Groundwater encountered at ~40' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 42.0 feet.

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BORING NUMBER BH-15

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/17/23
GROUND ELEVATION 379.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Laboratory area, 1945698.36 E, 374944.95 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface
	GB		OC = 1.2%			
					2.0	377.5
				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears dense to very dense, with cobbles and boulders >24"
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")
10						digging conditions indicate very dense (representative of SPT blow count >50/<6")
						excavated to ~13' BGS then began drilling
15	SPT	12-16-13 (29)	MC = 4%			medium dense, likely disturbed by excavation, poor recovery
20	SPT	50/6"				light gray, very dense
					21.0	358.5

- Drilling terminated at ~21' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 21.0 feet.

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BORING NUMBER BH-16

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 384.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Limestone Storage area, 1946130.02 E, 375004.46 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–1.5				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) tan, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	383.0
1.5–6.5				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears dense to very dense, with cobbles and large boulders digging conditions indicate very dense representative of SPT blow count >50/<6")	378.0
6.5–18.5				SP		POORLY GRADED SAND WITH GRAVEL, (SP) dark gray to black, fine to coarse grained, dry, appears dense to very dense, with cobbles and large boulders excavated to ~9' BGS then began drilling	366.0
10	SPT	4-5-6 (11)	MC = 1%			medium dense, likely disturbed by excavation	
15	SPT	17-20-19 (39)				dense, no recovery	
18.5–27.5				GP		POORLY GRADED GRAVEL, (GP) gray, dry, medium dense, poor recovery	357.0
20	SPT	24-14-18 (32)	MC = 3%				
25	SPT	20-37-45 (82)	MC = 3%			very dense, poor recovery	

- Drilling terminated at ~27.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 27.5 feet.

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BORING NUMBER BH-17

CLIENT	Tecnicas Reunidas	**PROJECT NAME**	Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER	223-1672	**PROJECT LOCATION**	Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED	8/15/23 **COMPLETED** 8/15/23	**GROUND ELEVATION**	387 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR	Geowest Drilling Inc	**GROUND WATER LEVELS:**	
DRILLING METHOD	Acker Recon Track Mounted Drill Rig w/HSA	**AT TIME OF DRILLING**	37.00 ft / Elev 350.00 ft
LOGGED BY	GR **CHECKED BY** IM	**AT END OF DRILLING**	---
NOTES	Milling area, 1946402.58 E, 375047.67 N	**AFTER DRILLING**	---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				SM	1.5	SILTY SAND (SM) / SANDY SILT, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	385.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, appears dense, with cobbles, trace boulders	
						digging conditions indicate dense (representative of SPT blow counts >30)	
10	SPT	3-4-7 (11)				excavated to ~10' BGS then began drilling, medium dense, likely disturbed by excavation, no recovery	
					13.5		373.5
				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, medium dense	
	SPT	6-11-16 (27)	MC = 2% Fines = 3%			gray	
20	SPT	8-19-48 (67)				very dense, no recovery	
					23.0		364.0
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) tan, dry to damp, dense	
	SPT	17-28-18 (46)	MC = 4%			with some Silty Sand (SM)	
30	SPT	21-50/6"	MC = 5%			very dense	
	SPT	17-23-21 (44)			∇	gray brown, damp, dense	
40	SPT	9-11-13 (24)	DD = 121 pcf Fines = 7%			brown, medium dense	
	SPT	12-12-12 (24)			46.5	gray brown	340.5

- Drilling terminated at ~46.5' BGS due to auger refusal
- Groundwater encountered at ~37' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 46.5 feet.

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BORING NUMBER BH-18+PZ

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 379 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING 29.50 ft / Elev 349.50 ft
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING 27.80 ft / Elev 351.20 ft
NOTES Substation area, 1945869.89 E, 375121.55 N
AFTER DRILLING 28.00 ft / Elev 351.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0–3.0	GB		OC = 1.9%	SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) tan, fine grained, dry, appears loose, with grass and weeds on surface	376.0
3.0–6.0				GP	POORLY GRADED GRAVEL WITH SAND, (GP) dark gray, dry, appears medium dense to dense, with cobbles and large boulders digging conditions indicate medium dense to dense (representative of SPT blow counts ±30)	373.0
6.0–9.0				SP	POORLY GRADED SAND WITH GRAVEL, (SP) black, fine to coarse grained, dry, appears medium dense, with cobbles and large boulders .	370.0
9.0–13.5	SPT (10 ft)	12-20-50/3"		GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, very dense	365.5
13.5–18.5	SPT (15 ft)	8-14-16 (30)	MC = 5%	SP	POORLY GRADED SAND WITH GRAVEL, (SP) dark gray, fine to medium grained, damp to moist, dense	360.5
18.5–27.0	SPT (20 ft)	12-19-22 (41)	MC = 6%	GP	POORLY GRADED GRAVEL WITH SAND, (GP) dark gray, damp to moist, dense	
	SPT (25 ft)	50/6"	MC = 11%		moist to wet, very dense	352.0
27.0–35.5	SPT (30 ft)	3-37-50/4"		SP	POORLY GRADED SAND WITH GRAVEL, (SP) tan, fine to medium grained, moist to wet, very dense	
	SPT (35 ft)	50/3"				343.5

- Piezometer installed
- Drilling terminated at ~35.25' BGS due to auger refusal
- Groundwater encountered at ~29.5' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 35.5 feet.

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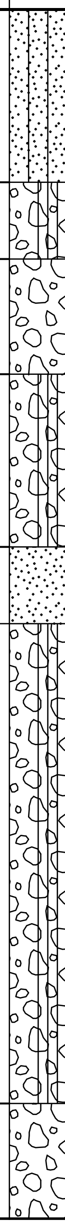
BORING NUMBER BH-19

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 388 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Calcium Nitrate area, 1946252.48 E, 375202.19 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears dense, with grass and weeds on surface met with auger refusal at ~4.5' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed .	
4.5							383.5
5	SPT	50-50/6"		GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense, with cobbles	
6.5							381.5
				GP		POORLY GRADED GRAVEL WITH SAND, (GP) dark gray, dry, very dense	
9.5							378.5
10	SPT	35-14-14 (28)	MC = 2%	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, medium dense	
14.0							374.0
15	SPT	8-21-40 (61)	MC = 2%	SP		POORLY GRADED SAND, (SP) gray, fine to medium grained, dry, dense to very dense, trace gravel	
16.0							372.0
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	
20	SPT	21-37-40 (77)	MC = 3%				
25	SPT	13-13-17 (30)	MC = 5%			damp, medium dense to dense	
28.5							359.5
30	SPT	41-41-50/3"		GP		POORLY GRADED GRAVEL, (GP) gray, damp, very dense, partial recovery	
31.5							356.5



- Drilling terminated at ~31.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 31.5 feet.

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BORING NUMBER BH-20

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 382 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Ammonium Nitrate Solution Unit area, 1946075.55 E, 375229.74 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	
3.5							378.5
				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears dense, with cobbles and large boulders	
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")	
						black to dark gray	
10						digging conditions indicate very dense (representative of SPT blow count >50/<6")	
						excavated to ~11' BGS then began drilling	
15	SPT	23-50/5"	MC = 2%			dark gray, very dense	
20	SPT	14-50/2"				poor recovery	
21.0							361.0

- Drilling terminated at ~21' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 21.0 feet.

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BORING NUMBER BH-21

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/16/23 **COMPLETED** 8/16/23

GROUND ELEVATION 387 ft **HOLE SIZE** 7 inches

DRILLING CONTRACTOR Geowest Drilling Inc

GROUND WATER LEVELS:

DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA

AT TIME OF DRILLING ---

LOGGED BY GR **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Granulation area, 1946446.05 E, 375242.36 N

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose to medium dense, trace gravel, with grass and weeds on surface
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")
						with gravel
						excavated to ~9' BGS then began drilling
10	SPT	8-12-19 (31)	MC = 3%			gray, dense, trace gravel
					13.5	373.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, dense
15	SPT	15-24-25 (49)	MC = 3%			
20	SPT	50/0"			20.5	very dense, no recovery 366.5

- Drilling terminated at ~20.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 20.5 feet.

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BORING NUMBER BH-22 (DH-22)

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 9/27/23 **COMPLETED** 9/27/23

GROUND ELEVATION 381 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Western States Soil Conservation, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Geoprobe 8150 LS - Sonic Drill Rig

∇ **AT TIME OF DRILLING** 31.50 ft / Elev 349.50 ft

LOGGED BY KAH/GR **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Power Generation area, 46.355974,-119.290320

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose to medium dense	
				4.0		377.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears dense	
				6.0		375.0
			SM		SILTY SAND, (SM) gray, fine grained, dry, appears medium dense, trace gravel	
				8.0		373.0
			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, appears dense	
10				10.0		371.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears very dense	
				19.0		362.0
20			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, appears very dense	
				23.0		358.0
30			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry to damp, appears very dense ∇	
				35.0		346.0
			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) gray, appears dense	
				36.5		344.5
40			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry to damp, appears very dense	
50				53.0		328.0

(Continued Next Page)

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BORING NUMBER BH-22 (DH-22)

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
			ML		SILT, (ML) light gray to white, appears very dense, slightly to moderately cemented	
	GB	Fines = 93%				
60						
67.0						314.0
			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) olive gray, fine grained, appears medium dense	
	GB	Fines = 11%				
70						
75.0						306.0
			GP		POORLY GRADED GRAVEL, (GP) dark gray, appears very dense	
80 / 80.0						301.0

- Boring prepared with PVC pipe grouted in place for down-hole seismic testing
- Groundwater encountered at ~31.5' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 80.0 feet.

Sample collected from boring BH-22 from 0 to 20' BGS

Sample collected from boring BH-22 from 10 to 30' BGS


Sample collected from boring BH-22 from 30 to 40' BGS

Sample collected from boring BH-22 from 40 to 50' BGS

Sample collected from boring BH-22 from 50 to 60' BGS

Sample collected from boring BH-22 from 60 to 70' BGS

GN Northern, Inc
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Telephone: (509) 248-9798

BORING NUMBER BH-23 (DH-23)

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 9/28/23 **COMPLETED** 9/28/23
GROUND ELEVATION 389 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Western States Soil Conservation, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Geoprobe 8150 LS - Sonic Drill Rig
∇ **AT TIME OF DRILLING** 39.50 ft / Elev 349.50 ft
LOGGED BY KAH/GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES ASU area, 46.356444,-119.291217
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose to medium dense	
	GB	MC = 2% Fines = 20%		3.5		385.5
			GM		SILTY GRAVEL, (GM) brown, dry to damp, appears dense	
				6.0		383.0
			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, appears very dense, some cobbles and boulders	
10	BULK	MC = 1% Fines = 5%				
	BULK	MC = 2% Fines = 12%				
20				20.0		369.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears very dense, with cobbles and boulders no recovery	
30					partial recovery	
40					∇	
50						
				58.0		331.0
60			SP-SM	60.0	POORLY GRADED SAND WITH SILT, (SP-SM) olive brown, fine grained, appears very dense	329.0

- Boring prepared with PVC pipe grouted in place for down-hole seismic testing
- Groundwater encountered at ~39.5' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 60.0 feet.

Sample collected from boring BH-23 from 0-10' BGS

Sample collected from boring BH-23 from 10-20' BGS

Sample collected from boring BH-23 from 20-23' BGS

Sample collected from boring BH-23 from 30-40' BGS

Sample collected from boring BH-23 from 40-50' BGS

Sample collected from boring BH-23 from 50-60' BGS

BORING NUMBER BH-24

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CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/18/23 **COMPLETED** 8/18/23
GROUND ELEVATION 383.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Ammonia area, 1945841.47 E, 375492.75 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
1.5				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, appears medium dense, with cobbles and large boulders (382.0)
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")
						.
9.5				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) gray brown to tan, fine to medium grained, dry, medium dense, trace gravel (374.0)
10	SPT	9-9-14 (23)	MC = 2% DD = 114 pcf SG = 2.8			
13.5				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense (370.0)
15	SPT	14-29-30 (59)	MC = 2%			
20	SPT	6-7-14 (21)	MC = 4%			dry to damp, medium dense
25	SPT	19-26-29 (55)	MC = 2%			gray brown, dry, very dense
30	SPT	50/6"				
30.5						(353.0)

- Drilling terminated at ~30.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 30.5 feet.

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BORING NUMBER BH-25 (DH-25)

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/23/23 **COMPLETED** 8/30/23

GROUND ELEVATION 381 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Johnson Exploration Drilling

GROUND WATER LEVELS:

DRILLING METHOD Mobile B-53 w/ ODEX and Rope & Cathead

∇ **AT TIME OF DRILLING** 31.50 ft / Elev 349.50 ft

LOGGED BY KAH/ABC/GR **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Nitric Acid area, 46.356616,-119.289144

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0				SM	SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose	
4.0						377.0
	SPT	50/3"		GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, very dense, no recovery	
	BULK		MC = 3% Fines = 10%			
10	SPT	50/4"				
13.5						367.5
	SPT	27-34-50/5"		GP	POORLY GRADED GRAVEL, (GP) gray, dry, very dense	
18.5						362.5
20	SPT	40-50/3"		GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	
23.5						357.5
	SPT	50/3"		GP	POORLY GRADED GRAVEL, (GP) gray brown, dry, very dense, poor recovery	
30	SPT	50/4"			∇	
	SPT	50/4"			with sand	
38.5						342.5
40	SPT	50/6"		GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, very dense poor recovery	
	SPT	50/5"	Fines = 4%		no recovery	
50	SPT	10-43-50/4"				
					drilling terminated at 51.5' BGS due to heaving sands, drilling resumed on 9/26 with Geoprobe 8150LS sonic drill rig	
55.0						326.0
	GB		Fines = 15%	SM	SILTY SAND, (SM) gray, fine grained, appears dense	
60 / 60.0						321.0

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BORING NUMBER BH-25 (DH-25)

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
60				ML		SILT WITH SAND, (ML) white to light gray, appears dense, slightly cemented
	SPT	36-50-50/2"				very dense
	GB		Fines = 71%			
70	SPT	12-50/5"				
75.0				GP		306.0 POORLY GRADED GRAVEL, (GP) dark gray, appears very dense
80 / 80.0						301.0

- Boring prepared with PVC pipe grouted in place for down-hole seismic testing
- Groundwater encountered at ~31.5' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 80.0 feet.

Sample collected from boring BH-25 from 0-10' BGS

Sample collected from boring BH-25 from 10-20' BGS

Sample collected from boring BH-25 from 25-30' BGS

Sample collected from boring BH-25 from 30-40' BGS

Sample collected from boring BH-25 from 40-50' BGS

Sample collected from boring BH-25 from 50-60' BGS

BORING BH-25 PHOTOGRAPHIC BORING LOGS (30-60') **PROJECT NO. 223-1672**

Sample collected from boring BH-25 from 60-70' BGS

Sample collected from boring BH-25 from 70-75' BGS

Sample collected from boring BH-25 from 75-80' BGS

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BORING NUMBER BH-26

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 387 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Nitric Acid area, 1946395.79 E, 375457.13 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
5	SPT	31-50/5"	MC = 3% DD = 119 pcf Fines = 11% SG = 2.68			very dense, with gravel
7.5						379.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense
10	SPT	20-25-43 (68)	MC = 3%			
15	SPT	10-21-35 (56)	MC = 4%			dry to damp
20	SPT	39-50/2"				dry, partial recovery
21.0						366.0

- Drilling terminated at ~21' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 21.0 feet.

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BORING NUMBER BH-27

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/18/23 **COMPLETED** 8/18/23
GROUND ELEVATION 395 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Ammonia Storage area, 1945124.76 E, 375464.26 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
	GB		OC = 0.8%			1st drilling attempt met with refusal at ~3' BGS indicating very dense (representative of SPT blow count >50/<6"), boring location moved to within previously excavated TP-11 and drilling resumed at ~14' BGS
3.0						392.0
				GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears dense to very dense
5						digging conditions indicate dense to very dense (representative of SPT blow counts ±50)
10						digging conditions indicate dense to very dense (representative of SPT blow counts ±50)
15	SPT	7-13-20 (33)				dense, poor recovery
20	SPT	17-50/1"				very dense, poor recovery
25	SPT	12-50/6"	MC = 4%			damp, poor recovery
27.0						368.0

- Drilling terminated at ~27' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 27.0 feet.

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BORING NUMBER BH-28

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 390 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES North of ASU area, 1945624.62 E, 375554.71 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
2.5				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, dense (elev. 387.5)
5	SPT	27-25-22 (47)	MC = 2%			
10	SPT	15-20-21 (41)				
13.5				GP		POORLY GRADED GRAVEL, (GP) gray, dry, very dense (elev. 376.5)
15	SPT	16-36-50/4"	MC = 2%			
17.0						(elev. 373.0)

- Drilling terminated at ~17' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 17.0 feet.

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BORING NUMBER BH-29

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/18/23 **COMPLETED** 8/18/23
GROUND ELEVATION 392.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY ABC **CHECKED BY** IM
AT END OF DRILLING ---
NOTES North of Ammonia Storage area, 1945317.35 E, 375568.60 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0–3.5				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) tan to light brown, fine to medium grained, dry to damp, appears loose to medium dense, with grass and weeds on surface	389.0
3.5–5.0				SP		POORLY GRADED SAND WITH GRAVEL, (SP) black to dark gray, fine grained, dry, appears dense, with cobbles, trace boulders	387.5
5.0	SPT	50/6"	MC = 3% DD = 120 pcf Fines = 12% SG = 2.67	SM		SILTY SAND, (SM) tan to light brown, fine grained, dry, very dense, with some gravel and cobbles	
10	SPT	20-50/6"	MC = 1% DD = 109 pcf Fines = 25% SG = 2.71	SM			
15	SPT	5-8-20 (28)		SM		medium dense, no recovery	
17.0				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, very dense	375.5
20	SPT	21-33-50/5"	MC = 2%	GP-GM			
23.0							369.5

- Drilling terminated at ~23' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 23.0 feet.

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BORING NUMBER BH-30

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 383 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Hydrogen Production Unit area, 1946001.88 E, 375686.32 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
2.5						380.5
				GP		POORLY GRADED GRAVEL, (GP) gray, dry, very dense, with cobbles and boulders
5	SPT	26-50/6"	MC = 2%			
						1st drilling attempt met with refusal at ~7' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed
8.5						374.5
				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) gray, fine to medium grained, dry to damp, very dense
10	SPT	21-27-30 (57)	MC = 4%			
15	SPT	31-40-50 (90)				
						met with auger refusal, spiked, apparent gravelly layer with cobbles and boulders
20	SPT	33-36-50 (86)				
24.3	SPT	50/2"				no recovery 358.8

- Drilling terminated at ~24.25' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 24.3 feet.

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BORING NUMBER BH-31

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 384 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Hydrogen Production Unit area, 1946476.62 E, 375702.00 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
4.0						380.0
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, medium dense
5	SPT	11-13-14 (27)	MC = 2%			1st drilling attempt met with refusal at ~5' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed
10	SPT	50/3"				very dense, no recovery
15	SPT	13-16-20 (36)				dense
16.5						367.5

- Drilling terminated at ~16.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 16.5 feet.

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BORING NUMBER BH-32

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 9/7/23 **COMPLETED** 9/7/23
GROUND ELEVATION 391 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Haz-Tech Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME-75 HSA & Autohammer
AT TIME OF DRILLING 38.00 ft / Elev 353.00 ft
LOGGED BY KAH/GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Flare area, 1945078.77 E, 375978.16 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0			SM	SILTY SAND, (SM) brown, fine grained, dry, appears loose	
2.5	SPT	22-42-36 (78)	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	388.5
	SPT	6-7-4 (11)		medium dense	
	SPT	3-10-10 (20)		partial recovery	
9.5	SPT	6-5-5 (10)	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) gray, fine to coarse grained, dry, loose to medium dense	381.5
	SPT	8-10-14 (24)		medium dense, some Poorly Graded Gravel (GP)	
13.0	SPT	40-46-39 (85)	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	378.0
20	SPT	8-17-31 (48)		damp, dense	
	SPT	7-25-31 (56)			
30	SPT	12-50/5"			
	SPT	22-50/4"			
40	SPT	12-35-49 (84)			
	SPT	8-21-48 (69)			
50	SPT	12-20-29 (49)		dense	
53.0	SPT	40-50/4"	GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray, very dense	338.0
57.5	SPT	50/4"	GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, very dense	333.5
62.0	SPT	50/3"			329.0

- Drilling terminated at ~62' BGS due to auger refusal
- Groundwater encountered at ~38' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 62.0 feet.

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BORING NUMBER BH-33

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/18/23 **COMPLETED** 8/18/23

GROUND ELEVATION 392 ft **HOLE SIZE** 7 inches

DRILLING CONTRACTOR Geologic Drill Partners, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA

AT TIME OF DRILLING ---

LOGGED BY KAH **CHECKED BY** IM

AT END OF DRILLING ---

NOTES Hydrogen Production Unit area, 1945649.66 E, 375831.90 N

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface
4.0						388.0
5	SPT	43-50/6"	MC = 2% Fines = 7%	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense
8.5						383.5
10	SPT	47-50/4"	MC = 2% Fines = 15%	SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, very dense
15	SPT	11-10-11 (21)				medium dense, with gravel
18.0						374.0
20	SPT	50/6"		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, very dense
25	SPT	50/5"				
26.0						366.0

- Drilling terminated at ~26' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 26.0 feet.

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Yakima, WA 99802
Telephone: (509) 248-9798

BORING NUMBER BH-34

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/18/23 **COMPLETED** 8/18/23
GROUND ELEVATION 392 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Hydrogen Production Unit area, 1945747.90 E, 375913.64 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM		SILTY SAND (SM) / POORLY GRADED SAND WITH SILT, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
5				GM		5.0 — 387.0 SILTY GRAVEL, (GM) gray, dry, digging conditions indicate medium dense to dense (representative of SPT blow counts ±30) excavated to ~9' BGS then began drilling
				SP		9.5 — 382.5 POORLY GRADED SAND WITH GRAVEL, (SP) coarse grained, dry, dense, no recovery
10	SPT	26-21-18 (39)				
15	SPT	15-10-9 (19)	MC = 3% DD = 120 pcf Fines = 5% SG = 2.66			medium dense, with interbedded Poorly Graded Sand with Silt (SP-SM)
				SP		18.5 — 373.5 POORLY GRADED SAND, (SP) gray, fine to medium grained, damp, very dense, with interbedded lenses of Sandy Silt (ML)
20	SPT	40-34-43 (77)	MC = 4%			
				GP		23.5 — 368.5 POORLY GRADED GRAVEL WITH SAND, (GP) gray, damp, very dense, with interbedded silt lenses
25	SPT	50/6"	MC = 4%			
						28.0 — 364.0

- Drilling terminated at ~28' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 28.0 feet.

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BORING NUMBER BH-35

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 383.5 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Hydrogen Production Unit area, 1946311.36 E, 375955.48 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	Depth / Elevation
0				SM	SILTY SAND, (SM) brown, fine grained, dry, appears loose to medium dense, with grass and weeds on surface	3.5 / 380.0
	SPT	20-30-35 (65)				
5				GM	SILTY GRAVEL, (GM) gray, dry, very dense 1st drilling attempt met with auger refusal at ~5' BGS indicating very dense (representative of SPT blow count >50/<6")	8.5 / 375.0
10	SPT	50/3"		GP	POORLY GRADED GRAVEL, (GP) gray, dry, very dense, partial recovery	14.5 / 369.0
15	SPT	10-11-13 (24)	MC = 4% DD = 121 pcf Fines = 9% SG = 2.68	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) gray, fine to medium grained, dry to damp, medium dense, some gravel	18.5 / 365.0
20	SPT	10-13-15 (28)	MC = 5%	GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray, damp, medium dense	
25	SPT	28-50/2"			damp to moist, very dense	26.0 / 357.5

- Drilling terminated at ~26' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 26.0 feet.

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BORING NUMBER BH-36

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 388 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Cooling Water System area, 1946774.70 E, 375727.00 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0				SP-SM	1.5	POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	386.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, dry, appears medium dense, with cobbles and boulders	
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")	
10						excavated to ~9' BGS then began drilling	
	SPT	6-8-6 (14)				medium dense, possibly disturbed by excavator	
					13.5		374.5
15				GP		POORLY GRADED GRAVEL, (GP) gray, dry, dense, partial recovery	
	SPT	35-19-24 (43)	MC = 2%				
					18.5		369.5
20				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, very dense	
	SPT	17-24-29 (53)	MC = 2%				
25	SPT	5-9-11 (20)				medium dense, no recovery	
30	SPT	13-19-20 (39)	MC = 4%			dry to damp, dense	
					33.0		355.0

- Drilling terminated at ~33' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 33.0 feet.

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BORING NUMBER BH-37

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/17/23
GROUND ELEVATION 385 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH/GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Cooling Water System area, 1946665.92 E, 375920.81 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	
2.0				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, appears medium dense to dense, with cobbles and large boulders	383.0
5						digging conditions indicate medium dense to dense (representative of SPT blow counts ±30)	
8.5				GP		POORLY GRADED GRAVEL, (GP) gray, dry, appears medium dense to dense .	376.5
10	SPT	5-10-17 (27)	MC = 2%			medium dense	
13.5				GP		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP) gray, dry, very dense	371.5
15	SPT	41-50/6"	MC = 2%				
20	SPT	7-8-10 (18)	MC = 5% Fines = 4%			damp, medium dense	
25	SPT	35-50/6"				very dense	
26.5							358.5

- Drilling terminated at ~26.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 26.5 feet.

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BORING NUMBER BH-38

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 388.5 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Deere 135D Excavator
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Cooling Water System area, 1946762.79 E, 376140.40 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, some Silty Sand (SM), with grass and weeds on surface	
	GB		MC = 2% DD = 107 pcf Fines = 6% OC = 1.7% NON-PLASTIC				
5					5.0		383.5
	SPT	23-50/3"		GP		POORLY GRADED GRAVEL, (GP) very dense, no recovery	
						1st attempt met with refusal at ~7' BGS indicating very dense (representative of SPT blow count >50/<6"), moved a few feet and drilling resumed	
10	SPT	50/2"				poor recovery	
	SPT	50/6"				poor recovery, pulverized rock fragments	
15					15.0		373.5

- Drilling terminated at ~15' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 15.0 feet.

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BORING NUMBER BH-39

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/18/23 **COMPLETED** 8/18/23
GROUND ELEVATION 385.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES HV Substation, 1946261.12 E, 376119.56 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	
2.5				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray and brown, dry, very dense, with cobbles and boulders	383.0
5	SPT	50/5"	MC = 1%				
10	SPT	15-21-27 (48)	MC = 3% DD = 127 pcf SG = 2.65			dense	
15	SPT	31-31-45 (76)	MC = 3%			very dense	
20	SPT	50/2"					
20.5							365.0

- Drilling terminated at ~20.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 20.5 feet.

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BORING NUMBER BH-40+PZ

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 390.5 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING 39.00 ft / Elev 351.50 ft
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING 39.00 ft / Elev 351.50 ft
NOTES HV Substation area, 1945963.13 E, 376220.38 N
AFTER DRILLING 39.40 ft / Elev 351.10 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	MATERIAL DESCRIPTION
0–3.5				SP-SM	POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface (387.0)
3.5–19.0				GP-GM	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray and brown, dry, appears medium dense, with cobbles digging conditions indicate medium dense (representative of SPT blow counts <30) excavated to ~9' BGS then began drilling
10	SPT	10-14-15 (29)	MC = 2%		medium dense
	SPT	24-50/6"			very dense (371.5)
19.0–28.5				SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) brown, fine grained, dry to damp, medium dense
20	SPT	14-26-30 (56)	MC = 3% Fines = 5%		
	SPT	6-8-8 (16)	MC = 5% DD = 112 pcf SG = 2.69		medium dense (362.0)
28.5–66.5				GP	POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, damp, very dense
30	SPT	5-6-5 (11)	MC = 6% DD = 119 pcf Fines = 5% SG = 2.66		
	SPT	3-18-8 (26)			damp to moist
40	SPT	4-7-4 (11)			loose to medium dense
	SPT	11-10-13 (23)			medium dense
50	SPT	6-7-9 (16)	Fines = 2%		black and brown
	SPT	9-14-29 (43)			dense
60	SPT	9-18-50/6"			very dense
66.5	SPT	50/3"			(324.0)

- Piezometer installed
- Groundwater encountered at ~39' BGS at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 66.5 feet.

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BORING NUMBER BH-41

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 390 ft **HOLE SIZE** 7 inches
DRILLING CONTRACTOR Geowest Drilling Inc
GROUND WATER LEVELS:
DRILLING METHOD Acker Recon Track Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY GR **CHECKED BY** IM
AT END OF DRILLING ---
NOTES HV Substation area, 1945755.13 E, 376216.10 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine grained, dry, appears loose, with grass and weeds on surface
1.5						388.5
				GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray brown, dry, appears medium dense, with cobbles and boulders
5						digging conditions indicate very dense (representative of SPT blow count >50/<6")
						excavated to ~9' BGS then began drilling
10	SPT	10-9-6 (15)	MC = 2% DD = 121 pcf SG = 2.65			medium dense
15	SPT	4-18-14 (32)	MC = 3%			
16.5						373.5

- Drilling terminated at ~16.5' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 16.5 feet.

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BORING NUMBER BH-42

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 389 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Geologic Drill Partners, Inc.
GROUND WATER LEVELS:
DRILLING METHOD DeepRock XL Trailer Mounted Drill Rig w/HSA
AT TIME OF DRILLING ---
LOGGED BY KAH **CHECKED BY** IM
AT END OF DRILLING ---
NOTES Hydrogen Production Unit area, 1945714.02 E, 375685.91 N
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0				SM		SILTY SAND, (SM) brown, fine grained, dry, appears loose, with grass and weeds on surface	
2.0							387.0
				GM		SILTY GRAVEL, (GM) gray brown, dry, appears dense	
5						digging conditions indicate dense (representative of SPT blow counts >30)	
6.0							383.0
				SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) dark gray, fine to coarse grained, dry, appears dense excavated to ~8' BGS then began drilling	
8.5							380.5
10	SPT	11-11-20 (31)	MC = 3% DD = 124 pcf SG = 2.66	GP		POORLY GRADED GRAVEL, (GP) gray, dry, medium dense to dense, partial recovery	
13.5							375.5
15	SPT	17-18-31 (49)	MC = 3% DD = 127 pcf SG = 2.67	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) gray, dry, dense	
18.5							370.5
20	SPT	37-50/6"	MC = 4%	GP		POORLY GRADED GRAVEL, (GP) gray, damp, very dense	
25	SPT	31-34-50 (84)					
30	SPT	26-28-31 (59)	MC = 4%			dry to damp	
32.0							357.0

- Drilling terminated at ~32' BGS due to auger refusal
- Groundwater not encountered at time of drilling
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of borehole at 32.0 feet.

Corrected SPT N_{60} and $N_{1(60)}$ values for SPT samples within selected borings

Depth	B-4			B-6			B-9			B-16			B-17			B-24			B-32			B-36			B-40			B-41		
(feet)	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$	N	N_{60}	$(N_1)_{60}$
2.5																			78	86	202									
5	27	30	52	13	14	25													11	12	21									
7.5	29	32	46																20	22	32									
10	31	34	43				75	83	104	11	12	15	11	12	16	23	25	32	10	11	14	14	15	19	29	32	40	15	17	21
12.5	13	16	18	59	74	83													24	30	34									
15	23	29	30	56	70	72	33	41	43	39	49	50	27	34	35	59	74	76	85	106	110	43	54	56				32	40	41
20				30	42	38				32	45	40	67	93	85	21	29	27	48	67	60	53	75	67	56	78	70			
25	63	88	71	23	32	26	37	52	42	82	114	93	46	64	52	55	77	62	56	78	63	20	28	23	16	22	18			
30	22	32	24	10	15	11	26	38	28													39	57	42	11	16	12			
35	44	65	44	11	16	12	16	23	17				44	65	45										26	38	26			
40	58	85	55				43	63	43				24	35	23				84	123	80				11	16	11			
45							45	66	44				24	35	23				69	101	64				23	34	21			
50	64	94	57																49	72	44				16	23	14			
55																									43	63	38			
60	46	67	54																											

TEST PIT NUMBER TP-1

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CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 386.5 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES West of Truck Loading Station, 1945916.95 E, 374276.15 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on surface
	BULK	MC = 4% Fines = 15% NON-PLASTIC		3.0	383.5
5			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears loose to medium dense, with cobbles, trace boulders
10					appears medium dense to dense
					appears dense to very dense, cemented
				14.0	372.5

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 14.0 feet.

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TEST PIT NUMBER TP-2

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 386 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES Northwest of Laboaratory, 1945524.94 E, 375023.26 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, appears loose, with grass and weeds on surface	
					some gravel, with cobbles	
5	BULK	MC = 2% Fines = 7% NON-PLASTIC				
6.0						380.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears medium dense, some caving	
10					appears medium dense to dense	
15.0						371.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 15.0 feet.

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TEST PIT NUMBER TP-3 / IT-1

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 386 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES North of Limestone Storage area, 1946201.03 E, 375115.69 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, appears loose, with grass and weeds on surface	
	BULK	MC = 2% Fines = 11% NON-PLASTIC				
4.0			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, dry, appears loose to medium dense, with cobbles	382.0
5						
6.0			GP		POORLY GRADED GRAVEL WITH SAND, (GP) black, fine to coarse grained, dry, appears medium dense, with cobbles and boulders, partially cemented	380.0
10						
					appears medium dense to dense	
15.0						371.0

- Infiltration test performed at ~3' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 15.0 feet.

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TEST PIT NUMBER TP-4 / IT-2

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 379 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES North of Power Generation area, 1945951.23 E, 375366.42 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, appears loose, with cobbles, with grass and weeds on the surface	
5	BULK	MC = 2% Fines = 7%		5.5		373.5
			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) black, dry, appears medium dense, with cobbles and boulders	
10					appears dense	
				14.0		365.0

- Infiltration test performed at ~8' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 14.0 feet.

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TEST PIT NUMBER TP-5

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 389.5 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES Southeast of Hydrogen Production Unit, 1945492.75 E, 375607.76 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM		SILTY SAND, (SM) brown, fine to coarse grained, dry, appears loose, with gravel, with grass and weeds on surface
	BULK	MC = 2% DD = 112 pcf Fines = 24% SG = 2.69 NON-PLASTIC			
				3.0	386.5
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray, dry, appears medium dense to dense, with cobbles and boulders, cemented to ~6' BGS with Silty Sand (SM)
5	BULK	MC = 2% Fines = 2% NON-PLASTIC			Non-Plastic
10					appears dense to very dense
				14.0	375.5

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 14.0 feet.

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TEST PIT NUMBER TP-6

CLIENT Tecnicas Reunidas

PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant

PROJECT NUMBER 223-1672

PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA

DATE STARTED 8/17/23 **COMPLETED** 8/17/23

GROUND ELEVATION 388 ft **TEST PIT SIZE** 30 x 72 inches

EXCAVATION CONTRACTOR Big D's Construction

GROUND WATER LEVELS:

EXCAVATION METHOD Link-Belt 460 Excavator

AT TIME OF EXCAVATION ---

LOGGED BY GV **CHECKED BY** IM

AT END OF EXCAVATION ---

NOTES East of Cooling Water System area, 1946601.07 E, 376032.51 N

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on surface	
	BULK	NON-PLASTIC MC = 3% Fines = 15% OC = 1.3% SG = 2.7		4.0		384.0
5			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears medium dense, with cobbles and boulders	
10						
15				15.0		373.0

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 15.0 feet.

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TEST PIT NUMBER TP-7 / IT-3

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 390 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES Truck Loading Station area, 1945801.59 E, 398730.47 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on surface	
	BULK	MC = 1% Fines = 11% OC = 1.7% NON-PLASTIC		3.0	some Poorly Graded Sand with Silt (SP-SM)	387.0
			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears loose to medium dense, with cobbles and boulders	
5	BULK	MC = 2% Fines = 1% NON-PLASTIC				
10					appears dense to very dense	
				14.0		376.0

- Infiltration test performed at ~4' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 14.0 feet.

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TEST PIT NUMBER TP-8

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 383.5 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES North of Truck Loading Station area, 1946091.32 E, 374728.51 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, appears loose, with grass and weeds on surface	
1.0			GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, dry, appears medium dense, with cobbles	382.5
5.0	BULK	MC = 3% Fines = 5% NON-PLASTIC	GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears medium dense, with cobbles and boulders, some caving	378.5
10					appears medium dense to dense	
13.0						370.5

- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 13.0 feet.

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TEST PIT NUMBER TP-9 / IT-4

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/16/23 **COMPLETED** 8/16/23
GROUND ELEVATION 380 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES Northwest of Effluent Waste Water System area, 1945555.87 E, 374718.48 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0 – 4.0		SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on surface	376.0
4.0 – 6.0		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, dry, appears loose to medium dense	374.0
6.0 – 10.0		SP		POORLY GRADED SAND WITH GRAVEL, (SP) gray brown, fine to coarse grained, dry, appears medium dense, with cobbles	370.0
10.0 – 13.0		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears dense	367.0

- Infiltration test performed at ~3' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 13.0 feet.

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TEST PIT NUMBER TP-10 / IT-5

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 386.5 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES West of Well Easement area, 1946689.56 E, 375434.66 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on surface	
5	BULK	MC = 2% Fines = 15% NON-PLASTIC				
7.0			GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears medium dense to dense, partially cemented	379.5
10						
15.0						371.5

- Infiltration test performed at ~5' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 15.0 feet.

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TEST PIT NUMBER TP-11 / IT-6

CLIENT	Tecnicas Reunidas	**PROJECT NAME**	Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER	223-1672	**PROJECT LOCATION**	Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED	8/17/23 **COMPLETED** 8/17/23	**GROUND ELEVATION**	395 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR	Big D's Construction	**GROUND WATER LEVELS:**	
EXCAVATION METHOD	Link-Belt 460 Excavator	**AT TIME OF EXCAVATION**	---
LOGGED BY	GV **CHECKED BY** IM	**AT END OF EXCAVATION**	---
NOTES	Ammonia Storage area, 1945115.35 E, 375452.08 N	**AFTER EXCAVATION**	---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0 – 3.0		SM		SILTY SAND, (SM) brown, fine to medium grained, dry, appears loose, with grass and weeds on the surface	392.0
3.0 – 9.0		GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) brown, dry, appears medium dense to dense	386.0
9.0 – 14.0		GP		POORLY GRADED GRAVEL WITH SAND, (GP) gray brown, dry, appears dense to very dense, with cobbles, partially cemented	381.0

- Infiltration test performed at ~3' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 14.0 feet.

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TEST PIT NUMBER TP-12 / IT-7

CLIENT Tecnicas Reunidas
PROJECT NAME Atlas Agro-Pacific Green Fertilizer Plant
PROJECT NUMBER 223-1672
PROJECT LOCATION Horn Rapids Rd. & Stevens Dr., Richland, WA, USA
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION 391 ft **TEST PIT SIZE** 30 x 72 inches
EXCAVATION CONTRACTOR Big D's Construction
GROUND WATER LEVELS:
EXCAVATION METHOD Link-Belt 460 Excavator
AT TIME OF EXCAVATION ---
LOGGED BY GV **CHECKED BY** IM
AT END OF EXCAVATION ---
NOTES West of Substation area, 1945661.56 E, 376076.80 N
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SP-SM		POORLY GRADED SAND WITH SILT, (SP-SM) brown, fine to coarse grained, dry, appears loose, with grass and weeds on surface	
3.0			GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, dry, appears medium dense	388.0
5	BULK	MC = 2% Fines = 3% NON-PLASTIC				
10.0						381.0

- Infiltration test performed at ~6' BGS
- Groundwater not encountered at time of excavation
- Referenced elevations are approximate and based on the Topographic Survey dated 9/19/2023 prepared by Rogers Surveying Inc., P.S.

Bottom of test pit at 10.0 feet.

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KEY CHART

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COARSE-GRAINED SOILS			FINE-GRAINED SOILS		
DENSITY	N (BLOWS/FT)	FIELD TEST	CONSISTENCY	N (BLOWS/FT)	FIELD TEST
Very Loose	0 – 4	Easily penetrated with ½-inch reinforcing rod pushed by hand	Very Soft	0 – 2	Easily penetrated several inches by thumb
Loose	4 – 10	Difficult to penetrate with ½-inch reinforcing rod pushed by hand	Soft	2 – 4	Easily penetrated one inch by thumb
Medium -Dense	10 – 30	Easily penetrated with ½-inch rod driven with a 5-lb hammer	Medium-Stiff	4 – 8	Penetrated over ½-inch by thumb with moderate effort
Dense	30 – 50	Difficult to penetrate with ½-inch rod driven with a 5-lb hammer	Stiff	8 – 15	Indented about ½-inch by thumb but penetrated with great effort
Very Dense	> 50	penetrated only a few inches with ½-inch rod driven with a 5-lb hammer	Very Stiff	15 – 30	Readily indented by thumb
			Hard	> 30	Indented with difficulty by thumbnail

USCS SOIL CLASSIFICATION

MAJOR DIVISIONS			GROUP DESCRIPTION	
Coarse-Grained Soils <50% passes #200 sieve	**Gravel** and **Gravelly Soils** <50% coarse fraction passes #4 sieve	**Gravel** (with little or no fines)	GW	Well-graded **Gravel**
			GP	Poorly Graded **Gravel**
		Gravel (with >12% fines)	GM	Silty **Gravel**
			GC	Clayey **Gravel**
	Sand and **Sandy Soils** >50% coarse fraction passes #4 sieve	**Sand** (with little or no fines)	SW	Well-graded **Sand**
			SP	Poorly graded **Sand**
		Sand (with >12% fines)	SM	Silty **Sand**
			SC	Clayey **Sand**
Fine-Grained Soils >50% passes #200 sieve	**Silt** and **Clay** Liquid Limit < 50		ML	**Silt**
			CL	Lean **Clay**
			OL	Organic **Silt** and **Clay** (low plasticity)
	Silt and **Clay** Liquid Limit > 50		MH	Inorganic **Silt**
			CH	Inorganic **Clay**
			OH	Organic **Clay** and **Silt** (med. to high plasticity)
Highly Organic Soils			PT	**Peat** / **Top Soil**

LOG SYMBOLS

2S	2" OD Split Spoon (SPT)
3S	3" OD Split Spoon
NS	Non-Standard Split Spoon
ST	Shelby Tube
CR	Core Run
BG	Bag Sample
TV	Torvane Reading
PP	Penetrometer Reading
NR	No Recovery
GW	Groundwater Table

MODIFIERS

DESCRIPTION	RANGE
Trace	<5%
Little	5% – 12%
Some	>12%

MOISTURE CONTENT

DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but not visible water
Wet	Visible free water

SOIL CLASSIFICATION INCLUDES

1. Group Name
2. Group Symbol
3. Color
4. Moisture content
5. Density / consistency
6. Cementation
7. Particle size (if applicable)
8. Odor (if present)
9. Comments

MAJOR DIVISIONS WITH GRAIN SIZE

SIEVE SIZE							
	12"	3"	3/4"	4	10	40	200
GRAIN SIZE (INCHES)							
	12	3	0.75	0.19	0.079	0.0171	0.0029
Boulders	Cobbles	Gravel		Sand			Silt and Clay
		Coarse	Fine	Coarse	Medium	Fine	

Conditions shown on boring and testpit logs represent our observations at the time and location of the fieldwork, modifications based on lab test, analysis, and geological and engineering judgment. These conditions may not exist at other times and locations, even in close proximity thereof. This information was gathered as part of our investigation, and we are not responsible for any use or interpretation of the information by others.

Appendix V

Site and Exploration Photographs **(Plates 1-17)**


View of site conditions near boring BH+PZ-04 looking west


Piezometer installed in boring BH+PZ-04


View of site conditions looking north form boring BH-05


Soil sample obtained from boring BH-05 from 35' BGS


View of site conditions near boring BH-06 looking south

Soil sample obtained from boring BH-06 from 30' BGS

PLATE 1: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**


Exposed soil profile of excavated upper ~9' within boring BH-07


Soil sample obtained from boring BH-07 from 25' BGS


View of site condition near boring BH-08 looking northwest


View of site conditions near boring BH-08 looking west


Exposed soil profile of excavated upper ~9' within boring BH-09


View of site conditions near boring BH-09 looking south

PLATE 2: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

View of site conditions near boring BH-10 looking east

Cobbles and boulders excavated from upper ~9' of boring BH-11

Exposed soil profile of excavated upper ~9' within boring BH-11

Exposed soil profile of excavated upper ~9' within boring BH-12

View of site conditions near boring BH-13 looking northeast

Exposed soil profile of excavated upper ~9' within boring BH-14

Soil obtained from boring BH-14 from 20' BGS

Soil obtained from boring BH-14 from 40' BGS

Cobbles & boulders excavated from upper ~13' from boring BH-15

Cobbles extracted from boring BH-15

Exposed soil profile of excavated upper ~9' within boring BH-16

Soil sample obtained from boring BH-17 from 40' BGS

View of site conditions looking south from boring BH+PZ-18

Piezometer installed in boring BH+PZ-18

Soil sample obtained from boring BH+PZ-18 from 30' BGS

Exposed soil profile of excavated upper ~9' within boring BH-19

View of site conditions near boring BH-19 looking west

Exposed soil profile of excavated upper ~11' within boring BH-20

PLATE 5: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

View of site conditions near boring BH-20 looking northeast

Exposed soil profile of excavated upper ~9' within boring BH-21

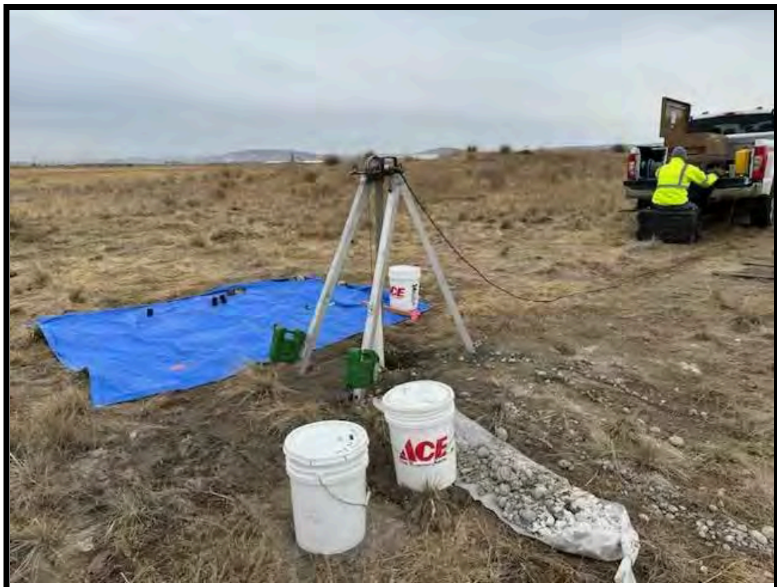
Soil sample obtained from boring BH-21 from 15' BGS

Sonic drill rig at boring BH-22 (DH-22)

View of sonic drill and site conditions near boring BH-22 (DH-22)

Soil sample from 40 to 60' BGS from boring BH-22 (DH-22) (sonic)

PLATE 6: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

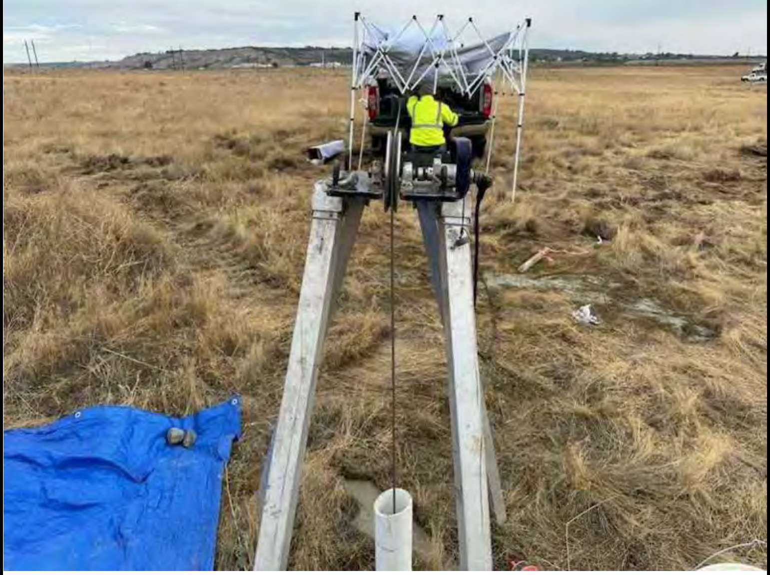


Down-hole seismic testing within boring BH-22 (DH-22)

Down-hole seismic testing within boring BH-22 (DH-22)

Soil sample obtained from borehole BH-23 (DH-23) (sonic)

Down-hole seismic testing within boring BH-23 (DH-23)



Down-hole seismic testing within boring BH-23 (DH-23)

Exposed soil profile of excavated upper ~9' within boring BH-24

PLATE 7: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

Soil sample obtained from boring BH-24 from 25' BGS

View of site conditions looking north from boring BH-25 (DH-25)

View of Mobile B-53 drill rig at boring BH-25 (DH-25) looking west

View of Geoprobe sonic drill rig at boring BH-25 (DH-25)

Site conditions near boring BH-25 (DH-25) (sonic)

Soil sample from boring BH-25 (DH-25) from 25' BGS (sonic)

PLATE 8: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

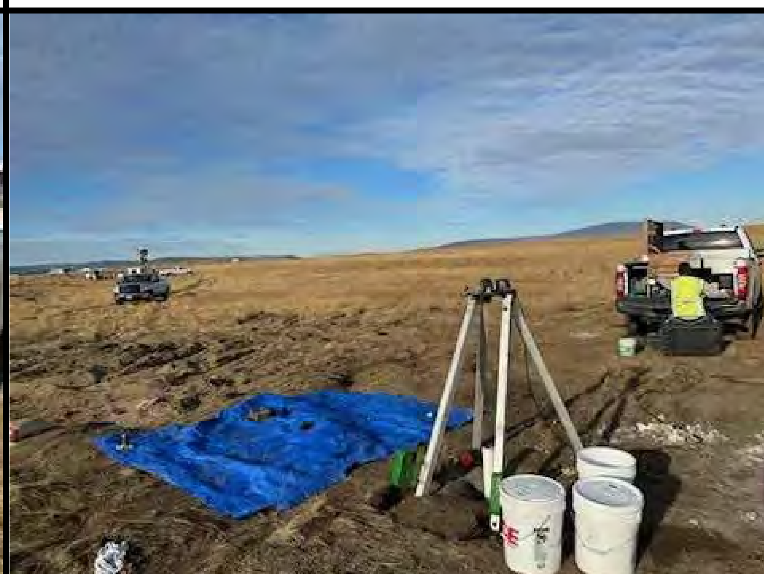
Soil sample from boring BH-25 (DH-25) from 63-65' BGS (sonic)

Soil sample from boring BH-25 (DH-25) from 65' BGS (sonic)

Soil sample from boring BH-25 (DH-25) from 65-75' BGS (sonic)

Down-hole seismic testing within boring BH-25 (DH-25)

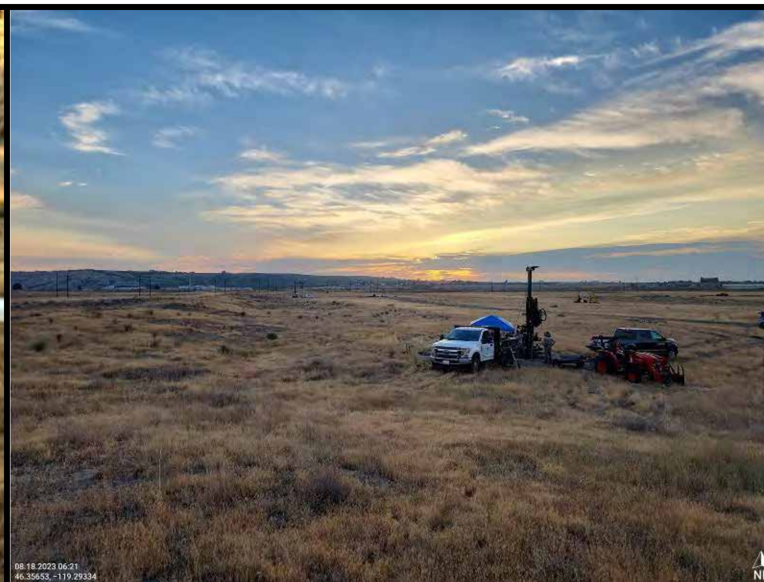
Down-hole seismic testing within boring BH-25 (DH-25)



Down-hole seismic testing within boring BH-25 (DH-25)

PLATE 9: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

Soil sample obtained from boring BH-26 from 10' BGS



View of site conditions near boring BH-27 looking northeast

View of site conditions near boring BH-28 looking southeast

View of site conditions near boring BH-29 looking southeast

Soil sample obtained from boring BH-29 from 20' BGS

Soil sample obtained from boring BH-31 from 15' BGS

PLATE 10: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

View of site conditions near boring BH-32 looking northwest

View of site conditions near BH-33 looking southwest

View of boring BH-33

Exposed soil profile of excavated upper ~9' within boring BH-34

View of site conditions near BH-34 looking southeast

View of site conditions near boring BH-35 looking southwest

PLATE 11: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**


Exposed soil profile of excavated upper ~10' within boring BH-35

Soil sample obtained from boring BH-36 from 30' BGS


Exposed soil profile of excavated upper ~9.5' within boring BH-37


View of site conditions near boring BH-38 looking southwest

Soil sample obtained from boring BH-39 from 10' BGS

Soil sample obtained from boring BH-39 from 15' BGS

PLATE 12: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**


Exposed soil profile of excavated upper 9' within boring BH+PZ-40

Soil sample obtained from boring BH-40 from 65' BGS


Exposed soil profile of excavated upper 9' within boring BH-41

Soil sample obtained from boring BH-41 from 15' BGS


View of site conditions near boring BH-42 looking northeast


Exposed soil profile of excavated upper 8' within boring BH-42

PLATE 13: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

Subsurface soil profile within test-pit TP-2

Excavated spoils from test-pit TP-2

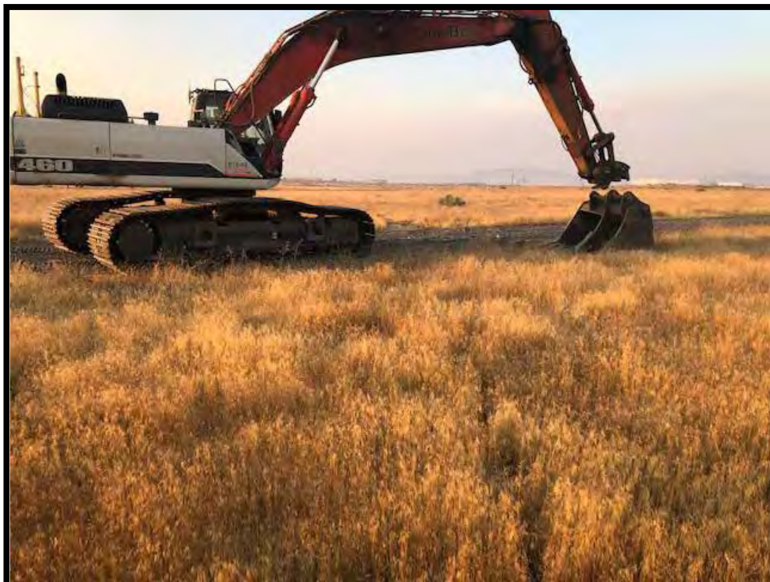
View of site condition near test-pit TP-3 / IT-1 looking northwest

Subsurface soil profile within test-pit TP-3 / IT-1

View of site conditions near test-pit TP-4 / IT-2 looking northeast

Subsurface soil profile within test-pit TP-4 / IT-2

PLATE 14: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**



View of site conditions near test-pit TP-5


Subsurface soil profile within test-pit TP-5


View of site conditions near test-pit TP-6

Excavated spoils from test-pit TP-5


Infiltration test performed within test-pit TP-7 / IT-3


Subsurface soil profile within test-pit TP-7 / IT-4

PLATE 15: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

View of site conditions near test-pit TP-8

Subsurface soil profile within test-pit TP-8

Infiltration test performed within test-pit TP-9 / IT-4

Subsurface soil profile within test-pit TP-9 / IT-4

Excavation of test-pit TP-10 / IT-5

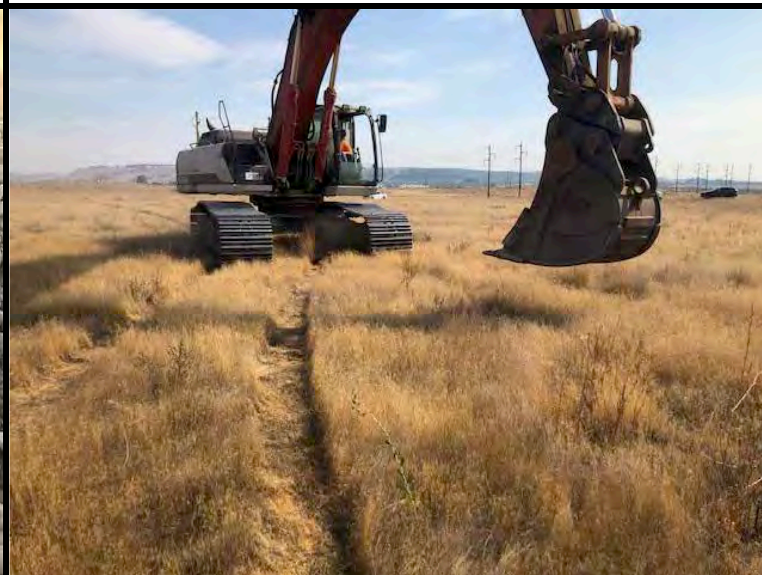
Infiltration test performed within test-pit TP-10 / IT-5

PLATE 16: SITE & EXPLORATION PHOTOGRAPHS **PROJECT NO. 223-1672**

Subsurface soil profile within test-pit TP-10 / IT-5

Test-pit TP-11 / IT-6 at start of excavation

Spoils excavated from test-pit TP-11 / IT-6



View of site conditions near test-pit TP-12 / IT-7

Infiltration test performed within test-pit TP-12 / IT-6

Subsurface soil profile within test-pit TP-12 / IT-7

Appendix VI

Subsurface Soil Profiles **(Plates 18-21)**

PLATE 18: SUBSURFACE SOIL PROFILE FROM UPPER ~9' OF BORING BH-12

PROJECT NO. 223-1672

PLATE 19: SUBSURFACE SOIL PROFILE FROM UPPER ~9' OF BORING BH-16

PROJECT NO. 223-1672

PLATE 20: SUBSURFACE SOIL PROFILE FROM UPPER ~11' OF BORING BH-20

PROJECT NO. 223-1672

PLATE 21: SUBSURFACE SOIL PROFILE FROM UPPER ~9' OF BORING BH-34

PROJECT NO. 223-1672

Appendix VII

Laboratory Soil Testing Results

Bore Hole / Test Pits	Sample ID	Sample Depth, ft	ASTM D2216		ASTM D422			Atterberg Test, ASTM D4318			AASHTO T267	ASTM D854	ASTM D1557
			Moisture Content (%)	Dry Density (pcf)	Fines (%)	Sieve Analysis Sand (%)	Gravel (%)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Specific Gravity	Modified Proctor
BH-04	171210	1.5	1		20.3	79.7					2.4		
BH-04		10	5	116.1									
BH-04		12.5	5	106.3								2.68	
BH-04		25	6	123.4								2.67	
BH-04		30	5	112.5									
BH-05	171223	20	6	121.7	7.9	33.1	59					2.66	
BH-06	171224	2.5	1		14.1	35.9	50						
BH-06	171226	5			6	44	50						
BH-06		10	2	126.8								2.66	
BH-06		15	5	120.8									
BH-06	171206	25	7		1.3	9.7	89						
BH-07		15	3	125.1								2.66	
BH-08		10	2										
BH-08	171225	15	5	122.5	3.6	65.4	31					2.68	
BH-08	171234	25	6		3.7	79.3	17						
BH-09		1.5									1.8		
BH-09		15	4										
BH-09	171216	25	8		6.7	28.7	64.6						
BH-09	171227	35			6.4	30.6	63						
BH-10	171208	10	3		9.8	68.2	15						
BH-10		15	3										
BH-11		1									1.9		
BH-11		20	2										
BH-12		10	2										
BH-12		15	1										
BH-12	171228	30		110.7	12.2	87.8	0						
BH-12	171209	35		118.7	10	78.6	11						

Bore Hole / Test Pits	Sample ID	Sample Depth, ft	ASTM D2216		ASTM D422			Atterberg Test, ASTM D4318			AASHTO T267	ASTM D854	ASTM D1557
			Moisture Content (%)	Dry Density (pcf)	Fines (%)	Sieve Analysis Sand (%)	Gravel (%)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Specific Gravity	Modified Proctor
BH-13	171218	3	4		12.3	87.7	0	NC	NP	NP			111 pcf@ 14.1%
BH-13		10	3										
BH-13		15	2										
BH-14	171215	10	3	123.2	8.7	21.4	69.9					2.66	
BH-14		20	3										
BH-14		30	3										
BH-15		1									1.2		
BH-15		15	4										
BH-16		10	1										
BH-16		20	3										
BH-16		25	3										
BH-17	171217	15	2		2.5	18.6	78.9						
BH-17		25	4										
BH-17		30	5										
BH-17	171229	40		121.4	7	37	56						
BH-18		1									1.9		
BH-18		15	5										
BH-18		20	6										
BH-18		25	11										
BH-19		10	2										
BH-19		15	2										
BH-19		20	3										
BH-19		25	5										
BH-20		15	2										
BH-21		10	3										
BH-21		15	3										
BH-22	171333	58			93.2	6.8		NC	NP	NP			
BH-22	171334	68			11.2	88.5	0.3	NC	NP	NP			

Bore Hole / Test Pits	Sample ID	Sample Depth, ft	ASTM D2216		ASTM D422			Atterberg Test, ASTM D4318			AASHTO T267	ASTM D854	ASTM D1557
			Moisture Content (%)	Dry Density (pcf)	Fines (%)	Sieve Analysis Sand (%)	Gravel (%)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Specific Gravity	Modified Proctor
BH-23	171330	3	1.5		20.3	79.7		NC	NP	NP			
BH-23	171331	10 to 15	0.8		4.8	33.2	62	NC	NP	NP			
BH-23	171239	15-20	2.4		11.8	44.2	44	NC	NP	NP			
BH-24		10	2	114.3								2.8	
BH-24		15	2										
BH-24		20	4										
BH-24		25	2										
BH-25	171238	6.5	2.5		10.4	36.6	53	NC	NP	NP			150 pcf @ 4.1%
BH-25	171335	55			14.9	85.1	0.3	NC	NP	NP			
BH-25	171332	67			71.2	22.5	6.3	NC	NP	NP			
BH-26	171212	5	3	119.2	10.7	74.3	15					2.68	
BH-26		10	3										
BH-26		15	4										
BH-27		1.5									0.8		
BH-27		25	4										
BH-28		5	2										
BH-28		15	2										
BH-29	171214	5	3	120.1	12.2	76.8	11					2.67	
BH-29	171232	10	1	109.3	25.3	73.7	1					2.71	
BH-29		20	2										
BH-30		5	2										
BH-30		10	4										
BH-30	171221	15-20	4		8.4	84.8	6.8	NC	NP	NP			114 pcf @ 12.5%
BH-31		5	2										
BH-33	171233	5	2		6.8	29.2	64						
BH-33	171231	10	2		14.8	63.2	22						
BH-33	171220	15-20	3		12.3	60.9	26.8	NC	NP	NP			124.9 pcf @ 10.7%

Bore Hole / Test Pits	Sample ID	Sample Depth, ft	ASTM D2216		ASTM D422			Atterberg Test, ASTM D4318			AASHTO T267	ASTM D854	ASTM D1557
			Moisture Content (%)	Dry Density (pcf)	Fines (%)	Sieve Analysis Sand (%)	Gravel (%)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Specific Gravity	Modified Proctor
BH-34	171230	15	3	120.1	5.2	50.8	44					2.66	
BH-34		20	4										
BH-34		25	4										
BH-35	171211	15	4	120.6	9.2	76.8	14					2.68	
BH-35		20	5										
BH-36		15	2										
BH-36		20	2										
BH-36		30	4										
BH-37		10	2										
BH-37		15	2										
BH-37	171235	20	5		3.5	44.5	52						
BH-38	171222	2.5	2	106.5	6.2	93.1	0.7	NC	NP	NP	1.7		113.9 pcf @ 12.3%
BH-39		5	1										
BH-39		10	3	126.8								2.65	
BH-39		15	3										
BH-40		10	2										
BH-40	171236	20	3		5.3	57.7	37						
BH-40		25	5	112.3								2.69	
BH-40	171237	30	6	119.1	4.6	24.4	71					2.66	
BH-40	171238	50			1.8	46.2	52						
BH-41		10	2	120.5								2.65	
BH-41		15	3										
BH-42		10	3	124.2								2.66	
BH-42		15	3	126.5								2.67	
BH-42		20	4										
BH-42		30	4										

Bore Hole / Test Pits	Sample ID	Sample Depth, ft	ASTM D2216		ASTM D422			Atterberg Test, ASTM D4318			AASHTO T267	ASTM D854	ASTM D1557
			Moisture Content (%)	Dry Density (pcf)	Fines (%)	Sieve Analysis Sand (%)	Gravel (%)	Liquid Limit	Plastic Limit	Plasticity Index	Organic Content (%)	Specific Gravity	Modified Proctor
TP-1	171013	2	4		15	85	0	NC	NP	NP			103.3 pcf @ 13.1%
TP-2	171015	4	2		7.3	92.7	0	NC	NP	NP			110.4 pcf @ 13.7%
TP-3	171016	3	2		11.4	79.6	9	NC	NP	NP			121.8 pcf @ 9.5%
TP-4	171017	4.5	2		6.6	83.4	10						121.4 pcf @ 10.6%
TP-5	171018	3	2	112.4	24.1	70.9	5	NC	NP	NP		2.69	127.4 pcf @ 10.5%
TP-5	171205	5	2		2.1	35.9	55	NC	NP	NP			132.4 pcf @ 6.6%
TP-6	171019	3	3		14.6	85.4	0	NC	NP	NP	1.3	2.7	107.1 pcf @ 10.1%
TP-7	171020	2.5	1		11.4	88.6		NC	NP	NP	1.7		105.7 pcf @ 12.4%
TP-7	171204	5	2		1.3	38.2	60.5	NC	NP	NP			133.4 pcf @ 6.5%
TP-8	171021	0.5	2		27.7	67.3	5	NC	NP	NP			135 pcf @ 8.6%
TP-8	171203	5	3		4.7	35.3	60	NC	NP	NP			131.2 pcf @ 11.8%
TP-9	171022	3	2		2.2	97.8							107.5 pcf @ 15.1%
TP-10	171023	5	2		14.6	85.4	0	NC	NP	NP			112.3 pcf @ 11.8%
TP-12	171202	4	2		3.1	32.9	64	NC	NP	NP			134.3 pcf @ 7.8%
TR-1	172041	1.5			13.8	86.2	0	NC	NP	NP			108.7 pcf @ 11.2%
TR-2	172042	1.5			11.6	85.4	3	NC	NP	NP			112.3 pcf @ 12.3%

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-04 @ 1.5' BGS	**Lab #:**	171210

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	91%		
#16			
#20	85%		
#30			
#40	78%		
#50			
#60	69%		
#80			
#100	36.0%		
#200	20.3%		

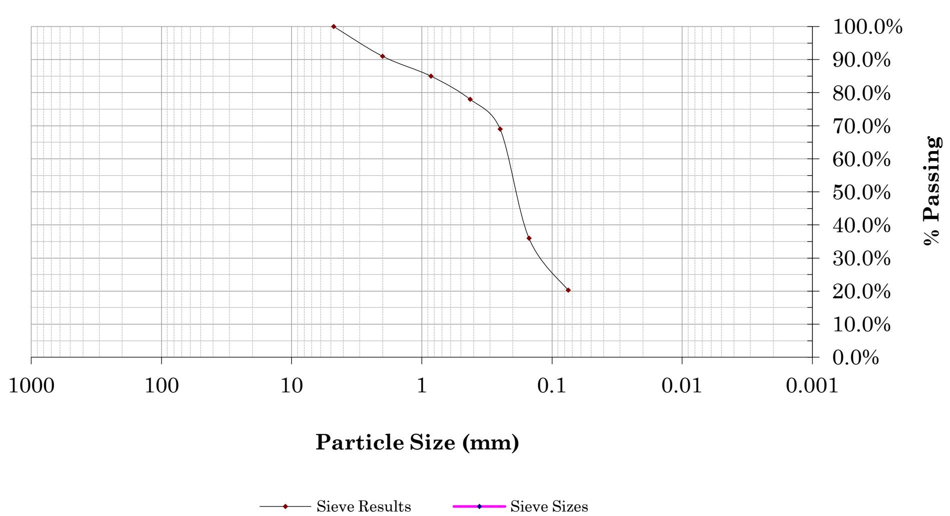
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	
% Sand:	79.70
% Silt & Clay:	20.30
Moisture Content:	1.0%

Soil Classification (USCS): ASTM D 2487

Silty Sand (SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-05 @ 20' BGS	**Lab #:**	171223

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	93%		
3/4"	75%		
5/8"	66%		
1/2"	60%		
3/8"	54%		
1/4"	45%		
#4	41%		
#8			
#10	30%		
#16			
#20	22%		
#30			
#40	17%		
#50			
#60			
#80	11.2%		
#100	10.0%		
#200	7.9%		

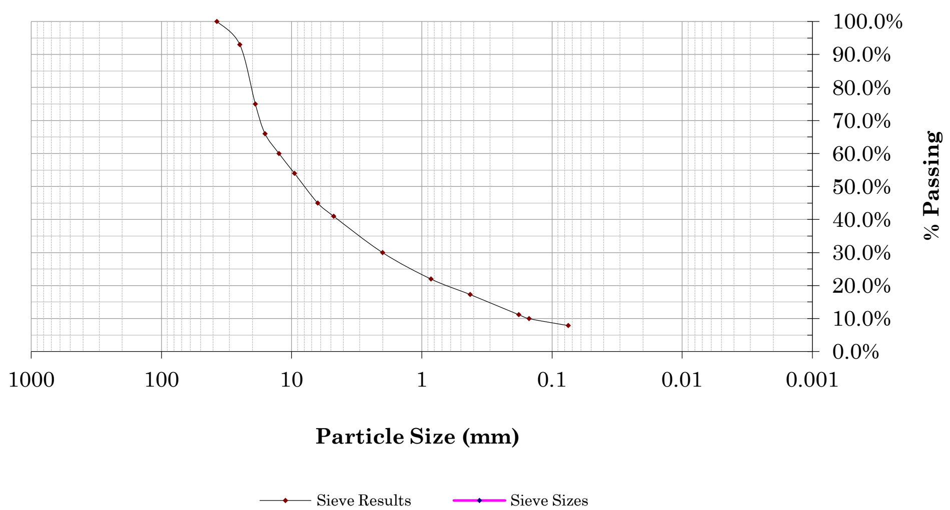
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	59.00
% Sand:	33.10
% Silt & Clay:	7.90
Moisture Content:	6.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silt and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-06 @ 2.5' BGS	**Lab #:**	171224

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	83%		
3/4"	78%		
5/8"	76%		
1/2"	67%		
3/8"	62%		
1/4"	54%		
#4	50%		
#8			
#10	40%		
#16			
#20	33%		
#30			
#40	25%		
#50			
#60			
#80	18.0%		
#100	17.0%		
#200	14.1%		

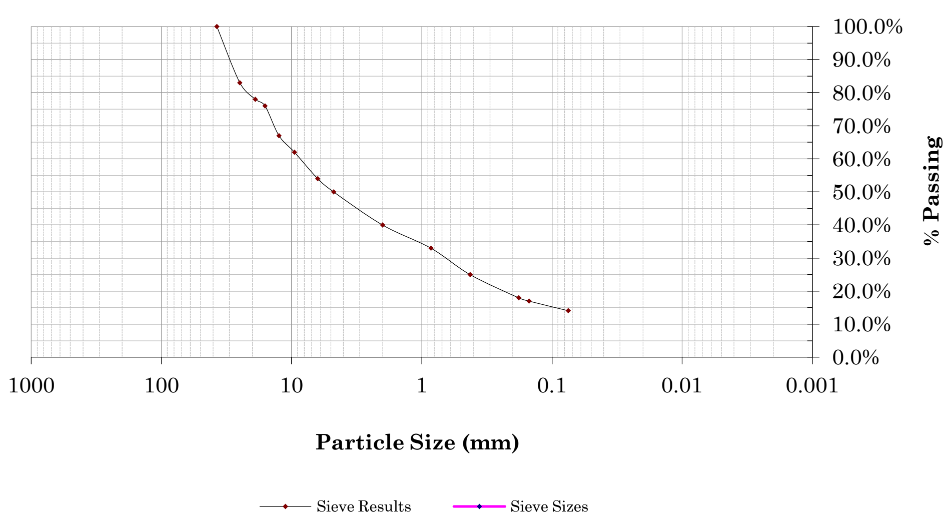
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	50.00
% Sand:	35.90
% Silt & Clay:	14.10
Moisture Content:	1.0%

Soil Classification (USCS): ASTM D 2487

Silty Gravel with Sand (GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-06 @ 5' BGS	**Lab #:**	171226

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	77%		
3/4"	72%		
5/8"	69%		
1/2"	63%		
3/8"	59%		
1/4"	54%		
#4	50%		
#8			
#10	42%		
#16			
#20	29%		
#30			
#40	16%		
#50			
#60			
#80	9.2%		
#100	8.0%		
#200	6.0%		

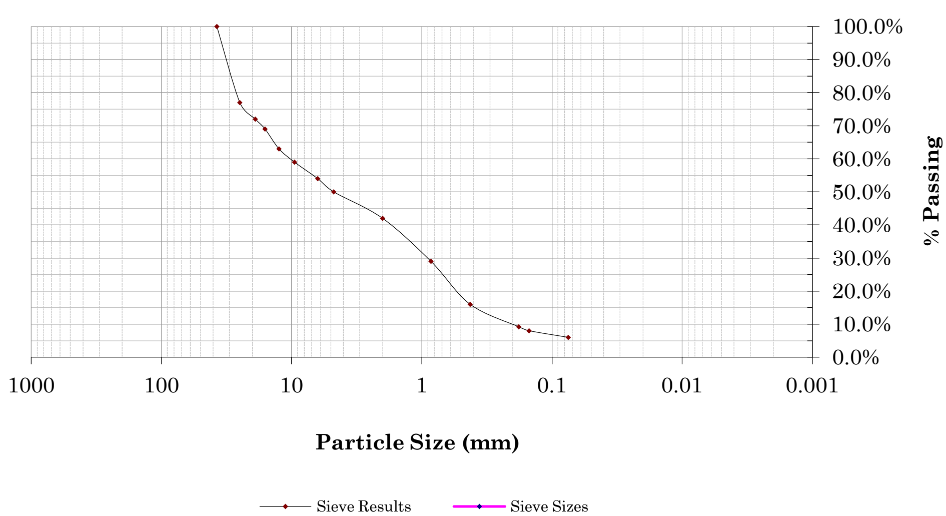
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	50.00
% Sand:	44.00
% Silt & Clay:	6.00
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silty and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-06 @ 25' BGS	**Lab #:**	171206

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2	100%		
1 3/4"			
1 1/2"	81%		
1 1/4"			
1"	72%		
3/4"			
5/8"			
1/2"	47%		
3/8"			
1/4"	30%		
#4	11%		
#8	7%		
#10			
#16			
#20			
#30			
#40	5%		
#50			
#60			
#80			
#100	3.0%		
#200	1.3%		

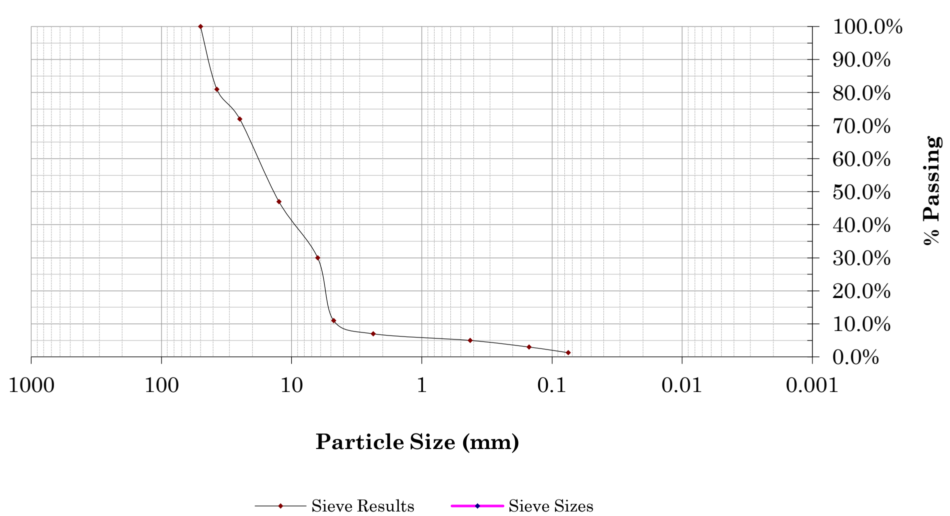
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	89.00
% Sand:	9.70
% Silt & Clay:	1.30
Moisture Content:	7.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel (GP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-08 @ 15' BGS	**Lab #:**	171225

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	93%		
3/4"	87%		
5/8"	87%		
1/2"	84%		
3/8"	79%		
1/4"	74%		
#4	69%		
#8			
#10	55%		
#16			
#20	30%		
#30			
#40	14%		
#50			
#60			
#80	6.0%		
#100	5.0%		
#200	3.6%		

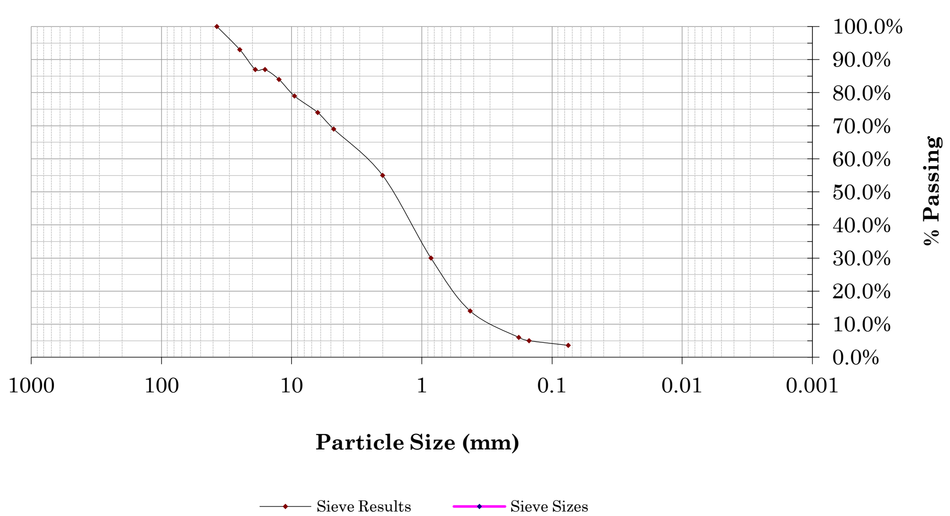
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	31.00
% Sand:	65.40
% Silt & Clay:	3.60
Moisture Content:	5.0%

Soil Classification (USCS): ASTM D 2487

Well Graded Sand with Gravel (SW)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-8 @ 25' BGS	**Lab #:**	171234

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"	100%		
5/8"	95%		
1/2"	94%		
3/8"	92%		
1/4"	86%		
#4	83%		
#8			
#10	66%		
#16			
#20	23%		
#30			
#40	11%		
#50			
#60			
#80	5.6%		
#100	5.0%		
#200	3.7%		

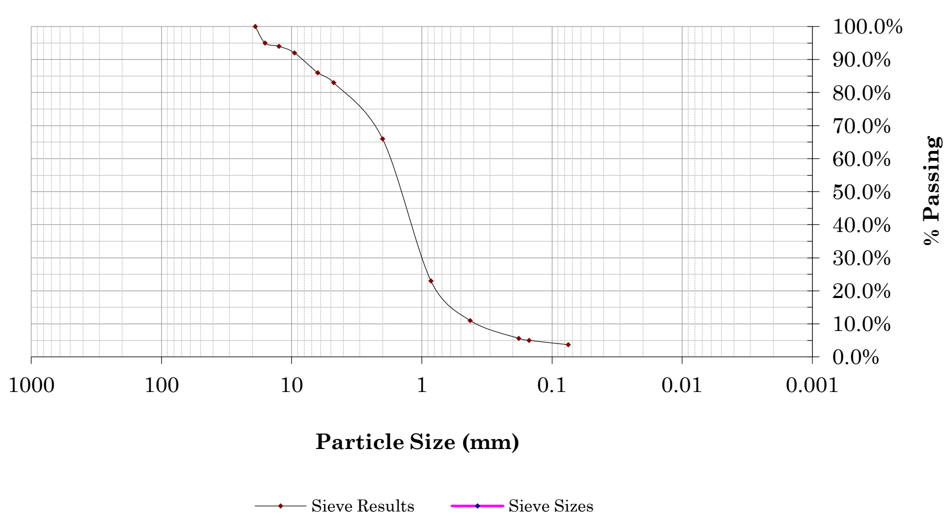
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	17.00
% Sand:	79.30
% Silt & Clay:	3.70
Moisture Content:	6.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Gravel (SP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-09 @ 25' BGS	**Lab #:**	171216

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2	74%		
1 3/4"			
1 1/2"	55%		
1 1/4"			
1"	42%		
3/4"	41%		
5/8"			
1/2"			
3/8"	35%		
1/4"			
#4	35%		
#8			
#10	31%		
#16	28%		
#20			
#30			
#40	26%		
#50			
#60	19%		
#80			
#100	11.1%		
#200	6.7%		

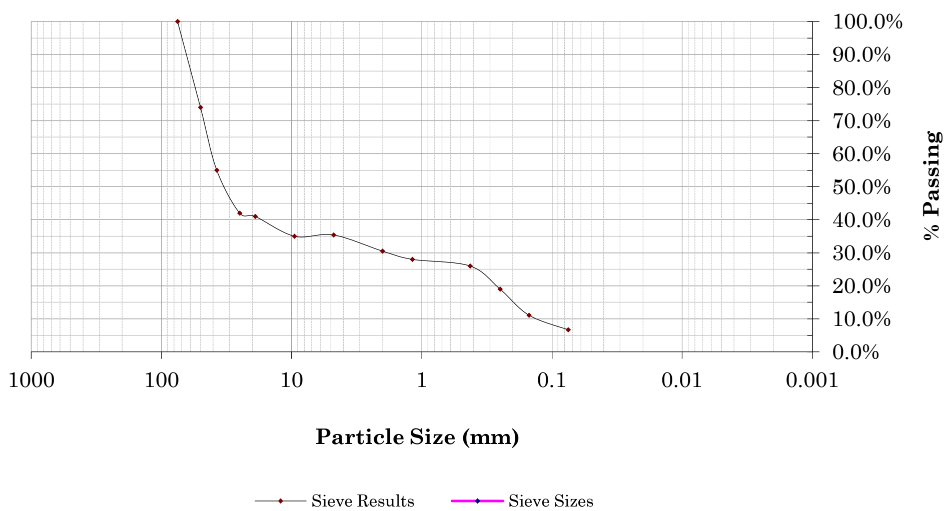
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	64.60
% Sand:	28.70
% Silt & Clay:	6.70
Moisture Content:	8.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silt and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-09 @ 35' BGS	**Lab #:**	171227

Sieve Size	**Percent Passing**	**Specifications Minimum**	**Specifications Maximum**
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	92%		
3/4"	82%		
5/8"	63%		
1/2"	58%		
3/8"	49%		
1/4"	42%		
#4	37%		
#8			
#10	31%		
#16			
#20	28%		
#30			
#40	26%		
#50			
#60			
#80	16.0%		
#100	13.0%		
#200	6.4%		

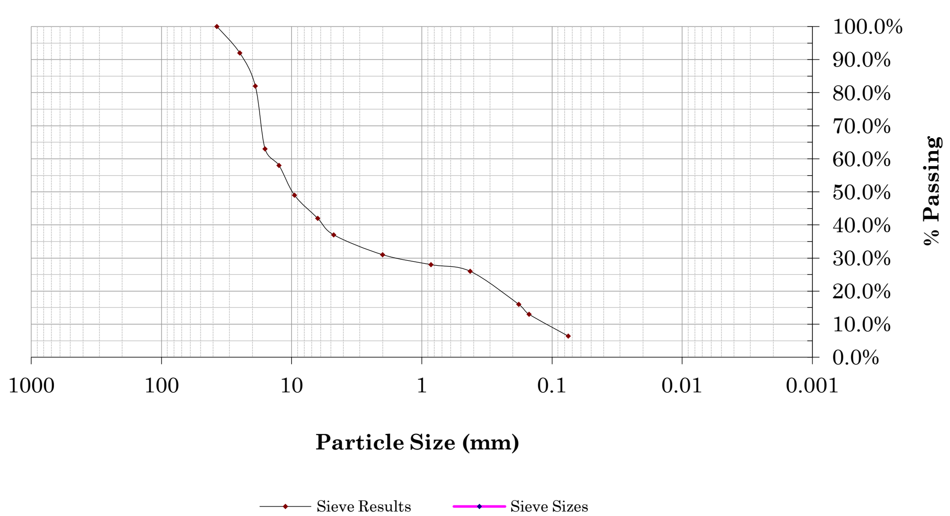
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	63.00
% Sand:	30.60
% Silt & Clay:	6.40
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silt and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-10 @ 10' BGS	**Lab #:**	171208

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"	100%		
1/2"	92%		
3/8"			
1/4"	87%		
#4	85%		
#8			
#10	78%		
#16			
#20			
#30	54%		
#40	36%		
#50			
#60			
#80	21.0%		
#100	14.0%		
#200	9.8%		

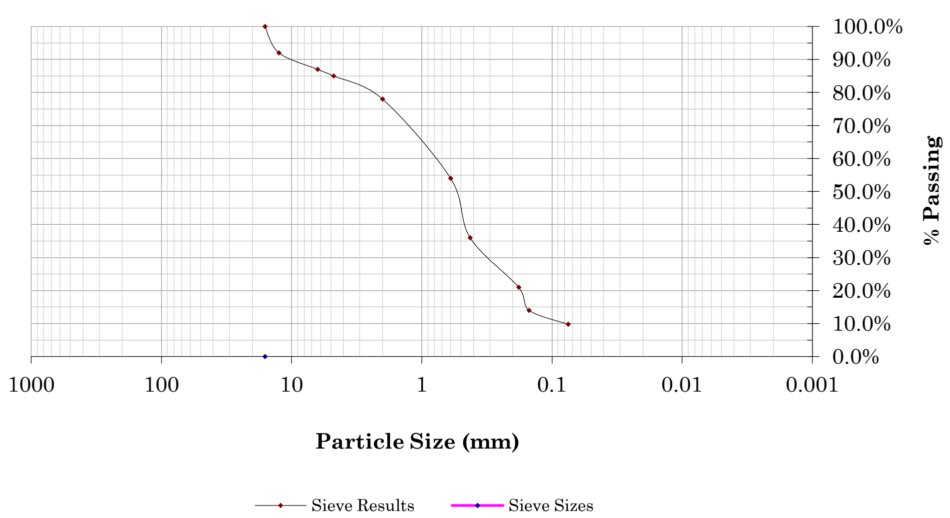
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	15.00
% Sand:	68.20
% Silt & Clay:	9.80
Moisture Content:	3.0%

Soil Classification (USCS): ASTM D 2487

Well Graded Sand with Silt and Gravel (SW-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-12 @ 30' BGS	**Lab #:**	171228

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	100%		
#16			
#20	96%		
#30			
#40	68%		
#50			
#60			
#80	26.8%		
#100	21.0%		
#200	12.2%		

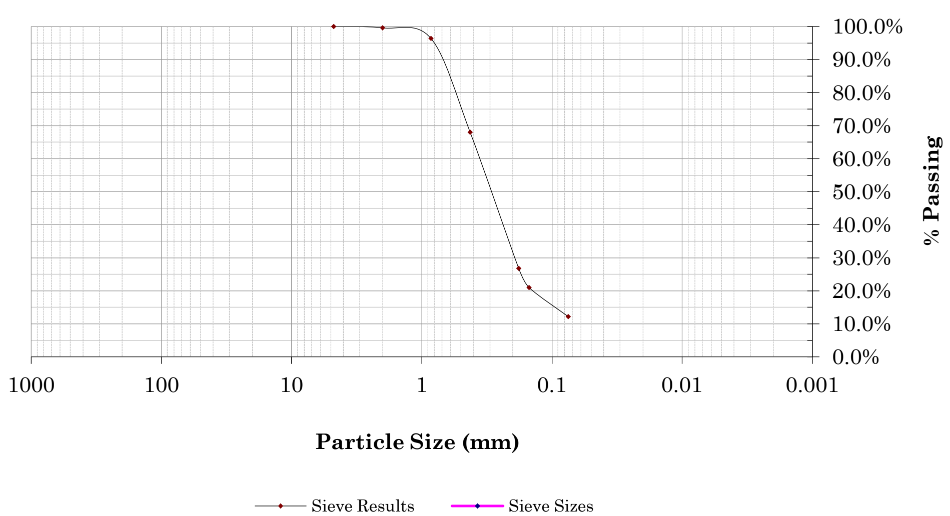
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	
% Sand:	87.80
% Silt & Clay:	12.20
Moisture Content:	4.0%

Soil Classification (USCS): ASTM D 2487

Well Graded Sand with Silty (SW-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/14/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-12 @ 35' BGS	**Lab #:**	171209

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"	100%		
3/8"			
1/4"	90%		
#4	89%		
#8			
#10	74%		
#16			
#20			
#30	55%		
#40	43%		
#50			
#60			
#80	28.0%		
#100	18.0%		
#200	10.4%		

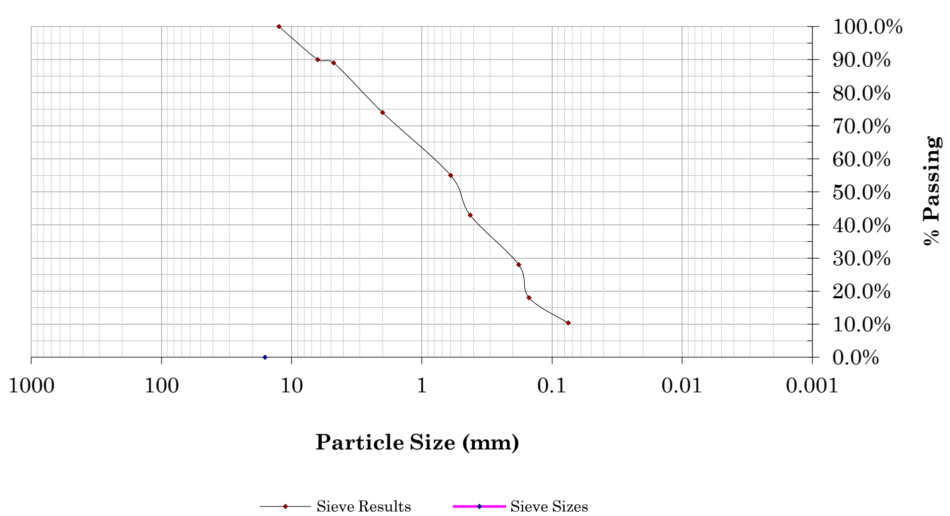
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	11.00
% Sand:	78.60
% Silt & Clay:	10.40
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silty (SP-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-13 @ 3' BGS	**Lab #:**	171218

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	96%		
#16	93%		
#20	88%		
#30			
#40	65%		
#50			
#60	32%		
#80			
#100	23.0%		
#200	12.3%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel:
% Sand: 87.70
% Silt & Clay: 12.30
Moisture Content: 4.0%

Moisture-Density Data

Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

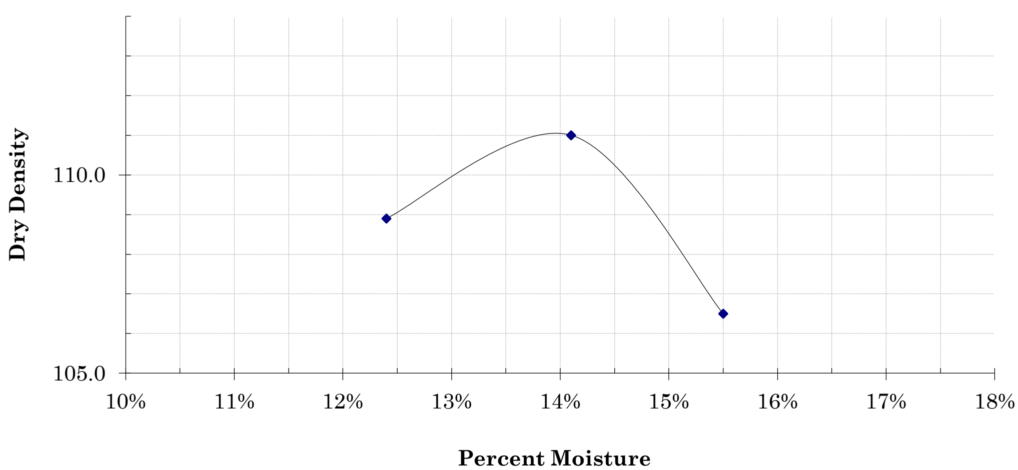
Point	% Moisture	Dry Density
1		
2	12.4%	108.9
3	14.1%	111.0
4	15.5%	106.5
5		

Maximum Dry Density: 111.0 pcf
Optimum Moisture %: 14.1%

Soil Classification (USCS): ASTM D 2487

Silty Sand (SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** ____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-14 @ 10' BGS	**Lab #:**	171215

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2	80%		
1 3/4"			
1 1/2"	66%		
1 1/4"			
1"	57%		
3/4"	52%		
5/8"			
1/2"			
3/8"	38%		
1/4"			
#4	30%		
#8			
#10	24%		
#16	20%		
#20			
#30			
#40	16%		
#50			
#60	14%		
#80			
#100	12.0%		
#200	8.7%		

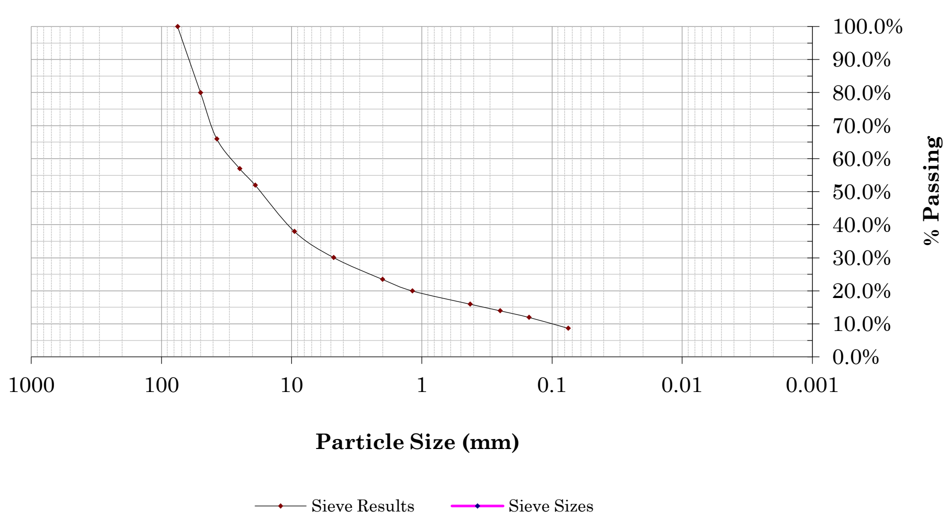
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	69.90
% Sand:	21.40
% Silt & Clay:	8.70
Moisture Content:	3.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silty and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-17 @ 15' BGS	**Lab #:**	171217

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"	100%		
3"	64%		
2	46%		
1 3/4"			
1 1/2"	43%		
1 1/4"			
1"	30%		
3/4"	28%		
5/8"			
1/2"			
3/8"	24%		
1/4"			
#4	21%		
#8			
#10	18%		
#16	15%		
#20			
#30			
#40	14%		
#50			
#60	12%		
#80			
#100	7.1%		
#200	2.5%		

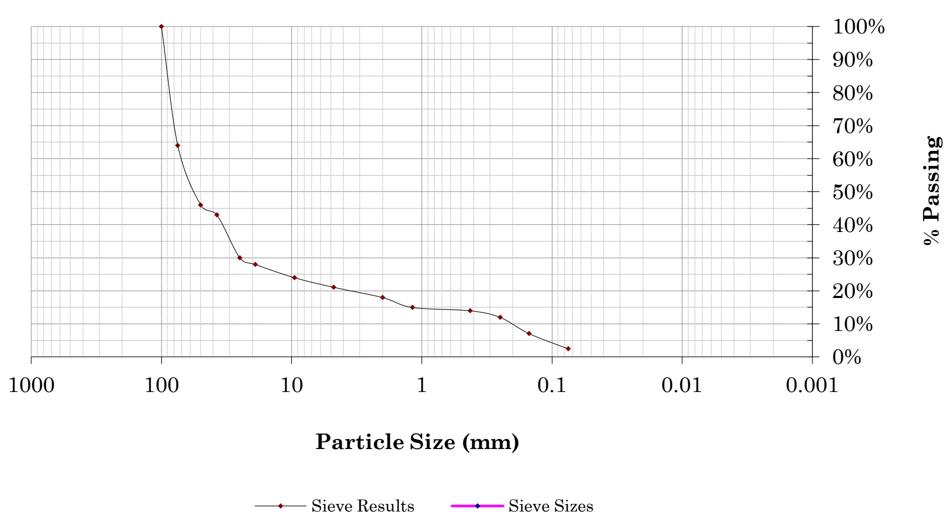
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	78.90
% Sand:	18.60
% Silt & Clay:	2.50
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Sand (GP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/15/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-17 @ 40' BGS	**Lab #:**	171229

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	87%		
3/4"	76%		
5/8"	74%		
1/2"	65%		
3/8"	56%		
1/4"	48%		
#4	44%		
#8			
#10	37%		
#16			
#20	34%		
#30			
#40	31%		
#50			
#60			
#80	14.0%		
#100	12.0%		
#200	7.0%		

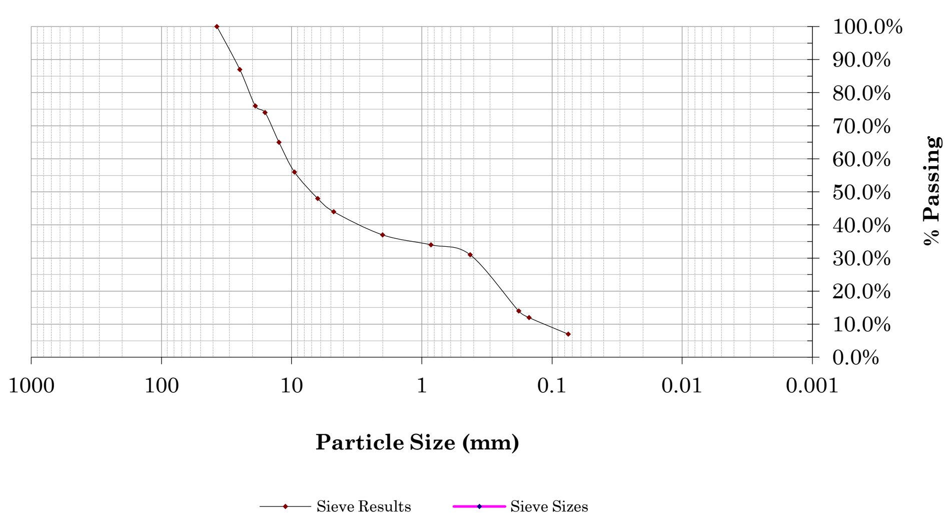
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	56.00
% Sand:	37.00
% Silt & Clay:	7.00
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Silt and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	9/29/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-22 @ 58' BGS	**Lab #:**	**171333**

Sieve Size	**Percent Passing**	**Specifications Minimum**	**Specifications Maximum**
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4			
#8			
#10	100%		
#16	99%		
#20			
#30	97%		
#40	96.3%		
#50	95.7%		
#60			
#80			
#100	94.4%		
#200	93.2%		

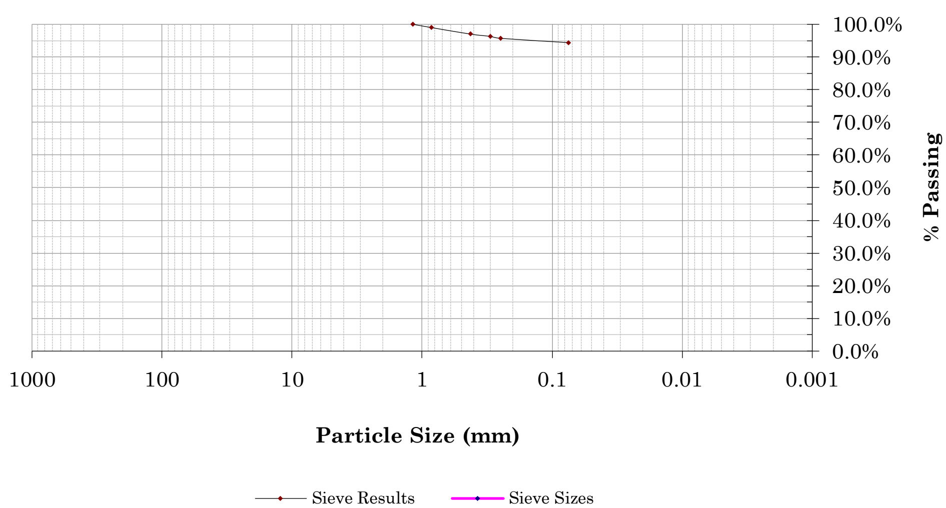
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	
% Sand:	6.80
% Silt & Clay:	93.20
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Silt (ML)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	9/29/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-22 @ 68' BGS	**Lab #:**	**171334**

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"	100.0%		
#4	99.7%		
#8	99.6%		
#10	99.6%		
#16	99.6%		
#20			
#30	99.5%		
#40	95.6%		
#50	51.7%		
#60			
#80			
#100	18.0%		
#200	11.2%		

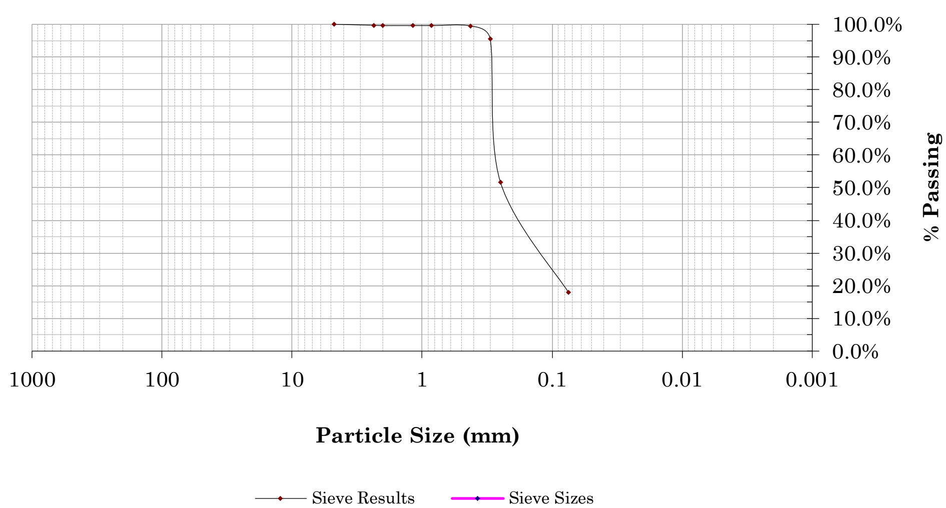
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	0.30
% Sand:	88.50
% Silt & Clay:	11.20
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silty (SP-SM)

Grain Size Distribution



Reviewed by: ______________________ **Date:** _______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

CLIENT:	**Tecnicas Reunidas**	JOB NO:	**223-1672**
PROJECT:	**Atlas Agro Pacific Green Fertilizer**	LABORATORY NO:	**17330**
SAMPLE SOURCE:	**BH-23 @ 3' BGS**	WORK ORDER NO:	**164582**
DATE SAMPLED:	**9/28/2023**	DATE TESTED:	**9/27/2023**
MATERIAL TYPE:	**native**	TESTED BY:	**KJ**

ASTM C 136/D 1140 - SIEVE ANALYSIS OF SOILS

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
9"			
8"			
7"			
6"			
5"			
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"	100%		
1/4"	100%		
#4	100%		
#8			
#10	100%		
#16			
#20	98%		
#30			
#40	81%		
#50			
#60			
#80	37%		
#100	32%		
#200	20%		

Sieve Analysis Data: ASTM D422, D1140

Fineness Modulus:	0.7%
% Gravel:	0.0
% Sand:	79.7
% Silt & Clay:	20.3
Moisture Content:	1.5%

Soil Classification (USCS): ASTM D 2488

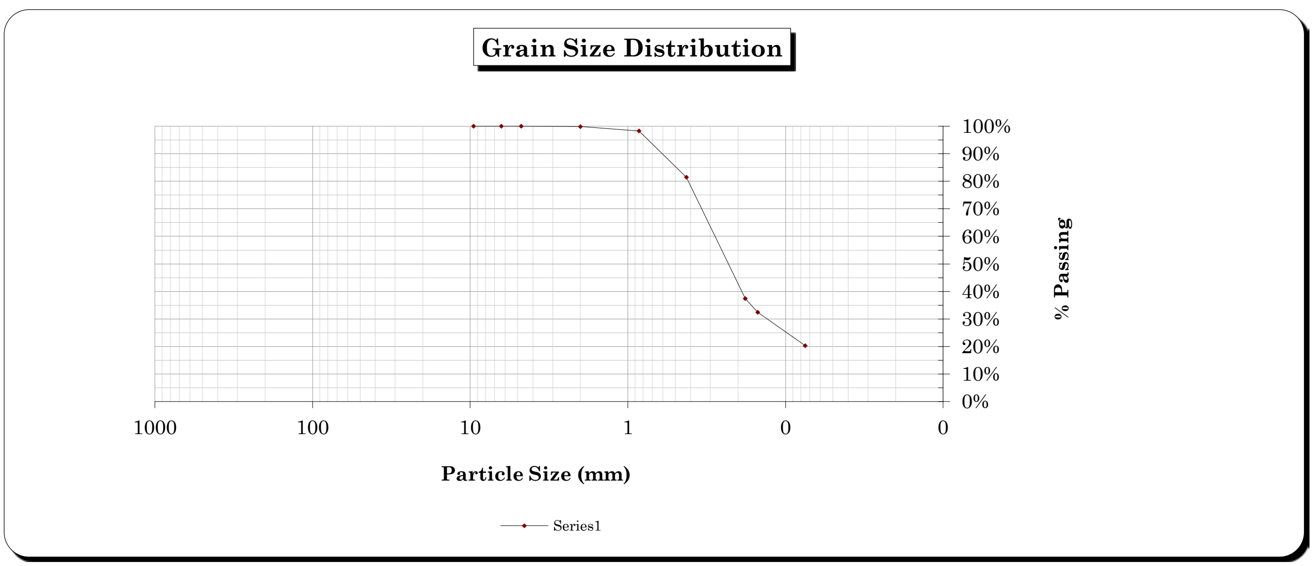
SM Silty sand

Atterburg Limits: ASTM D 4318

Liquid Limit:	NC
Plastic Limit:	NP
Plasticity Index:	NP

Gradation Coeffecient of Uniformity Cu

%passing	sieve (mm)
D10 :	Less than 0.075 mm
D30 :	0.14
D60 :	0.36
C_u:	
C_c:	



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

CLIENT:	**Tecnicas Reunidas**	JOB NO:	**223-1672**
PROJECT:	**Atlas Agro Pacific Green Fertilizer**	LABORATORY NO:	**171331**
SAMPLE SOURCE:	**BH-23 @ 10-15' BGS**	WORK ORDER NO:	**164582**
DATE SAMPLED:	**9/28/2023**	DATE TESTED:	**9/27/2023**
MATERIAL TYPE:	**native**	TESTED BY:	**KJ**

ASTM C 136/D 1140 - SIEVE ANALYSIS OF SOILS

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
9"			
8"			
7"			
6"			
5"			
4"			
3"			
2 1/2"			
2"	100%		
1 1/2"	89%		
1 1/4"			
1"	75%		
3/4"	62%		
5/8"			
1/2"	51%		
3/8"	46%		
1/4"	41%		
#4	38%		
#8			
#10	31%		
#16			
#20	24%		
#30			
#40	15%		
#50			
#60			
#80	7%		
#100	7%		
#200	5%		

Sieve Analysis Data: ASTM D422, D1140

Fineness Modulus:	2.6%
% Gravel:	62.0
% Sand:	33.2
% Silt & Clay:	4.8
Moisture Content:	0.8%

Soil Classification (USCS): ASTM D 2488

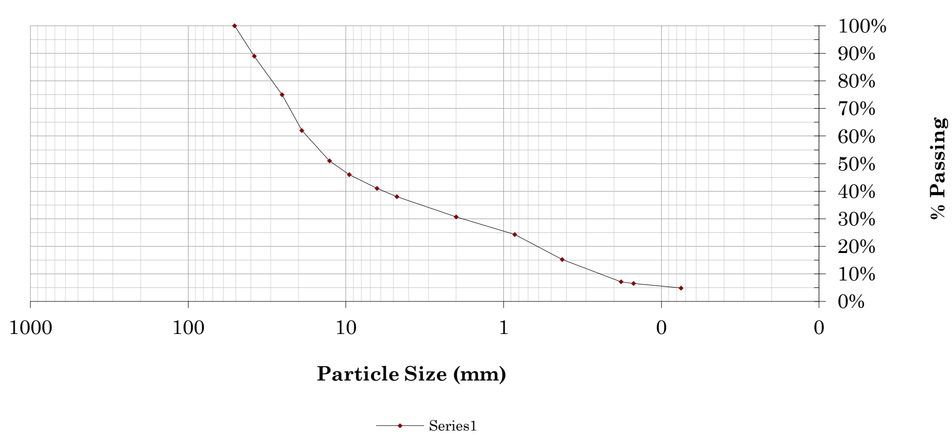
GP Poorly-graded gravel with sand

Atterburg Limits: ASTM D 4318

Liquid Limit:	NC
Plastic Limit:	NP
Plasticity Index:	NP

Gradation Coeffecient of Uniformity Cu

%passing	sieve (mm)
D10 :	0.34
D30 :	1.92
D60 :	18.47
C_u:	**53.6**
C_c:	**0.6**



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

CLIENT:	**Tecnicas Reunidas**	JOB NO:	**223-1672**
PROJECT:	**Atlas Agro Pacific Green Fertilizer**	LABORATORY NO:	**171239**
SAMPLE SOURCE:	**BH 23 @ 15-20' BGS**	WORK ORDER NO:	**164582**
DATE SAMPLED:	**9/28/2023**	DATE TESTED:	**9/27/2023**
MATERIAL TYPE:	**native**	TESTED BY:	**KJ**

ASTM C 136/D 1140 - SIEVE ANALYSIS OF SOILS

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
9"			
8"			
7"			
6"			
5"			
4"			
3"			
2 1/2"	100%		
2"	98%		
1 1/2"	93%		
1 1/4"			
1"	84%		
3/4"	78%		
5/8"			
1/2"	71%		
3/8"	66%		
1/4"	59%		
#4	56%		
#8			
#10	45%		
#16			
#20	33%		
#30			
#40	22%		
#50			
#60			
#80	16%		
#100	15%		
#200	12%		

Sieve Analysis Data: ASTM D422, D1140

Fineness Modulus:	1.9%
% Gravel:	44.0
% Sand:	44.2
% Silt & Clay:	11.8
Moisture Content:	2.4%

Soil Classification (USCS): ASTM D 2488

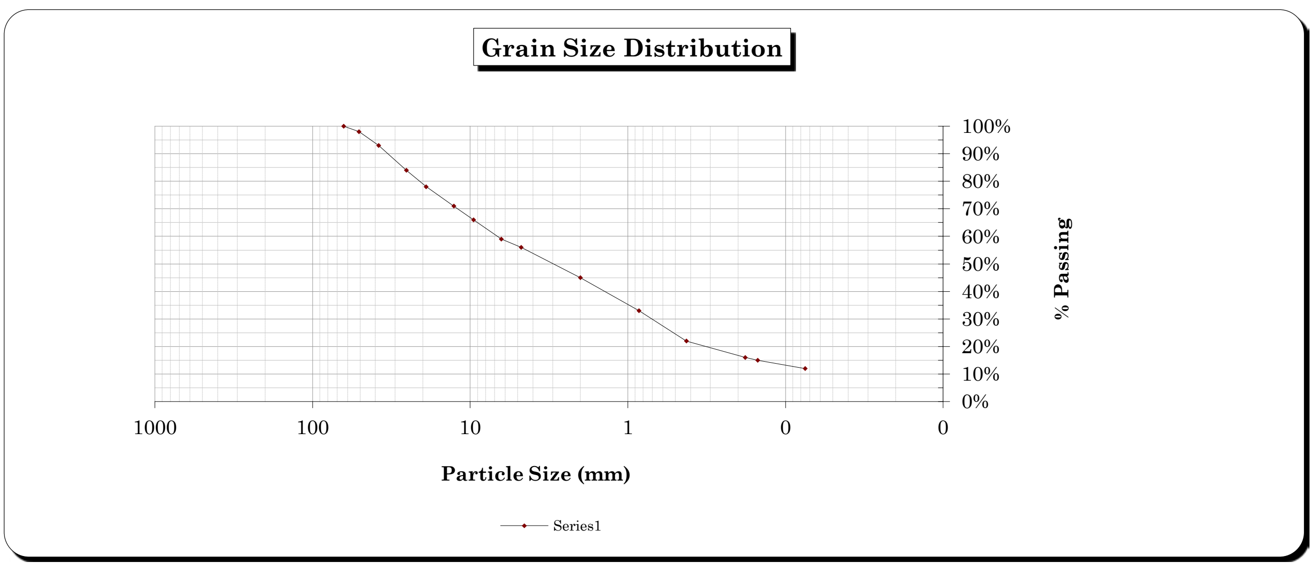
GP-GM Poorly graded gravel with silt and sand

Atterburg Limits: ASTM D 4318

Liquid Limit:	NC
Plastic Limit:	NP
Plasticity Index:	NP

Gradation Coeffecient of Uniformity Cu

%passing	sieve (mm)
D10 :	Less than 0.075 mm
D30 :	0.78
D60 :	6.80
C_u:	
C_c:	



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

CLIENT:	**Tecnicas Reunidas**	JOB NO:	**223-1672**
PROJECT:	**Atlas Agro Pacific Green Fertilizer**	LABORATORY:	**171238**
SAMPLE SOURCE:	**BH-25 @ 6'9"**	WORK ORDER:	**164582**
DATE SAMPLED:	**8/23/2023**	DATE TESTED:	**10/2/2023**
MATERIAL TYPE:	**native**	TESTED BY:	**KJ**

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
		1/2"	60%
9"		3/8"	55%
8"		1/4"	50%
7"		#4	47%
6"		#8	
5"		#10	40%
4"		#16	
3"		#20	33%
2 1/2"	100%	#30	
2"	91%	#40	23%
1 1/2"	83%	#50	
1 1/4"		#60	
1"	75%	#80	14%
3/4"	69%	#100	13%
5/8"		#200	10.4%

USCS CLASSIFICATION - ASTM D 2487

GP-GM Poorly graded gravel with silt and sand)

SAND EQUIVALENT - ASTM D 2419

MOISTURE DENSITY RELATIONSHIP
STANDARD: ASTM 1557

% Moisture	Dry Density	Note
		Moist Preparation Method
3.5%	**140.5**	Manual Rammer
5.7%	**143.2**	Procedure: C
7.6%	**140.8**	S.G. (est): 2.7

Proctor Values:	uncorrected	corrected
Dry Density:	**143.0**	**150.0**
% Moisture:	**5.5%**	**4.1%**

LL, PL & PI - ASTM D 4318

Liquid Limit	Plastic Limit	Plast. Index
NC	NP	NP

MOISTURE - ASTM D 2216
Moisture Content: **2.5%**

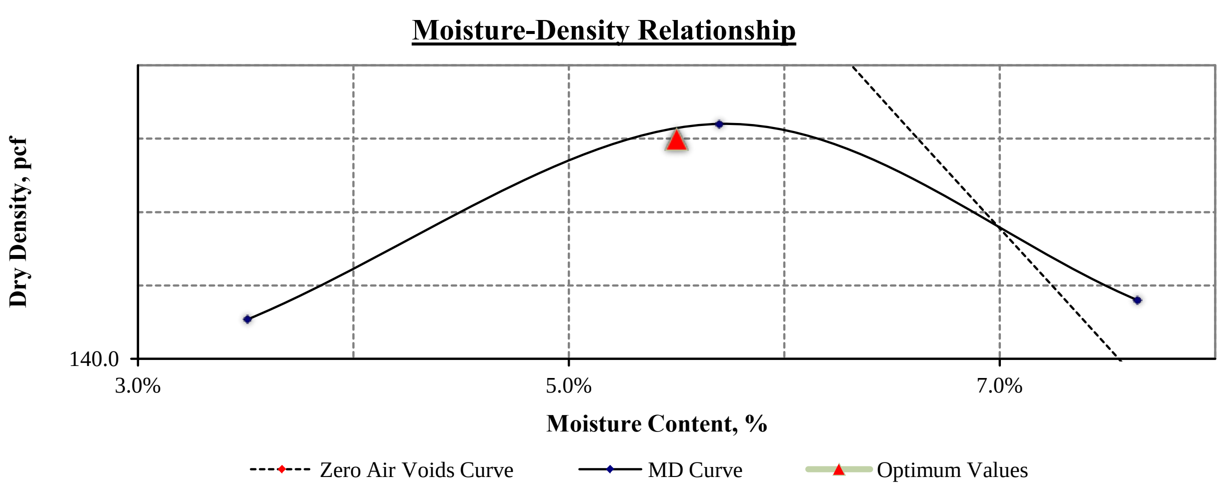
SOIL S.G. - ASTM D 854
Specific Gravity @ 20°C:

FINENESS MODULUS - ASTM C 136
Fineness Modulus: **0.02**

ORGANIC IMPURITIES - ASTM C 40
Organic Plate Number:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		



Reviewed By: ______________________________

Guy Vincent, Materials Testing Manager

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	9/29/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-25 @55' BGS	**Lab #:**	**171335**

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4			
#8			
#10			
#16			
#20	100%		
#30	99.3%		
#40	97.5%		
#50	90.4%		
#60			
#80			
#100	47.6%		
#200	14.9%		

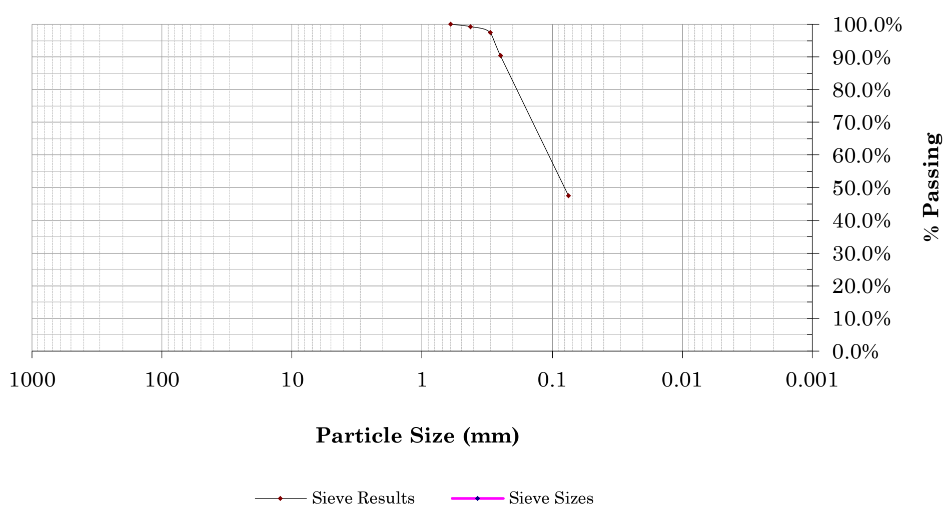
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	0.30
% Sand:	85.10
% Silt & Clay:	14.90
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Silty Sand (SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	9/29/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-25 @67' BGS	**Lab #:**	**171332**

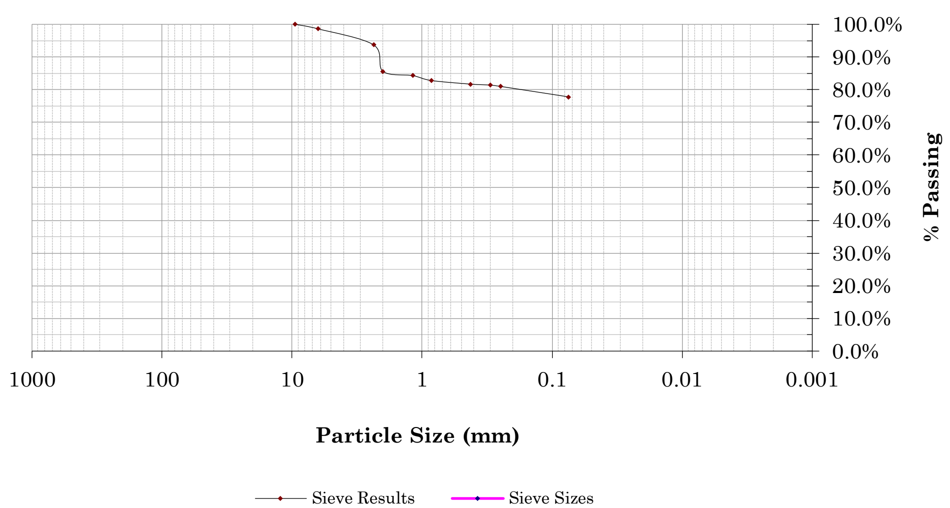
Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"	100%		
3/8"	98.6%		
1/4"			
#4	93.7%		
#8	85.6%		
#10	84.3%		
#16	82.8%		
#20			
#30	81.7%		
#40	81.4%		
#50	81.0%		
#60			
#80			
#100	77.8%		
#200	71.2%		

Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	6.30
% Sand:	22.56
% Silt & Clay:	71.20
Moisture Content:	

Soil Classification (USCS): ASTM D 2487
Silty with Sand (ML)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-26 @ 5' BGS	**Lab #:**	171212

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"	100%		
5/8"			
1/2"	93%		
3/8"	87%		
1/4"			
#4	85%		
#8			
#10	76%		
#16			
#20	68%		
#30			
#40	65%		
#50			
#60	59%		
#80			
#100	41.0%		
#200	10.7%		

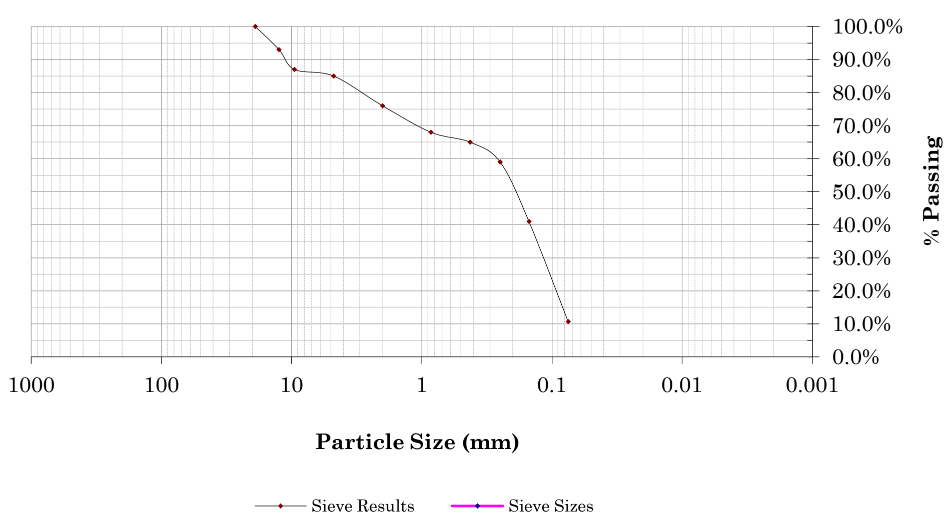
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:
% Gravel: 15.00
% Sand: 74.30
% Silt & Clay: 10.70
Moisture Content: 3.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt (SP-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-29 @ 5' BGS	**Lab #:**	171214

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	96%		
5/8"			
1/2"			
3/8"	93%		
1/4"			
#4	89%		
#8			
#10	74%		
#16			
#20	65%		
#30			
#40	39%		
#50			
#60	32%		
#80			
#100	26.1%		
#200	12.2%		

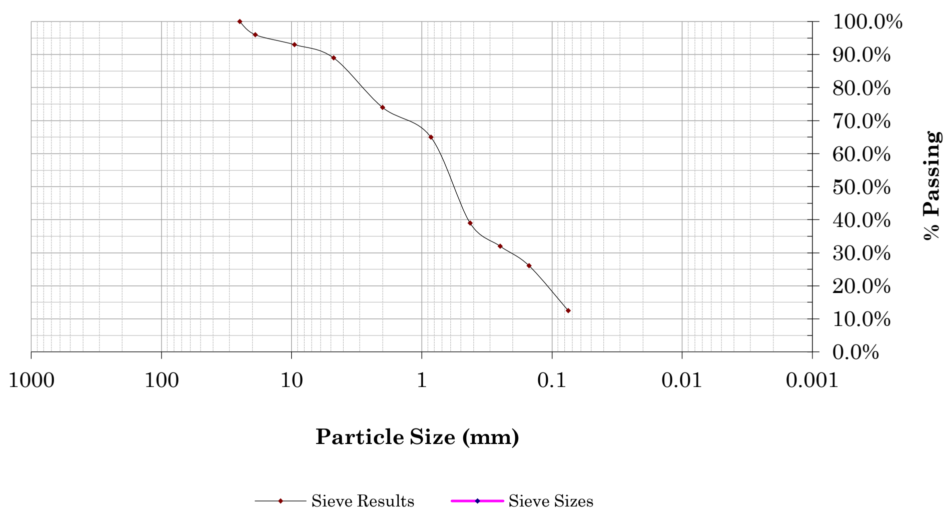
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	11.00
% Sand:	76.80
% Silt & Clay:	12.20
Moisture Content:	3.0%

Soil Classification (USCS): ASTM D 2487

Silty Sand (SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-29 @ 10' BGS	**Lab #:**	171232

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"	100%		
1/4"	99%		
#4	99%		
#8			
#10	98%		
#16			
#20	97%		
#30			
#40	79%		
#50			
#60			
#80	41.0%		
#100	36.0%		
#200	25.3%		

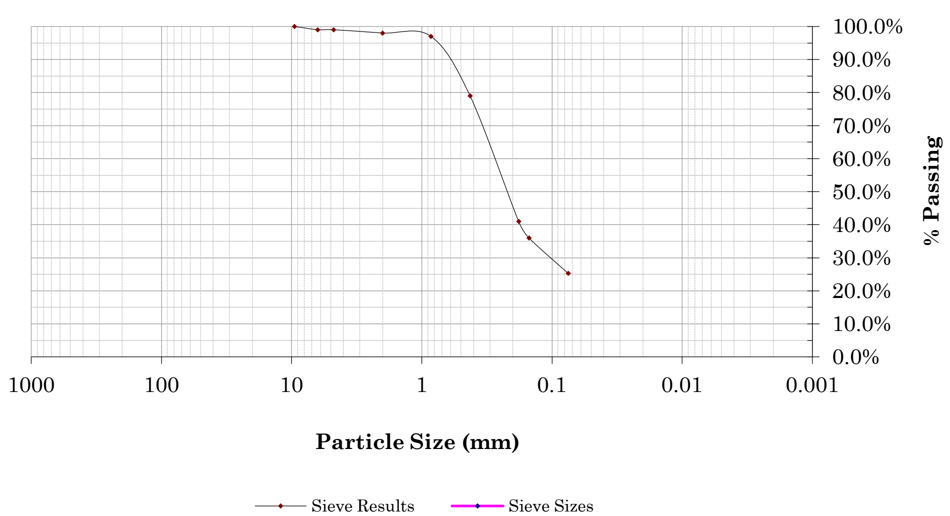
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	1.00
% Sand:	73.70
% Silt & Clay:	25.30
Moisture Content:	1.0%

Soil Classification (USCS): ASTM D 2487

Silty Sand(SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-33 @ 5' BGS	**Lab #:**	171233

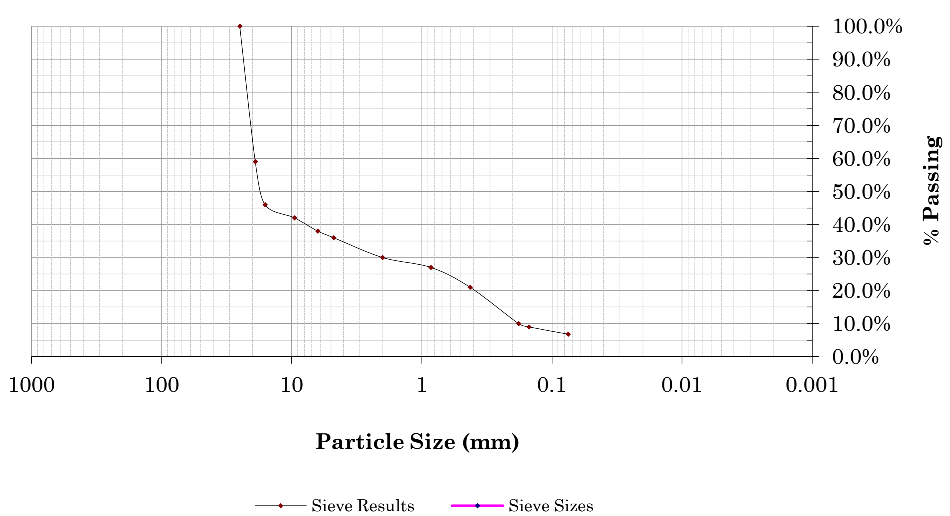
Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	59%		
5/8"	46%		
1/2"			
3/8"	42%		
1/4"	38%		
#4	36%		
#8			
#10	30%		
#16			
#20	27%		
#30			
#40	21%		
#50			
#60			
#80	10.0%		
#100	9.0%		
#200	6.8%		

Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	64.00
% Sand:	29.20
% Silt & Clay:	6.80
Moisture Content:	2.0%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Gravel with Silt and Sand (GP-GM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-30 composite sample @ 15-20' BGS	**Lab #:**	171221

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"	100%		
5/8"			
1/2"	98%		
3/8"	96%		
1/4"			
#4	93%		
#8	88%		
#10			
#16	79%		
#20	57%		
#30			
#40	37%		
#50			
#60	24%		
#80			
#100	16.3%		
#200	8.4%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	6.80
% Sand:	84.80
% Silt & Clay:	8.40
Moisture Content:	4.0%

Moisture-Density Data

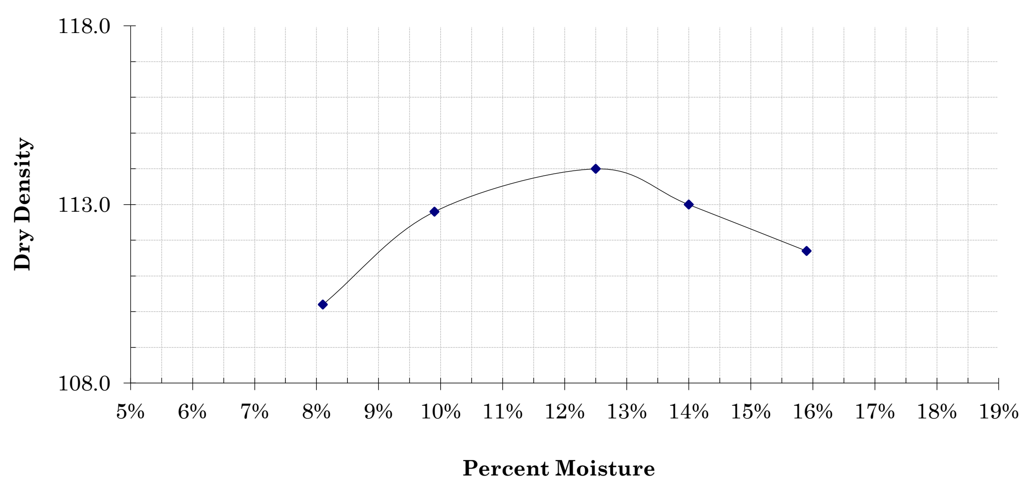
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	8.1%	110.2
2	9.9%	112.8
3	12.5%	114.0
4	14.0%	113.0
5	15.9%	111.7

Maximum Dry Density: 114.0 pcf
Optimum Moisture %: 12.5%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-33 @ 10' BGS	**Lab #:**	171231

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	96%		
5/8"	91%		
1/2"	88%		
3/8"	83%		
1/4"	80%		
#4	78%		
#8			
#10	74%		
#16			
#20	70%		
#30			
#40	53%		
#50			
#60			
#80	26.0%		
#100	22.0%		
#200	14.8%		

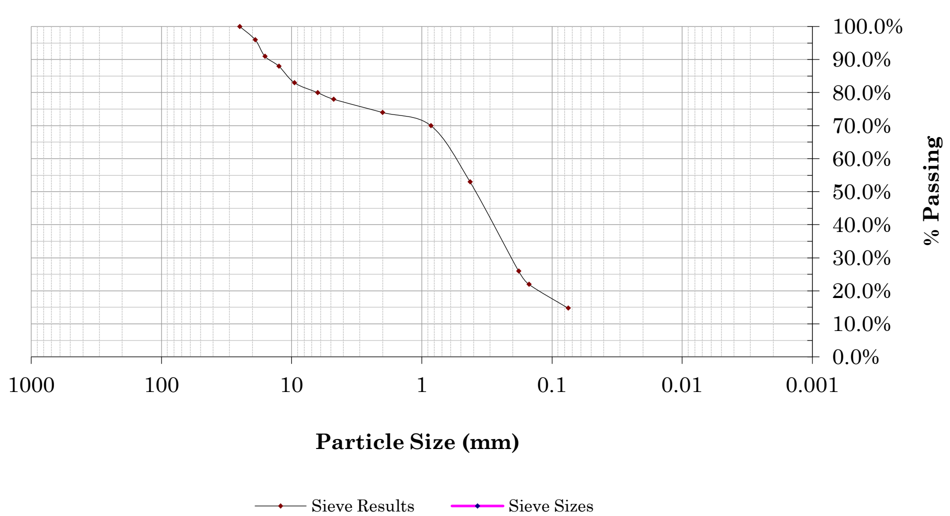
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	22.00
% Sand:	63.20
% Silt & Clay:	14.80
Moisture Content:	2.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt and Gravel (SP-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-33 @ composite 15-20' BGS	**Lab #:**	171220

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	81%		
5/8"			
1/2"			
3/8"	77%		
1/4"			
#4	73%		
#8			
#10	68%		
#16			
#20	57%		
#30			
#40	45%		
#50			
#60	27%		
#80			
#100	19.3%		
#200	12.3%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	26.80
% Sand:	60.90
% Silt & Clay:	12.30
Moisture Content:	3.0%

Moisture-Density Data

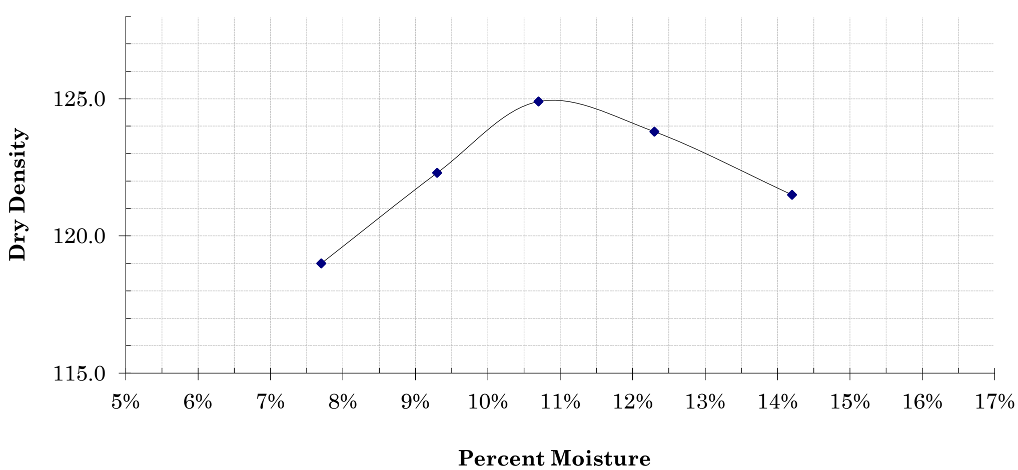
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	7.7%	119.0
2	9.3%	122.3
3	10.7%	124.9
4	12.3%	123.8
5	14.2%	121.5

Maximum Dry Density: 124.9 pcf
Optimum Moisture %: 10.7%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Sand with Silt and Gravel (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-34 @ 15' BGS	**Lab #:**	171230

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	93%		
5/8"	82%		
1/2"	71%		
3/8"	68%		
1/4"	60%		
#4	56%		
#8			
#10	47%		
#16			
#20	35%		
#30			
#40	19%		
#50			
#60			
#80	7.4%		
#100	7.0%		
#200	5.2%		

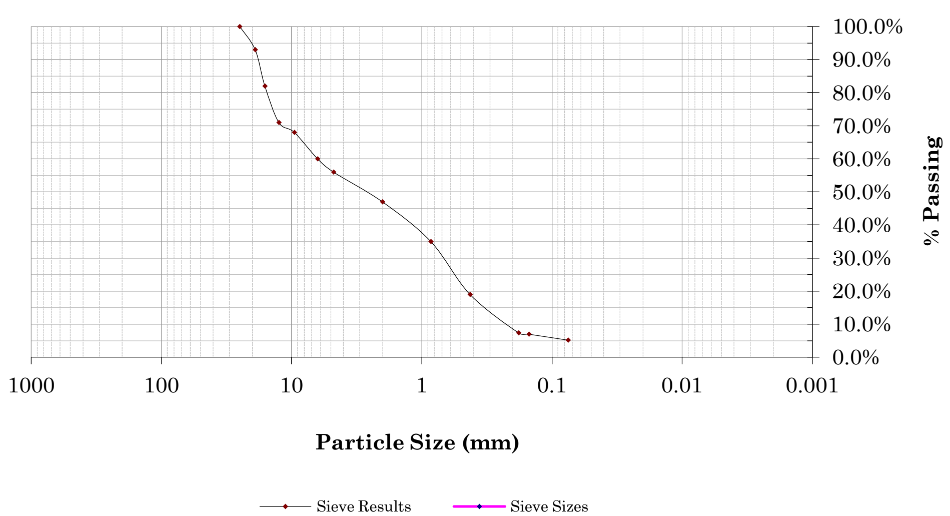
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	44.00
% Sand:	50.80
% Silt & Clay:	5.20
Moisture Content:	3.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt and Gravel (SP-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-35 @ 15' BGS	**Lab #:**	171211

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	94%		
5/8"			
1/2"	91%		
3/8"	90%		
1/4"			
#4	86%		
#8			
#10	84%		
#16			
#20	73%		
#30			
#40	69%		
#50			
#60	56%		
#80			
#100	22.0%		
#200	9.2%		

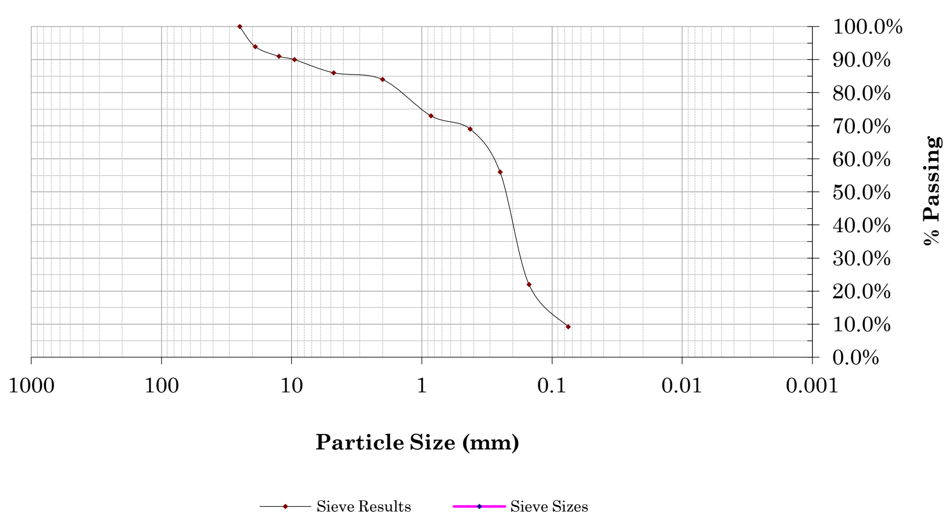
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	14.00
% Sand:	76.80
% Silt & Clay:	9.20
Moisture Content:	4.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with silt (SP-SM)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-37 @ 20' BGS	**Lab #:**	171235

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	83%		
5/8"	78%		
1/2"	70%		
3/8"	56%		
1/4"	50%		
#4	48%		
#8			
#10	38%		
#16			
#20	26%		
#30			
#40	17%		
#50			
#60			
#80	7.1%		
#100	6.0%		
#200	3.5%		

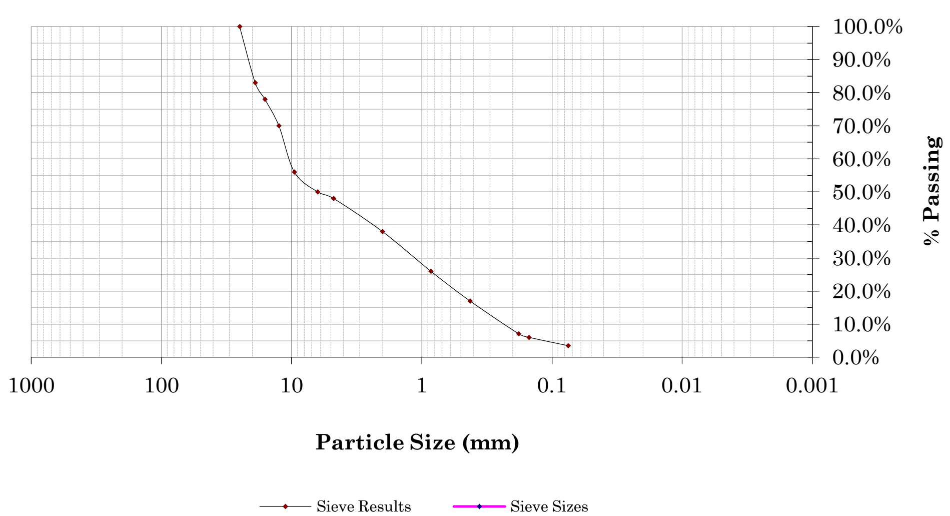
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	52.00
% Sand:	44.50
% Silt & Clay:	3.50
Moisture Content:	5.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Sand (GP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-38 auger cutting bulk sample @ 2.5' BGS	**Lab #:**	171222

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"	100%		
1/4"			
#4	99%		
#8	98%		
#10			
#16	95%		
#20	82%		
#30	64%		
#40	35%		
#50			
#60	13%		
#80			
#100	9.1%		
#200	6.2%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	0.70
% Sand:	93.10
% Silt & Clay:	6.20
Moisture Content:	2.0%

Moisture-Density Data

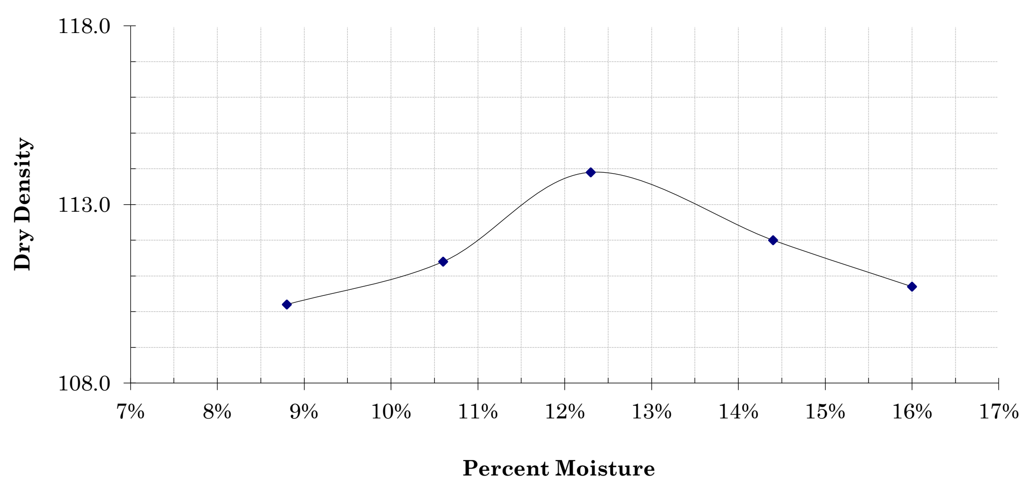
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	8.8%	110.2
2	10.6%	111.4
3	12.3%	113.9
4	14.4%	112.0
5	16.0%	110.7

Maximum Dry Density: 113.9 pcf
Optimum Moisture %: 12.3%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-40 @ 20' BGS	**Lab #:**	171236

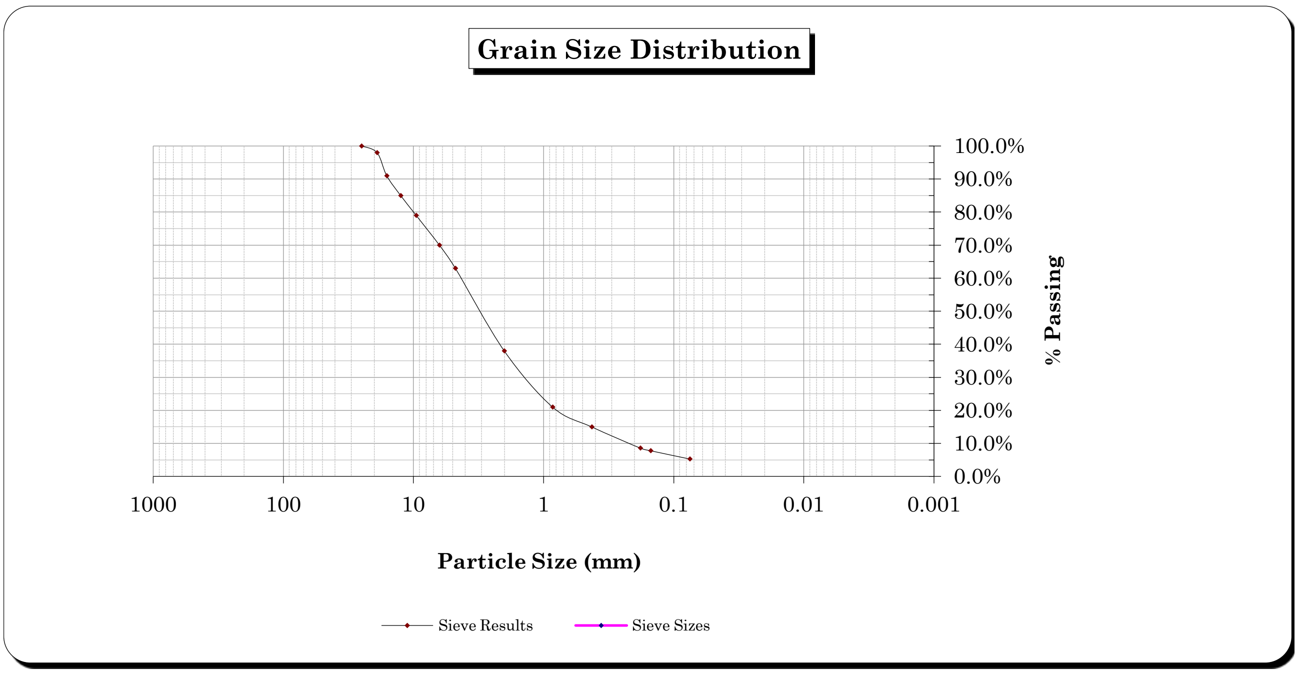
Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	98%		
5/8"	91%		
1/2"	85%		
3/8"	79%		
1/4"	70%		
#4	63%		
#8			
#10	38%		
#16			
#20	21%		
#30			
#40	15%		
#50			
#60			
#80	8.6%		
#100	7.8%		
#200	5.3%		

Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	37.00
% Sand:	57.70
% Silt & Clay:	5.30
Moisture Content:	3.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt and Gravel (SP-SM)



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-40 @ 30' BGS	**Lab #:**	171237

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"	100%		
1 1/4"			
1"	73%		
3/4"	72%		
5/8"	64%		
1/2"	56%		
3/8"	45%		
1/4"	31%		
#4	29%		
#8			
#10	18%		
#16			
#20	14%		
#30			
#40	12%		
#50			
#60			
#80	7.5%		
#100	7.0%		
#200	4.6%		

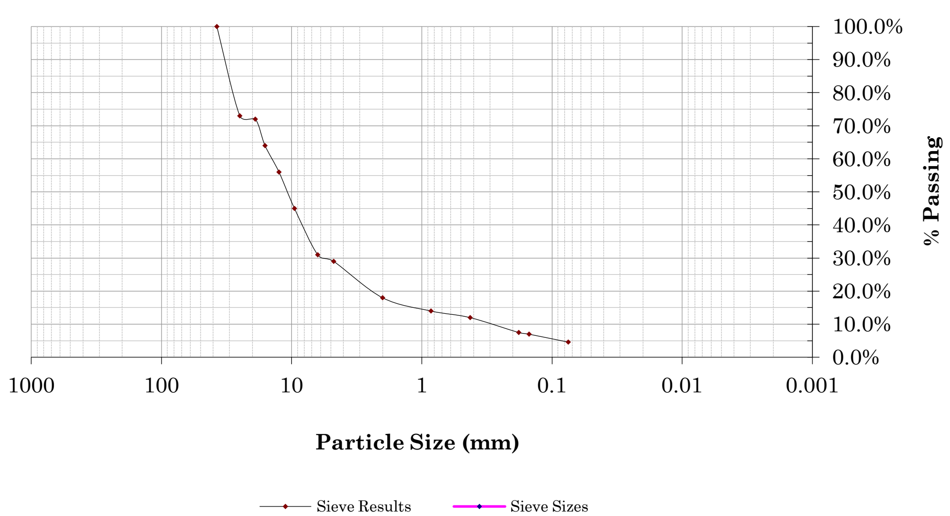
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	71.00
% Sand:	24.40
% Silt & Clay:	4.60
Moisture Content:	6.0%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Sand (GP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	BH-40 @ 50' BGS	**Lab #:**	171238

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2			
1 3/4"			
1 1/2"			
1 1/4"			
1"	100%		
3/4"	79%		
5/8"	75%		
1/2"	70%		
3/8"	65%		
1/4"	55%		
#4	48%		
#8			
#10	32%		
#16			
#20	24%		
#30			
#40	17%		
#50			
#60			
#80	6.2%		
#100	4.7%		
#200	1.8%		

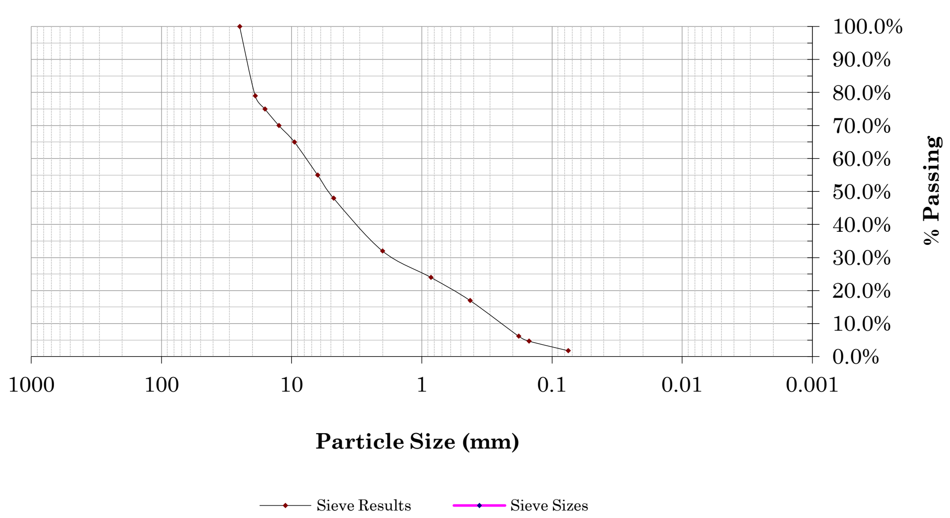
Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:	
% Gravel:	52.00
% Sand:	46.20
% Silt & Clay:	1.80
Moisture Content:	

Soil Classification (USCS): ASTM D 2487

Poorly Graded Gravel with Sand (GP)

Grain Size Distribution



Reviewed by: ____________________ **Date:** _____________

Northern, Inc.
Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

CLIENT:	Tecnicas Reunidas	JOB NO:	222-1672
PROJECT:	Atlas Agro Pacific Green Fertilizer	LABORATORY:	171013
SAMPLE SOURCE:	TP-1 @ 2' BGS	WORK ORDER:	164582
DATE SAMPLED:	8/18/2023	DATE TESTED:	8/22/2023
MATERIAL TYPE:	Native	TESTED BY:	GV

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
4"		#4	
3"		#8	
2 1/2"		#10	100%
2"		#16	
1 1/2"		#20	94%
1 1/4"		#30	
1"		#40	72%
3/4"		#50	
5/8"		#60	
1/2"		#80	34%
3/8"		#100	25%
1/4"		#200	15.0%

USCS CLASSIFICATION - ASTM D 2487

Silty Sand (SM)

SAND EQUIVALENT - ASTM D 2419

MOISTURE DENSITY RELATIONSHIP ASTM D 1557

% Moisture	Dry Density	Note
9.9%	96.7	Moist Preparation Method
11.5%	100.7	Manual Rammer
13.1%	**103.3**	Procedure: A
14.8%	100.7	S.G. (est): **2.3**
16.3%	98.4	

OVERSIZE CORRECTION - ASTM D 4718

Dry Density: **103.3 pcf** **% Moisture:** **13.1%**

LL, PL & PI - ASTM D 4318

Liquid Limit Plastic Limit Plast. Index

MOISTURE - ASTM D 2216

Moisture Content:

SOIL S.G. - ASTM D 854

Specific Gravity @ 20°C:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		

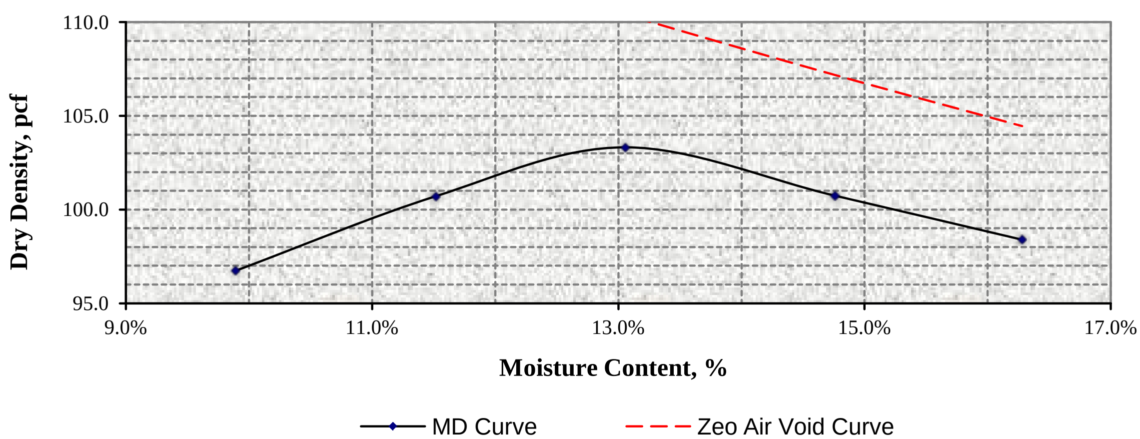
FINENESS MODULUS - ASTM C 136

Fineness Modulus: **0.75**

ORGANIC IMPURITIES - ASTM C 40

Organic Plate Number:

MOISTURE-DENSITY RELATIONSHIP



Reviewed By: ________________________________

Guy Vincent, Materials Testing Manager

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-2 @ 4' BGS	**Lab #:**	171015

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	99%		
#16			
#20	97%		
#30			
#40	75%		
#50	54%		
#60			
#80	27%		
#100	16%		
#200	7.3%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	
% Sand:	92.70
% Silt & Clay:	7.30
Moisture Content:	2.0%

Moisture-Density Data

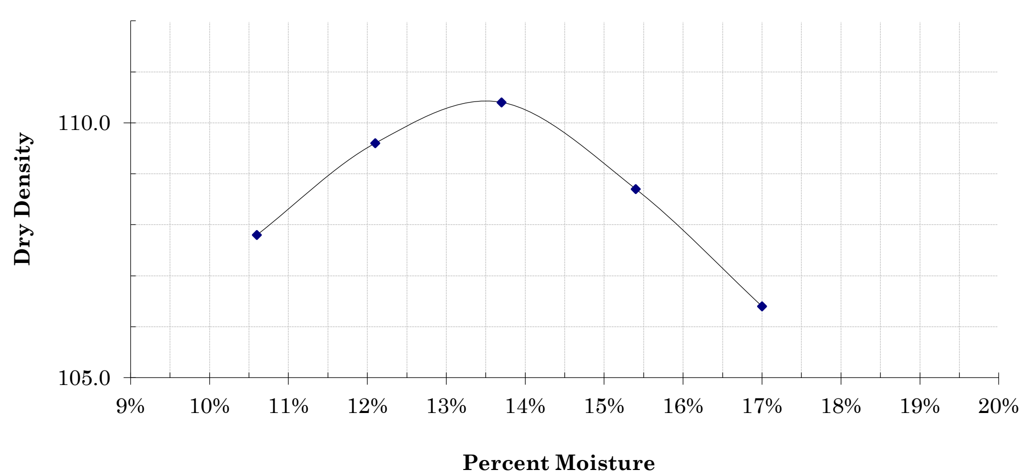
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	10.6%	107.8
2	12.1%	109.6
3	13.7%	110.4
4	15.4%	108.7
5	17.0%	106.4

Maximum Dry Density: 110.4 pcf
Optimum Moisture %: 13.7%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-3 @ 3' BGS	**Lab #:**	171016

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"	100%		
3"	99%		
2"			
1 3/4"	99%		
1 1/2"			
1 1/4"			
1"	98%		
3/4"	98%		
5/8"			
1/2"	98%		
3/8"	98%		
1/4"			
#4	91%		
#8			
#10	82%		
#16			
#20	74%		
#30			
#40	71%		
#50	54%		
#60			
#80	26%		
#100	21%		
#200	11.4%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel: 9.00
% Sand: 79.60
% Silt & Clay: 11.40
Moisture Content: 2.0%

Moisture-Density Data

Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

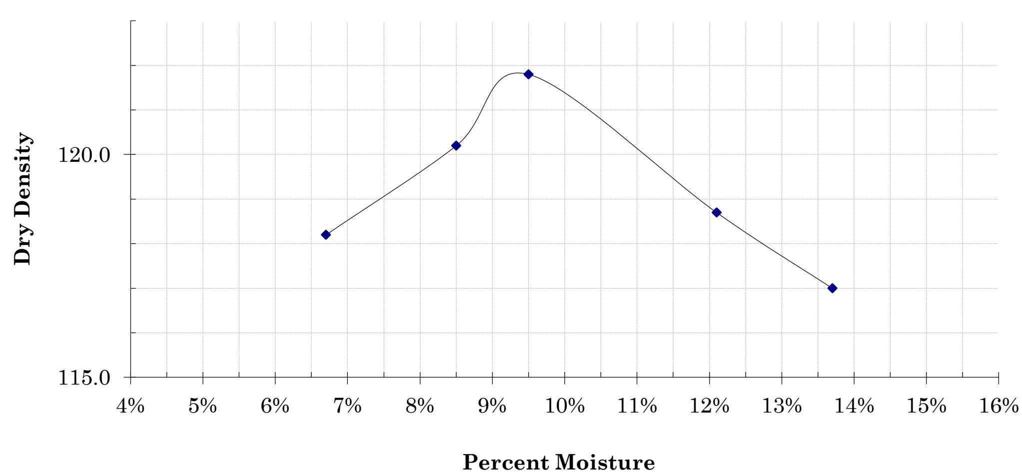
Point	% Moisture	Dry Density
1	6.7%	118.2
2	8.5%	120.2
3	9.5%	121.8
4	12.1%	118.7
5	13.7%	117.0

Maximum Dry Density: 121.8 pcf
Optimum Moisture %: 9.5%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP- 4 @ 4.5' BGS	**Lab #:**	171016

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2"	97%		
1 3/4"			
1 1/2"	99%		
1 1/4"			
1"	93%		
3/4"	97%		
5/8"			
1/2"	95%		
3/8"	92%		
1/4"			
#4	90%		
#8			
#10	83%		
#16			
#20	79%		
#30			
#40	63%		
#50			
#60			
#80	22%		
#100	17%		
#200	6.6%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	10.00
% Sand:	83.40
% Silt & Clay:	6.60
Moisture Content:	2.0%

Moisture-Density Data

Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

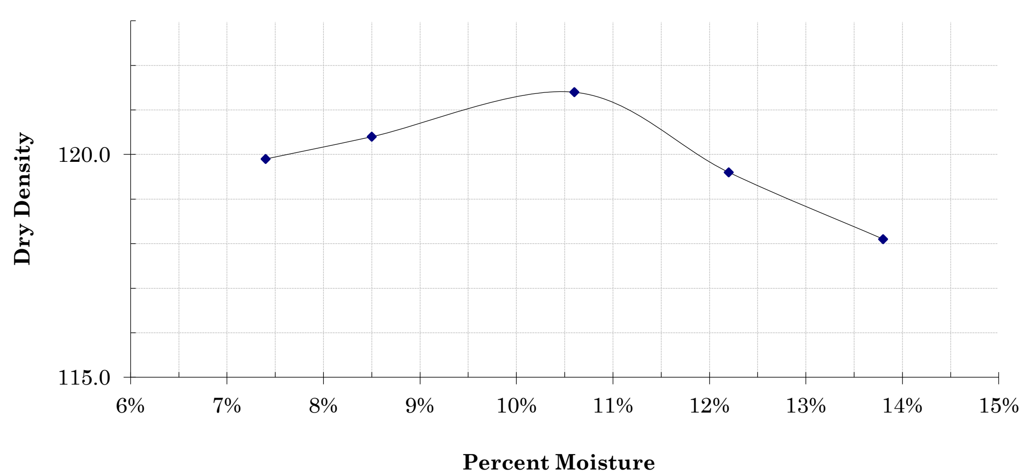
Point	% Moisture	Dry Density
1	7.4%	119.9
2	8.5%	120.4
3	10.6%	121.4
4	12.2%	119.6
5	13.8%	118.1

Maximum Dry Density: 121.4 pcf
Optimum Moisture %: 10.6%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP- 5 @ 3' BGS	**Lab #:**	171018

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"	100%		
1 3/4"			
1 1/2"	99%		
1 1/4"			
1"	96%		
3/4"	96%		
5/8"			
1/2"			
3/8"	95%		
1/4"			
#4	95%		
#8			
#10	94%		
#16			
#20	92%		
#30			
#40	96%		
#50			
#60			
#80	42%		
#100	38%		
#200	24.1%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	5.00
% Sand:	70.90
% Silt & Clay:	24.10
Moisture Content:	2.0%

Moisture-Density Data

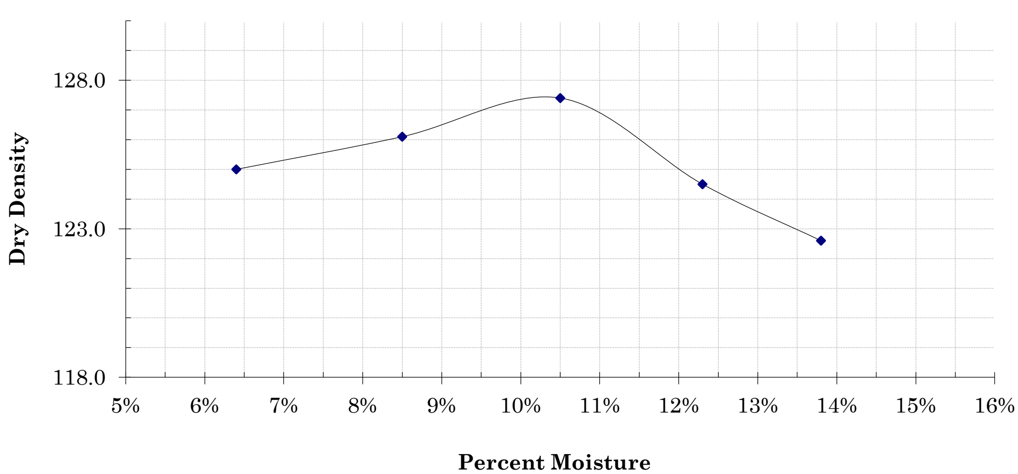
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	6.4%	125.0
2	8.5%	126.1
3	10.5%	127.4
4	12.3%	124.5
5	13.8%	122.6

Maximum Dry Density: 127.4 pcf
Optimum Moisture %: 10.5%

Soil Classification (USCS): ASTM D 2487
Silty Sand (SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-5 @ 5' BGS	**Lab #:**	171205

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2"	93%		
1 3/4"			
1 1/2"			
1 1/4"	87%		
1"	81%		
3/4"	78%		
5/8"			
1/2"	68%		
3/8"	55%		
1/4"	46%		
#4	38%		
#8			
#10	25%		
#16			
#20	17%		
#30			
#40	13%		
#50			
#60			
#80	10.5%		
#100	7.1%		
#200	2.1%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	55.00
% Sand:	35.90
% Silt & Clay:	2.10
Moisture Content:	2.0%

Moisture-Density Data

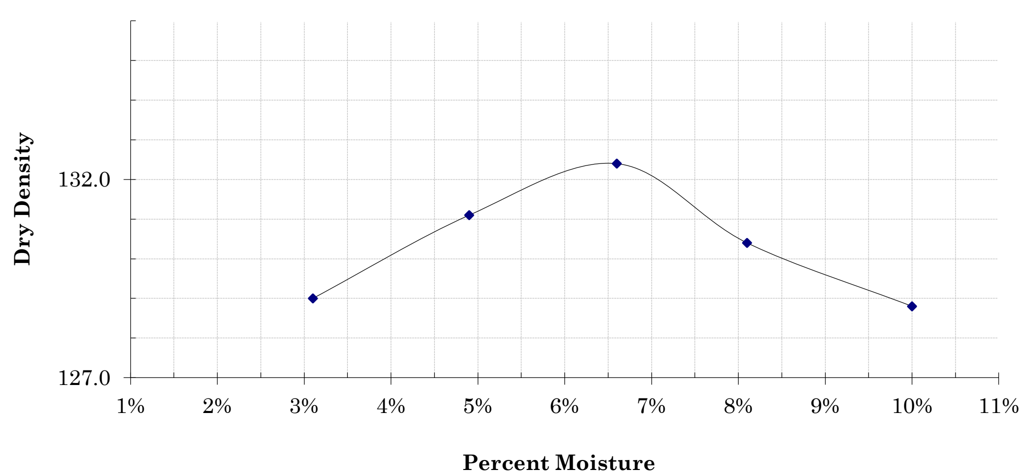
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	3.1%	129.0
2	4.9%	131.1
3	6.6%	132.4
4	8.1%	130.4
5	10.0%	128.8

Maximum Dry Density: 132.4 pcf
Optimum Moisture %: 6.6%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Gravel with Sand (GP)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP- 6 @ 3' BGS	**Lab #:**	171019

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	83%		
#16			
#20	75%		
#30			
#40	55%		
#50			
#60			
#80	38%		
#100	22%		
#200	14.6%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel:
% Sand: 85.40
% Silt & Clay: 14.60
Moisture Content: 3.0%

Moisture-Density Data

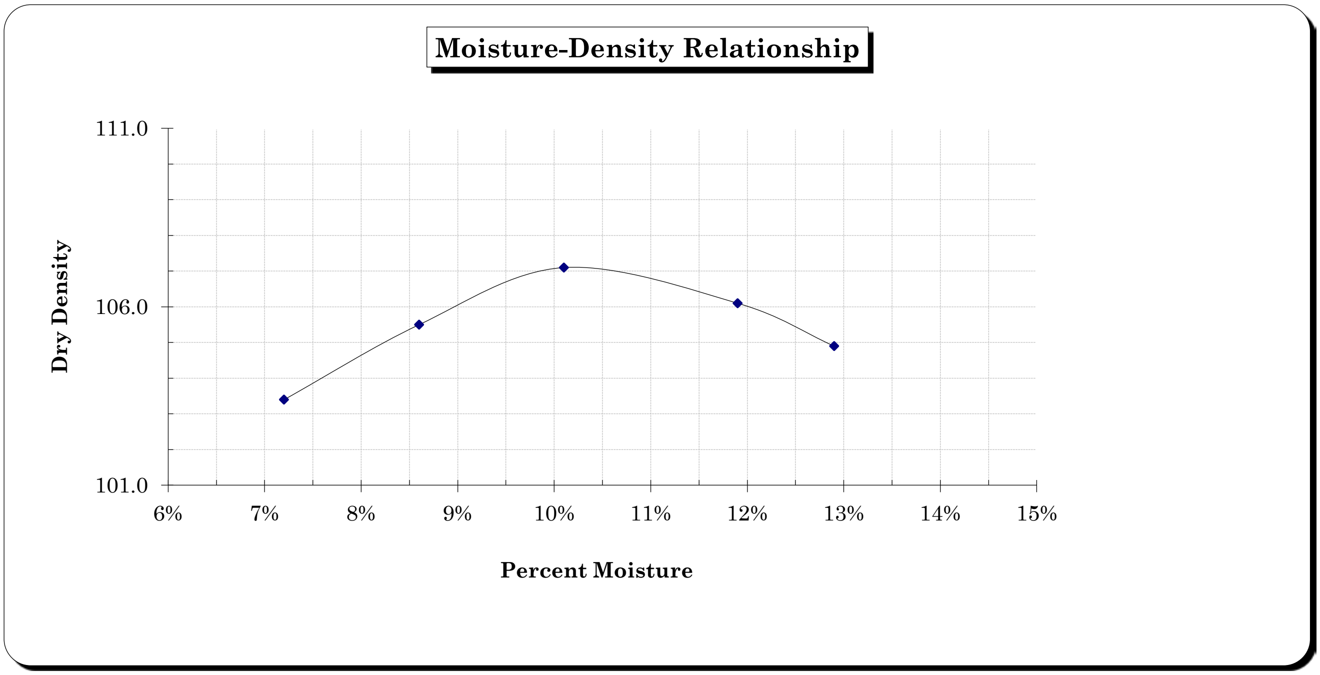
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	7.2%	103.4
2	8.6%	105.5
3	10.1%	107.1
4	11.9%	106.1
5	12.9%	104.9

Maximum Dry Density: 107.1 pcf
Optimum Moisture %: 10.1%

Soil Classification (USCS): ASTM D 2487

Silty Sand (SM)



Reviewed by: ____________________ **Date:** _____________

Northern, Inc.
Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

CLIENT:	Tecnicas Reunidas	JOB NO:	223-1672
PROJECT:	Atlas Agro Pacific Green	LABORATORY:	171020
SAMPLE SOURCE:	TP-7 @ 2.5' BGS	WORK ORDER:	164582
DATE SAMPLED:	8/18/2023	DATE TESTED:	8/22/2023
MATERIAL TYPE:	Native	TESTED BY:	GV

USCS CLASSIFICATION - ASTM D 2487

Poorly Graded Sand with Silt (SP-SM)

SAND EQUIVALENT - ASTM D 2419

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
4"		#4	100%
3"		#8	
2 1/2"		#10	81%
2"		#16	
1 1/2"		#20	72%
1 1/4"		#30	
1"		#40	57%
3/4"		#50	
5/8"		#60	
1/2"		#80	29%
3/8"		#100	26%
1/4"		#200	11.4%

MOISTURE DENSITY RELATIONSHIP ASTM D 1557

% Moisture	Dry Density	Note
7.8%	101.7	Moist Preparation Method
10.7%	103.2	Manual Rammer
12.4%	**105.7**	Procedure: A
14.9%	102.6	S.G. (est): **2.4**
16.5%	100.7	

OVERSIZE CORRECTION - ASTM D 4718

Dry Density: **105.7 pcf** **% Moisture:** **12.4%**

LL, PL & PI - ASTM D 4318

Liquid Limit | Plastic Limit | Plast. Index

MOISTURE - ASTM D 2216

Moisture Content:

SOIL S.G. - ASTM D 854

Specific Gravity @ 20°C:

FINENESS MODULUS - ASTM C 136

Fineness Modulus: **0.74**

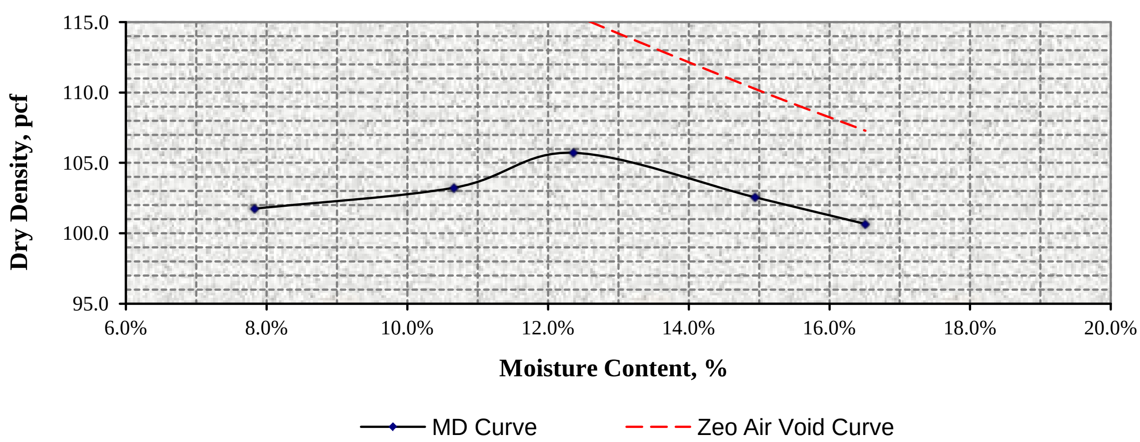
ORGANIC IMPURITIES - ASTM C 40

Organic Plate Number:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		

MOISTURE-DENSITY RELATIONSHIP



Reviewed By: ____________________

Guy Vincent, Materials Testing Manager

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-7 @ 5' BGS	**Lab #:**	171204

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"	100%		
1 3/4"			
1 1/2"			
1 1/4"	94%		
1"			
3/4"	87%		
5/8"			
1/2"	70%		
3/8"	62%		
1/4"	49%		
#4	40%		
#8			
#10	23%		
#16			
#20	15%		
#30			
#40	11%		
#50			
#60			
#80	8.0%		
#100	6.0%		
#200	1.3%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel: 60.50
% Sand: 38.20
% Silt & Clay: 1.30
Moisture Content: 2.0%

Moisture-Density Data

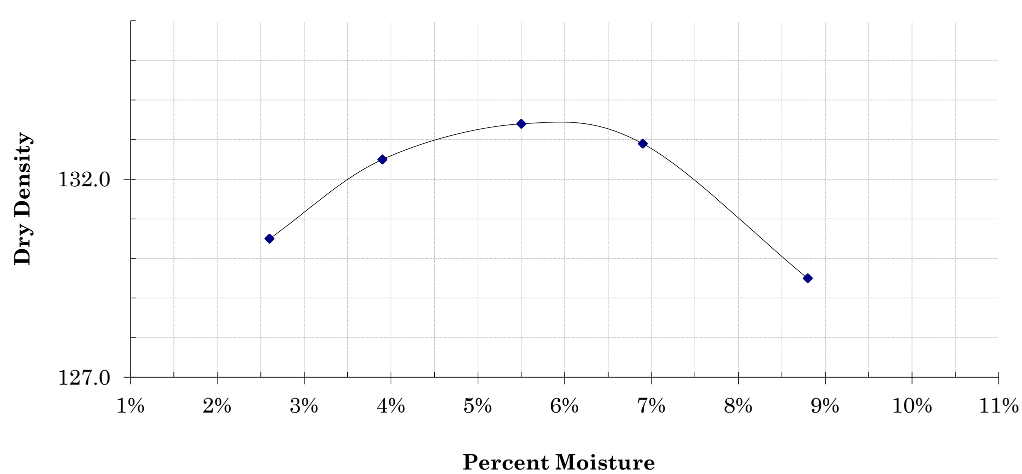
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	2.6%	130.5
2	3.9%	132.5
3	5.5%	133.4
4	6.9%	132.9
5	8.8%	129.5

Maximum Dry Density: 133.4 pcf
Optimum Moisture %: 4.5%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Gravel with Sand (GP)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-8 @ 0.5' BGS	**Lab #:**	171021

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"	100%		
3"	99%		
2"	99%		
1 3/4"			
1 1/2"	98%		
1 1/4"			
1"	97%		
3/4"	97%		
5/8"			
1/2"	96%		
3/8"	95%		
1/4"			
#4	95%		
#8			
#10	87%		
#16			
#20	83%		
#30			
#40	67%		
#50			
#60			
#80	41%		
#100	38%		
#200	27.7%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel: 5.00
% Sand: 67.30
% Silt & Clay: 27.70
Moisture Content: 2.0%

Moisture-Density Data

Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

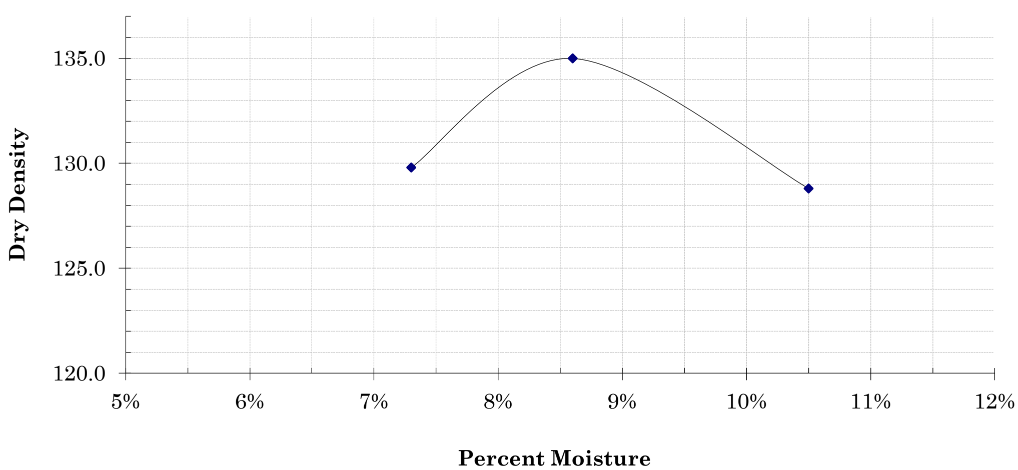
Point	% Moisture	Dry Density
1		
2	7.3%	129.8
3	8.6%	135.0
4	10.5%	128.8
5		

Maximum Dry Density: 135.0 pcf
Optimum Moisture %: 8.6%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand with Silt (SP-SM)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-8 @ 5' BGS	**Lab #:**	171203

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2"	91%		
1 3/4"			
1 1/2"			
1 1/4"			
1"	90%		
3/4"	81%		
5/8"			
1/2"	77%		
3/8"	64%		
1/4"	57%		
#4	40%		
#8			
#10	32%		
#16			
#20	20%		
#30			
#40	18%		
#50	11%		
#60			
#80	8.5%		
#100	7.9%		
#200	4.7%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel: 60.00
% Sand: 35.30
% Silt & Clay: 4.70
Moisture Content: 4.0%

Moisture-Density Data

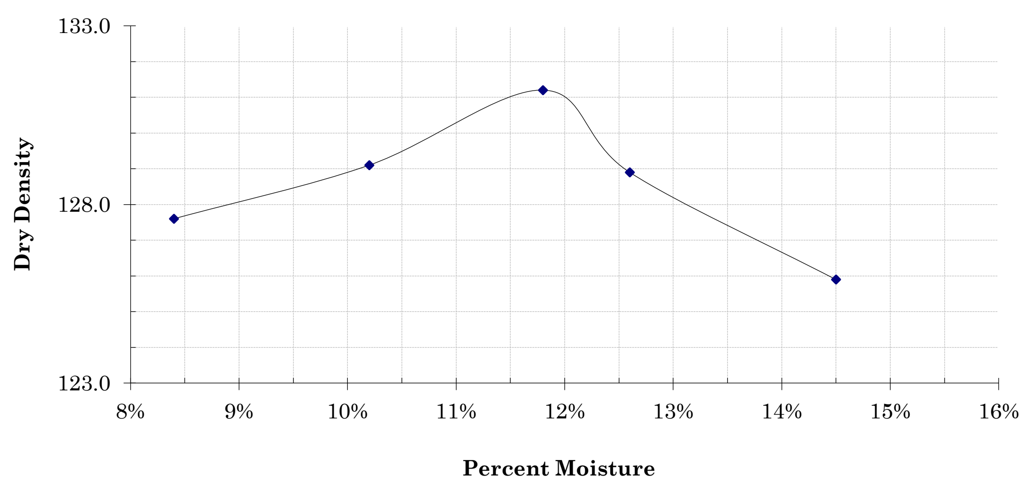
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	8.4%	127.6
2	10.2%	129.1
3	11.8%	131.2
4	12.6%	128.9
5	14.5%	125.9

Maximum Dry Density: 131.2 pcf
Optimum Moisture %: 11.8%

Soil Classification (USCS): ASTM D 2487
Poorly Graded Gravel with Sand (GP)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/16/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-9 @ 3' BGS	**Lab #:**	171022

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10			
#16			
#20	97%		
#30			
#40	58%		
#50			
#60			
#80	9%		
#100	7%		
#200	2.2%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:	
% Gravel:	
% Sand:	97.80
% Silt & Clay:	2.20
Moisture Content:	2.0%

Moisture-Density Data

Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

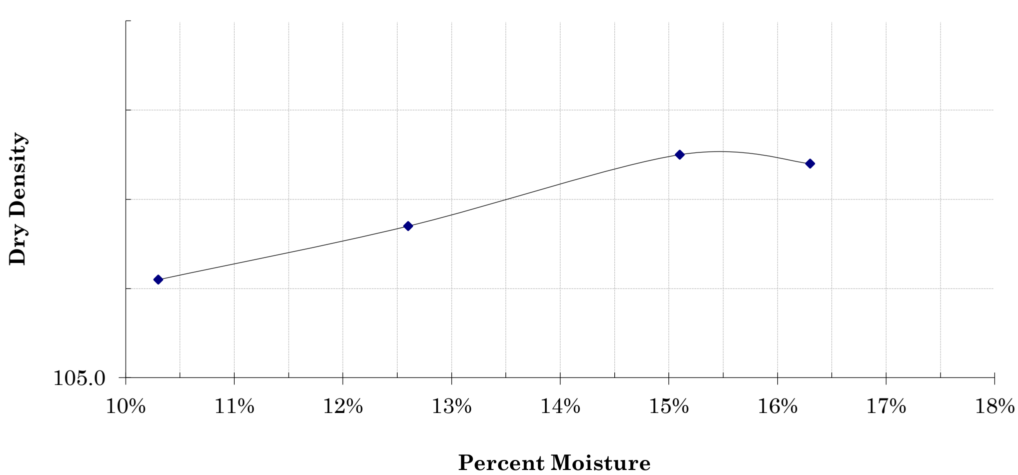
Point	% Moisture	Dry Density
1	10.3%	106.1
2	12.6%	106.7
3	15.1%	107.5
4	16.3%	107.4
5		

Maximum Dry Density: 107.5 pcf
Optimum Moisture %: 15.1%

Soil Classification (USCS): ASTM D 2487

Poorly Graded Sand (SP)

Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

Northern, Inc.
Consulting Engineers   Environmental Scientists   Geologists
Construction Materials Testing   Geophysical Services

CLIENT:	Tecnicas Reunidas	JOB NO:	223-1672
PROJECT:	Atlas Agro Pacific Green Fertilizer	LABORATORY:	171023
SAMPLE SOURCE:	TP-10 @ 5' BGS	WORK ORDER:	164582
DATE SAMPLED:	8/18/2023	DATE TESTED:	8/22/2023
MATERIAL TYPE:	Native	TESTED BY:	GV

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
4"		#4	
3"		#8	
2 1/2"		#10	99%
2"		#16	
1 1/2"		#20	85%
1 1/4"		#30	
1"		#40	45%
3/4"		#50	
5/8"		#60	
1/2"		#80	19%
3/8"		#100	17%
1/4"		#200	14.6%

USCS CLASSIFICATION - ASTM D 2487
Silty Sand (SM)

SAND EQUIVALENT - ASTM D 2419

MOISTURE DENSITY RELATIONSHIP   ASTM D 1557

% Moisture	Dry Density	Note
7.0%	107.7	Moist Preparation Method
9.6%	110.5	Manual Rammer
11.8%	**112.3**	Procedure: A
13.4%	110.3	S.G. (est): **2.4**
15.4%	107.4	

OVERSIZE CORRECTION - ASTM D 4718

Dry Density: **112.3 pcf**   **% Moisture:** **11.8%**

LL, PL & PI - ASTM D 4318
Liquid Limit   Plastic Limit   Plast. Index

MOISTURE - ASTM D 2216
Moisture Content:

SOIL S.G. - ASTM D 854
Specific Gravity @ 20°C:

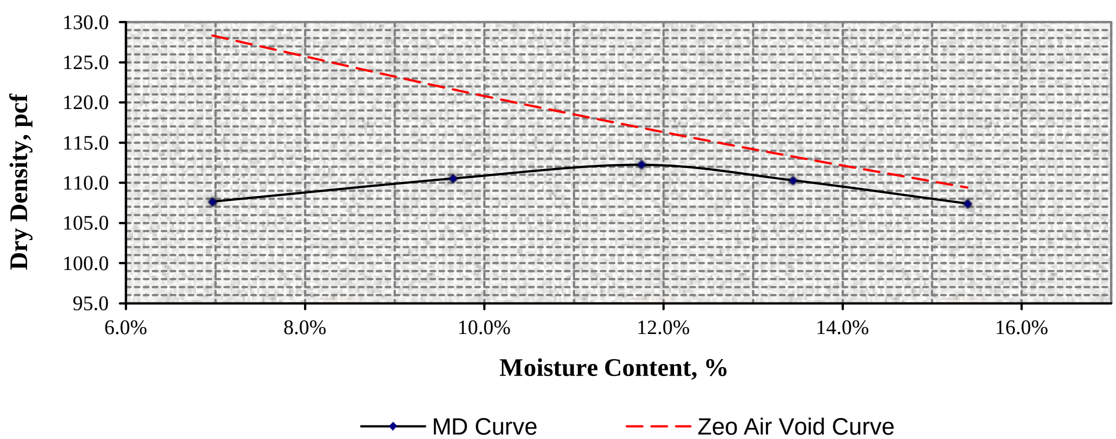
FINENESS MODULUS - ASTM C 136
Fineness Modulus: **0.83**

ORGANIC IMPURITIES - ASTM C 40
Organic Plate Number:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		

MOISTURE-DENSITY RELATIONSHIP



Reviewed By: ______________________

Guy Vincent, Materials Testing Manager

GN Northern, Inc.
722 N. 16th Ave. Suite 31
Yakima, WA 98902

Moisture-Density Results

Project:	Atlas Agro Pacific Green Fertilizer Plant	**Date Received:**	8/17/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	native	**W.O. #:**	164582
Source:	TP-12 @ 4' BGS	**Lab #:**	171202

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"	100%		
2"	97%		
1 3/4"			
1 1/2"	90%		
1 1/4"			
1"	76%		
3/4"	71%		
5/8"			
1/2"	62%		
3/8"	5%		
1/4"			
#4	36%		
#8			
#10	24%		
#16			
#20	19%		
#30			
#40	13%		
#50			
#60			
#80	10.0%		
#100	7.0%		
#200	3.1%		

Sieve Analysis Data: ASTM D 6913/ D 1140

Fineness Modulus:
% Gravel: 64.00
% Sand: 32.90
% Silt & Clay: 3.10
Moisture Content: 2.0%

Moisture-Density Data

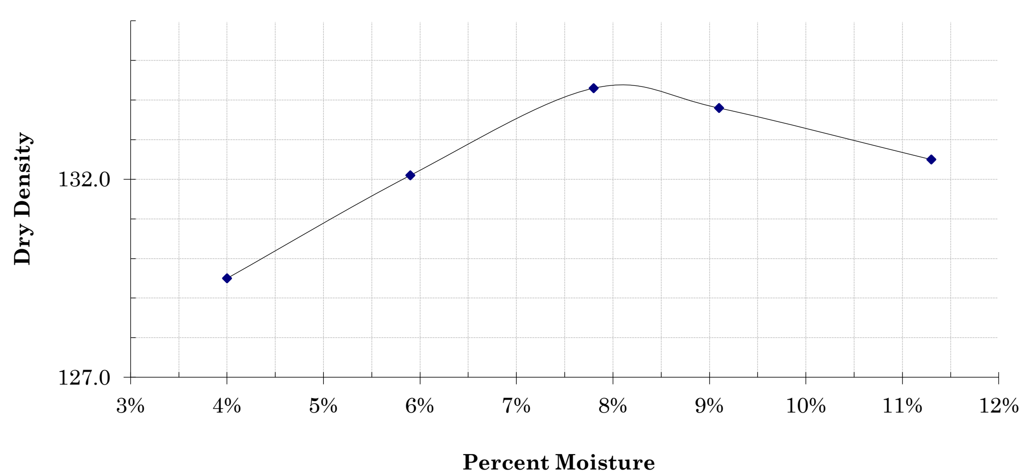
Test Method: ASTM D1557
Dry Preparation Method, Manual Rammer

Point	% Moisture	Dry Density
1	4.0%	129.5
2	5.9%	132.1
3	7.8%	134.3
4	9.1%	133.8
5	11.3%	132.5

Maximum Dry Density: 134.3 pcf
Optimum Moisture %: 7.8%

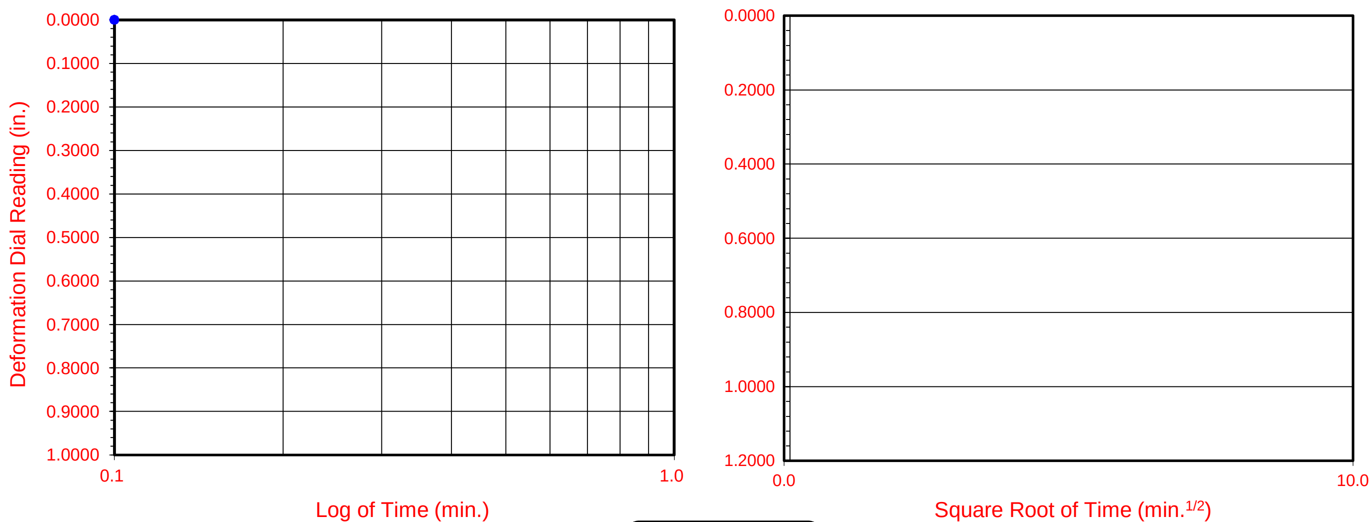
Soil Classification (USCS): ASTM D 2487
Poorly Graded Gravel with Sand (GP)

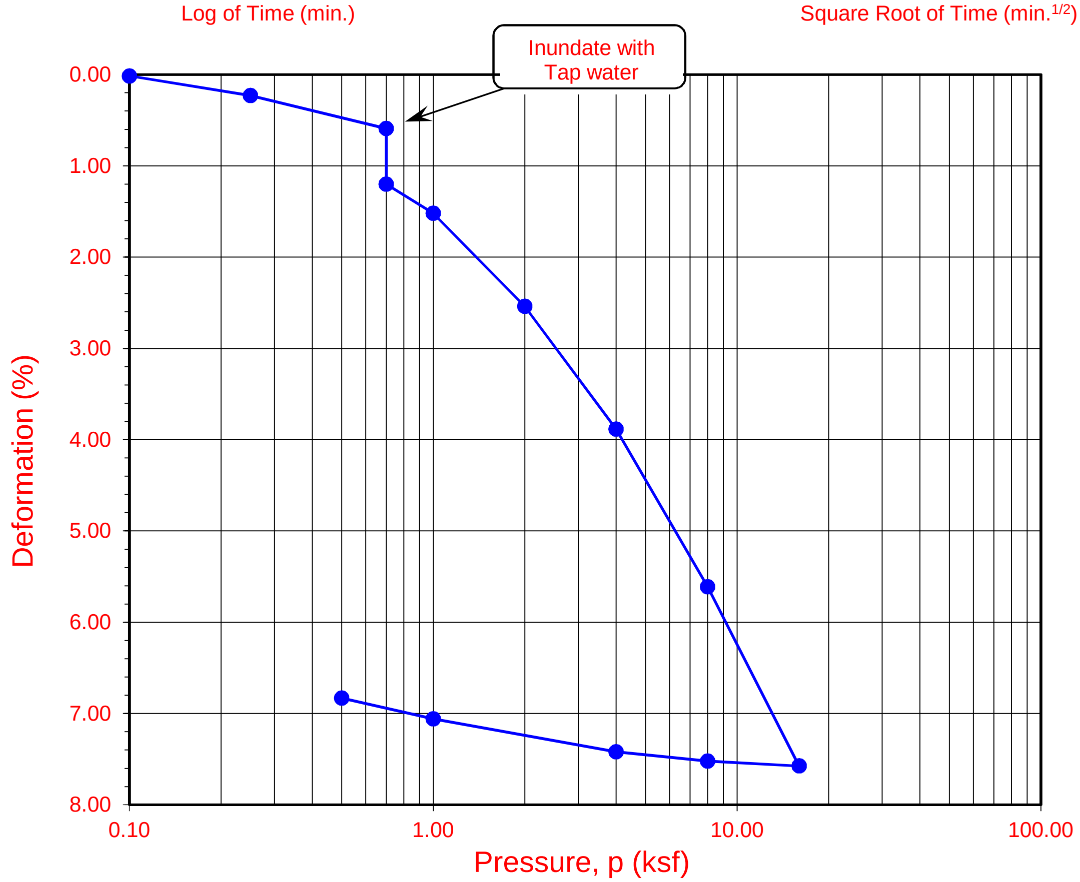
Moisture-Density Relationship



Reviewed by: ____________________ **Date:** _____________

Time Readings



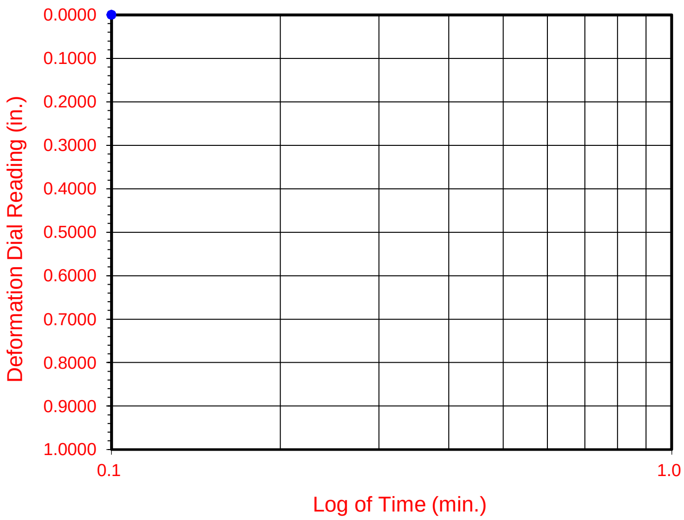


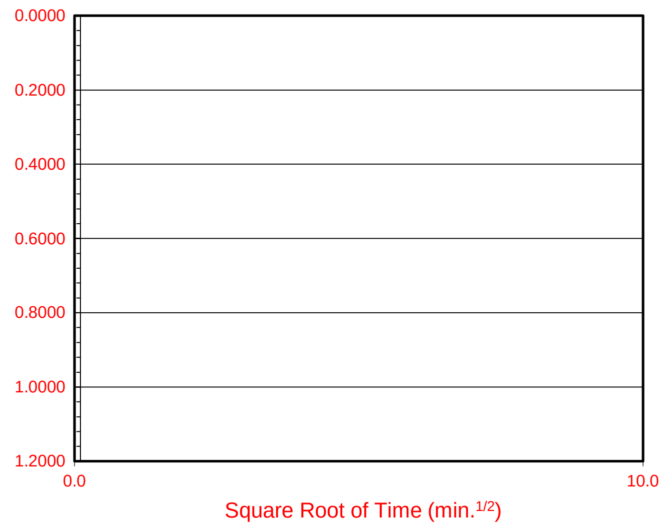
Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
BH-13	**171218**	**3**	**4.0**	**14.0**	**105.7**	**110.2**	**0.503**	**0.401**	**26**	**89**

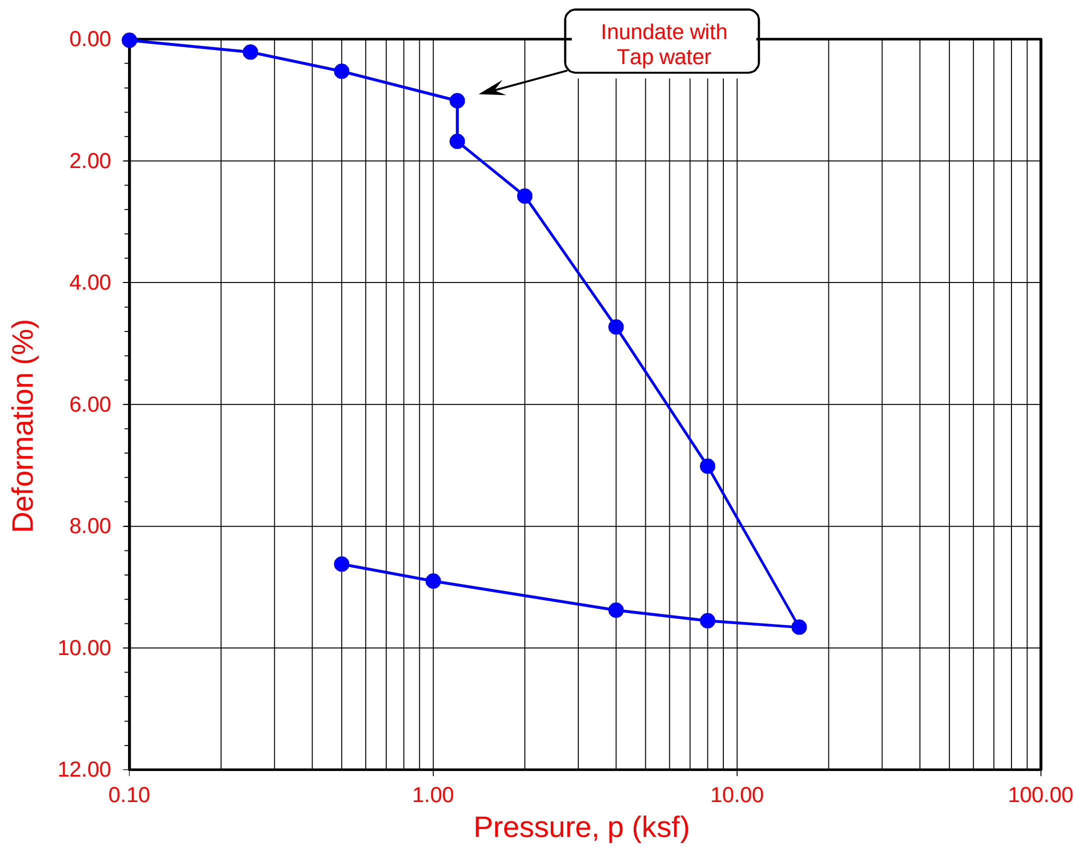
Soil Identification: Brown silty sand (SM)

Northern, Inc.	**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS** **ASTM D 2435**	GNN Project No.: 223-1672 Atlas Agro Green Fertilizer Plant

Time Readings







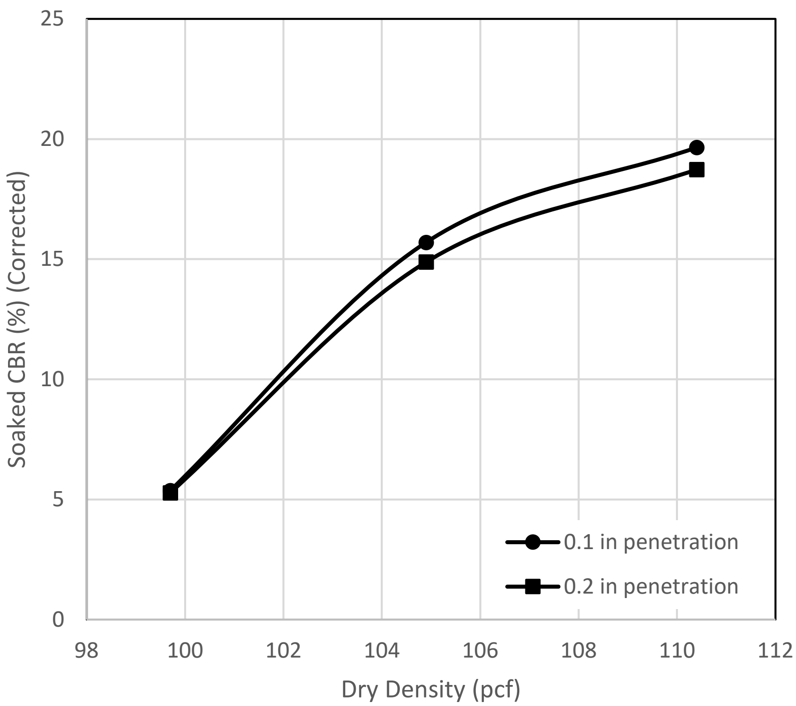
Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
BH-20	**181021**	**3**	**7.6**	**15.6**	**108.7**	**116.6**	**0.551**	**0.417**	**37**	**94**

Soil Identification: Sand with Silt (SP-SM)

GN Northern, Inc.	**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS** **ASTM D 2435**	GNN Project No.: 223-1672 Atlas Agro Green Fertilizer Plant

CALIFORNIA BEARING RATIO
ASTM D1887-07

Client	Técnicas Reunidas
Project	Atlas Agro Pacific Green Fertilizer Plant
GNN Project No.	233-1672

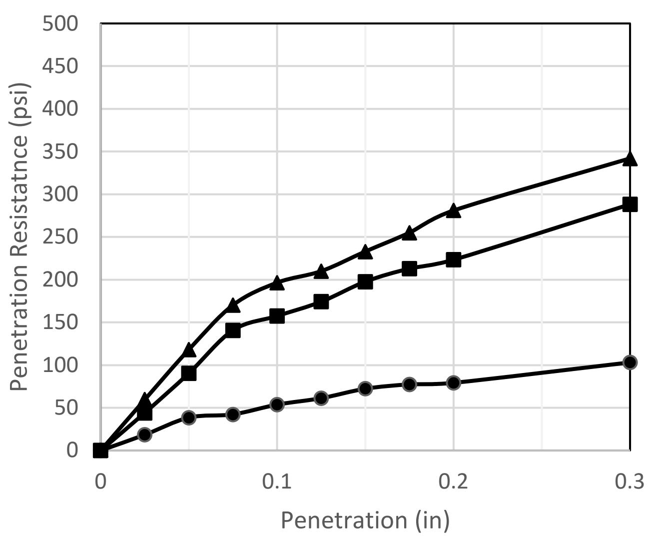


Sample Parameters

Sample No.	**171015**
Source of Material	**TP-2 @ 4 feet**
Description of Material	**Sand with Silt (SP-SM)**
Date Sampled	**8/16/2023**
Date Tested	**9/26/2023**

Test Parameters

Displacement (in/min)	**0.05**
Probe Area (in^2)	**3**
Sample Type	**Remolded**



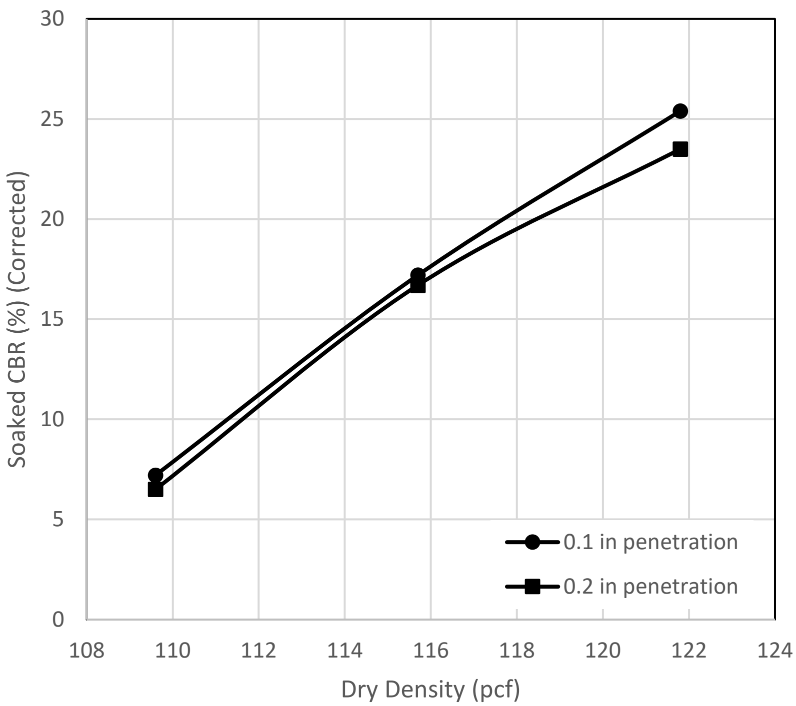
Sample No.	1	2	3
Sample Correction	Soaked		
Compaction Method	ASTM D1557		
Maximum Dry Denstiy, (pcf)	110.4	110.4	110.4
Optimum Moisture Content, (%)	13.7	13.7	13.7
Dry Density before Soaking, (pcf)	111.5	107.6	105.1
Moisture Content, (%)			
After Compaction	13.9	14.1	13.7
Top 1" after Soaking	15.0	17.0	19.1
Surcharge, (lbs)	10.00	10.00	10.00
Swell, (%)	0.04	0.08	0.03

	0.1 in penetration	0.2 in penetration
Dry Density @ 90% = 99.7 pcf	CBR @ 90% Density = 5.37	CBR @ 90% Density = 5.28
Dry Density @ 95% = 104.9 pcf	CBR @ 95% Density = 15.7	CBR @ 95% Density = 14.88
Dry Density @ 100% = 110.4 pcf	CBR @ 100% Density = 19.65	CBR @ 100% Density = 18.73

Northern, Inc.

Client	Técnicas Reunidas
Project	Atlas Agro Pacific Green Fertilizer Plant
GNN Project No.	233-1672

CALIFORNIA BEARING RATIO
ASTM D1887-07

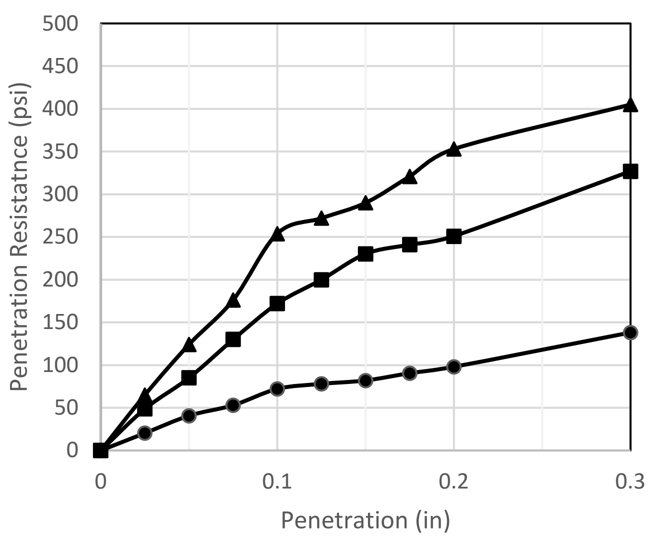


Sample Parameters

Sample No.	**171016**
Source of Material	**TP-3 @ 3 feet**
Description of Material	**Sand with Silt (SP-SM)**
Date Sampled	**8/16/2023**
Date Tested	**9/28/2023**

Test Parameters

Displacement (in/min)	**0.05**
Probe Area (in^2)	**3**
Sample Type	**Remolded**

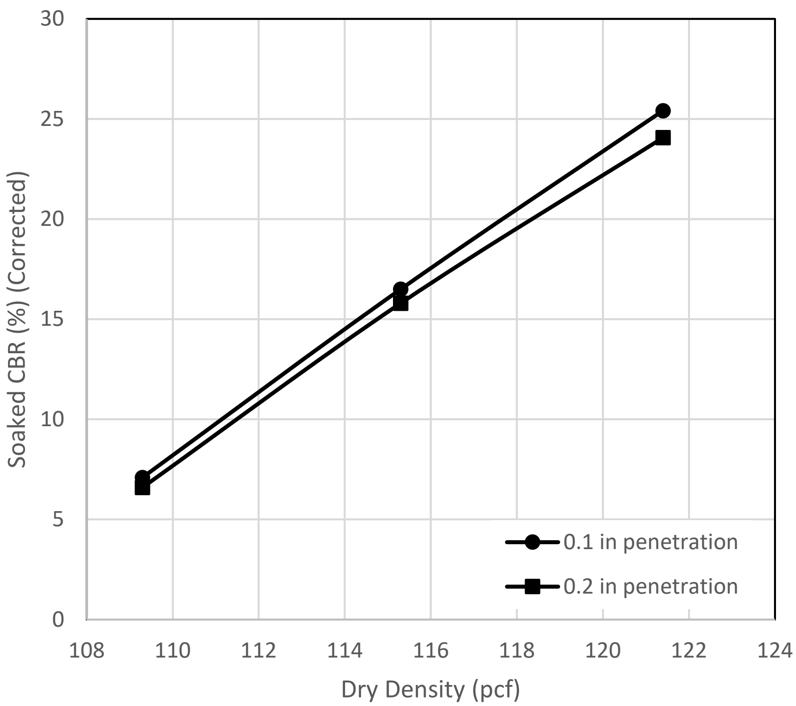


Sample No.	1	2	3
Sample Correction	Soaked		
Compaction Method	ASTM D1557		
Maximum Dry Denstiy, (pcf)	121.8	121.8	121.8
Optimum Moisture Content, (%)	9.5	9.5	9.5
Dry Density before Soaking, (pcf)	122.3	114.3	111.2
Moisture Content, (%)			
After Compaction	9.8	9.6	9.7
Top 1" after Soaking	13.0	15.0	17.0
Surcharge, (lbs)	10.00	10.00	10.00
Swell, (%)	0.01	0.03	0.02

	0.1 in penetration	0.2 in penetration
Dry Density @ 90% = 109.6 pcf	CBR @ 90% Density = 7.21	CBR @ 90% Density = 6.5
Dry Density @ 95% = 115.7 pcf	CBR @ 95% Density = 17.2	CBR @ 95% Density = 16.7
Dry Density @ 100% = 121.8 pcf	CBR @ 100% Density = 25.4	CBR @ 100% Density = 23.5

Client	Técnicas Reunidas
Project	Atlas Agro Pacific Green Fertilizer Plant
GNN Project No.	233-1672

CALIFORNIA BEARING RATIO
ASTM D1887-07

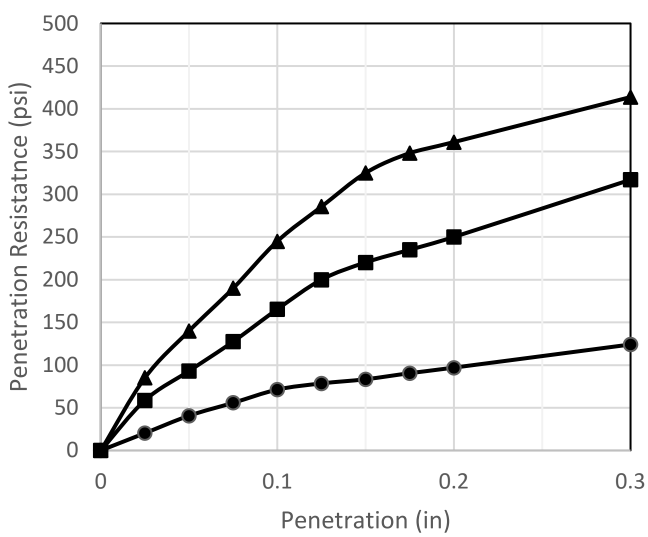


Sample Parameters

Sample No.	**171017**
Source of Material	**TP-4 @ 4.5 feet**
Description of Material	**Sand with Silt (SP-SM)**
Date Sampled	**8/16/2023**
Date Tested	**9/29/2023**

Test Parameters

Displacement (in/min)	**0.05**
Probe Area (in^2)	**3**
Sample Type	**Remolded**



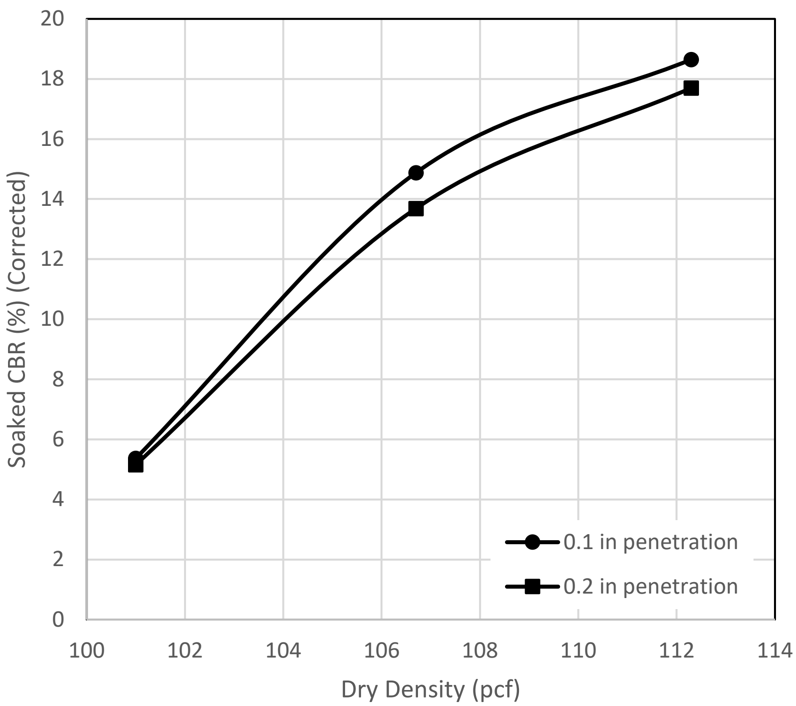
Sample No.	1	2	3
Sample Correction	Soaked		
Compaction Method	ASTM D1557		
Maximum Dry Denstiy, (pcf)	121.4	121.4	121.4
Optimum Moisture Content, (%)	10.6	10.6	10.6
Dry Density before Soaking, (pcf)	122.1	114.1	110.8
Moisture Content, (%)			
After Compaction	10.8	10.6	10.5
Top 1" after Soaking	14.0	16.0	18.0
Surcharge, (lbs)	10.00	10.00	10.00
Swell, (%)	0.01	0.03	0.02

	0.1 in penetration	0.2 in penetration
Dry Density @ 90% = 109.3 pcf	CBR @ 90% Density = 7.1	CBR @ 90% Density = 6.6
Dry Density @ 95% = 115.3 pcf	CBR @ 95% Density = 16.5	CBR @ 95% Density = 15.8
Dry Density @ 100% = 121.4 pcf	CBR @ 100% Density = 25.42	CBR @ 100% Density = 24.07

Northern, Inc.

Client	Técnicas Reunidas
Project	Atlas Agro Pacific Green Fertilizer Plant
GNN Project No.	233-1672

CALIFORNIA BEARING RATIO
ASTM D1887-07

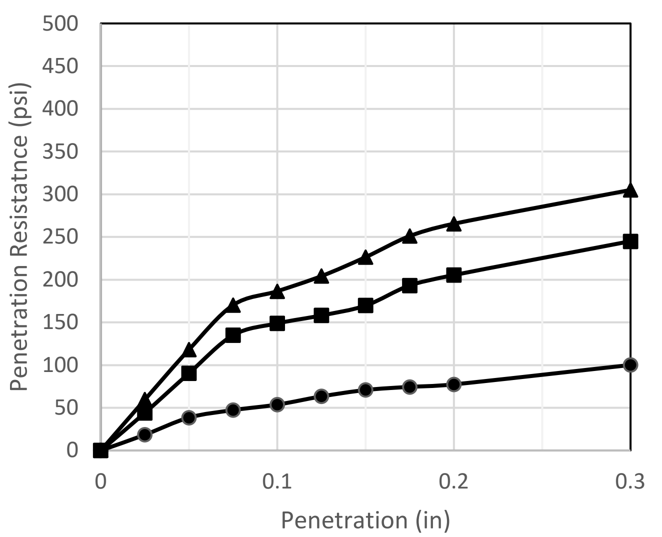


Sample Parameters

Sample No.	**171023**
Source of Material	**TP-10 @ 5 feet**
Description of Material	**Silty Sand (SM)**
Date Sampled	**8/17/2023**
Date Tested	**9/30/2023**

Test Parameters

Displacement (in/min)	**0.05**
Probe Area (in^2)	**3**
Sample Type	**Remolded**



Sample No.	1	2	3
Sample Correction	Soaked		
Compaction Method	ASTM D1557		
Maximum Dry Denstiy, (pcf)	112.3	112.3	112.3
Optimum Moisture Content, (%)	11.8	11.8	11.8
Dry Density before Soaking, (pcf)	104.4	108.6	110.1
Moisture Content, (%)			
After Compaction	11.2	11.5	11.3
Top 1" after Soaking	14.0	16.4	18.3
Surcharge, (lbs)	10.00	10.00	10.00
Swell, (%)	0.08	0.12	0.10

	0.1 in penetration	0.2 in penetration
Dry Density @ 90% = 101 pcf	CBR @ 90% Density = 5.37	CBR @ 90% Density = 5.16
Dry Density @ 95% = 106.7 pcf	CBR @ 95% Density = 14.88	CBR @ 95% Density = 13.69
Dry Density @ 100% = 112.3 pcf	CBR @ 100% Density = 18.65	CBR @ 100% Density = 17.7

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

ANALYSIS REPORT

GN NORTHERN, INC.
722 N. 16TH AVE #31
YAKIMA, WA 98902
Attention: Rebecca Larsen
Project Name: ATLAS AGRO FERT. PLANT RICHLAND
Project #: 223-1672
PO Number: 223-1672
All results reported on an as received basis.

Date Received: 08/24/23
Date Reported: 9/ 6/23

AMTEST Identification Number	**23-A014551**
Client Identification	**TP-1 @ 3'**
Sampling Date	**08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	5.5	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	4.8	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	27000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.05	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	386.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	< 10	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014552**
Client Identification **TP-2 @ 4'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.0	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	4.5	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	24000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.13	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	406.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	11.	ug/g		10	EPA 300.0	AY	08/31/23

GN NORTHERN, INC.
Project Name: ATLAS AGRO FERT. PLANT RICHLAND
AmTest ID: 23-A014553

AMTEST Identification Number **23-A014553**
Client Identification **TP-3 @ 4'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.5	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	6.5	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	25000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.11	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	403.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	< 10	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014554**
Client Identification **TP-4 @ 6'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.2	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	5.8	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	22000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.13	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	416.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	< 10	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014555**
Client Identification **TP-5 @ 3'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.3	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	8.2	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	12000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.12	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	379.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	31.	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014556**
Client Identification **TP-9 @ 3'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.2	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	3.7	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	48000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.05	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	437.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	16.	ug/g		10	EPA 300.0	AY	08/31/23

GN NORTHERN, INC.
Project Name: ATLAS AGRO FERT. PLANT RICHLAND
AmTest ID: 23-A014557

AMTEST Identification Number **23-A014557**
Client Identification **TP-7 @ 4'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.2	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	4.6	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	33000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	< 0.05	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	405.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	30.	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014558**
Client Identification **TP-8 @ 2'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.1	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	8.7	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	12000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.16	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	401.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	27.	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014559**
Client Identification **TP-10 @ 5'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	5.8	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	4.2	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	31000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.08	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	391.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	27.	ug/g		10	EPA 300.0	AY	08/31/23

AMTEST Identification Number **23-A014560**
Client Identification **TP-11 @ 3'**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	5.9	unit		1	SW-846 9045D	KL	08/28/23
Cation Exchange Capacity	6.8	meq/100g		0.5	SW-846 9081	CM	08/30/23
Resistivity	25000	ohms cm		100	ASTM G-187	HV	08/30/23
Salinity	0.09	g/kg		0.05	SM 2520B	KL	08/28/23
Redox Potential	395.	unit		200	ASTM D1498-76	AJS	09/05/23
Sulfide	< 2.5	ug/g		2.5	SM 4500-S2-D	AJS	08/31/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	< 10	ug/g		10	EPA 300.0	AY	08/31/23
Sulfate	17.	ug/g		10	EPA 300.0	AY	08/31/23

Kathy Fugiel
Kathy Fugiel
President

Am Test Inc.
13600 NE 126th PL
Suite C
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(425) 885-1664
www.amtestlab.com

Professional Analytical Services

QC Summary for sample numbers: 23-A014551 to 23-A014560

DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	DUP VALUE	RPD
23-A014560	pH	unit	5.9	5.9	0.00
23-A014560	Redox Potential	unit	395.	396.	0.25
23-A014559	Cation Exchange Capacity	meq/100g	4.2	4.1	2.4
23-A014560	Cation Exchange Capacity	meq/100g	6.8	6.7	1.5
23-A014560	Chloride	ug/g	< 10	< 10	
23-A014560	Resistivity	ohms cm	25000	21000	17.
23-A014556	Salinity	g/kg	0.05	0.05	0.00
23-A014560	Sulfide	ug/g	< 2.5	< 2.5	
23-A014560	Sulfate	ug/g	17.	20.	16.

MATRIX SPIKES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	SMPL+ SPK	SPK AMT	RECOVERY
23-A014560	Chloride	ug/g	< 10	91.	93.	97.85 %
23-A014560	Sulfide	ug/g	< 2.5	8.5	10.	85.00 %
23-A014560	Sulfate	ug/g	17.	110	93.	100.00 %

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
pH	unit	6.9	6.8	98.6 %
Redox Potential	unit	440.	436.	99.1 %
Cation Exchange Capacity	meq/100g	2.0	2.0	100. %
Chloride	ug/g	2.0	2.0	100. %
Salinity	g/kg	0.20	0.20	100. %
Sulfide	ug/g	5.0	4.9	98.0 %
Sulfate	ug/g	2.0	1.9	95.0 %

BLANKS

ANALYTE	UNITS	RESULT
Cation Exchange Capacity	meq/100g	< 0.2
Chloride	ug/g	< 10
Salinity	g/kg	< 0.05
Sulfide	ug/g	< 2.5
Sulfate	ug/g	< 10

AMTEST LABORATORIES

AmTest Chain of Custody Record

13600 NE 126th PL, Suite C, Kirkland, WA 98034
Ph (425) 885-1664 Fx (425) 820-0245
www.amtestlab.com

Chain of Custody No. 5000

Client Name & Address: GN Northern, Inc. 722 N. 16th Ave #31 Yakima WA 98902	Invoice To: GN Northern
Contact Person: Rebecca Larsen	Invoice Contact: Rebecca
Phone No: 509-248-9798	PO Number: 223-1672
Fax No: 509-248-4220	Invoice Ph/Fax:
E-mail: rebecca@gnnorthern.com	Invoice E-mail: rebecca@gnnorthern.com
Report Delivery: (Choose all that apply) Mail / Fax / Email / Posted Online	Data posted to online account: YES / NO Web Login ID:

Special Instructions:

Requested TAT: **(Rush must be pre-approved by lab)** Standard RUSH (5 Day / 3 Day / 48 HR / 24 HR)

Temperature upon Receipt: 20.4°C

Project Name: Atlas Agro Fertilizer Plant, Richland

Project Number: 223-1672

Analysis Requested: See attached for test methods corrosivity suite analysis & CEC

AmTest ID	Client ID (35 characters max)	Date Sampled	Time Sampled	Matrix	No. of containers	QA/QC
14551	TP-1 @ 3'	8/16/23	N/A	soil	1	
14552	TP-2 @ 4'				1	
14553	TP-3 @ 4'				1	
14554	TP-4 @ 6'				1	
14555	TP-5 @ 3'				1	
14556	TP-9 @ 3'				1	
14557	TP 7 @ 4'				1	
14558	TP 8 @ 2'				1	
14559	TP 10 @ 5'				1	
14560	TP 11 @ 3'				1	

Collected/Relinquished By:	Date	Time	Received By:	Date	Time
AC			KL	8/24/23	11:14
Relinquished By: AC	Date	Time	Received By:	Date	Time
Relinquished By:	Date	Time	Received By:	Date	Time

COMMENTS:

FedEx

Appendix VIII

Groundwater Testing Data

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

ANALYSIS REPORT

GN NORTHERN, INC.
722 N. 16TH AVE #31
YAKIMA, WA 98902
Attention: Rebecca Larson
Project Name: Atlas Agro Pacific Green Fert Plant
All results reported on an as received basis.

Date Received: 08/31/23
Date Reported: 9/13/23

AMTEST Identification Number	**23-A014843**
Client Identification	**B9**
Sampling Date	**08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	6.86	unit	*	0.1	SM 4500H B	KH	09/01/23
Total Dissolved Solids	740	mg/l		5	SM 2540C	AJS	09/05/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	82.1	mg/l	D	2	EPA 300.0	AY	09/06/23
Sulfate	70.8	mg/l	D	2	EPA 300.0	AY	09/06/23

AMTEST Identification Number **23-A014844**
Client Identification **B12**
Sampling Date **08/16/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.22	unit	*	0.1	SM 4500H B	KH	09/01/23
Total Dissolved Solids	350	mg/l		5	SM 2540C	AJS	09/05/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	81.2	mg/l	D	2	EPA 300.0	AY	09/06/23
Sulfate	62.2	mg/l	D	2	EPA 300.0	AY	09/06/23

AMTEST Identification Number **23-A014845**
Client Identification **B17**
Sampling Date **08/15/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.25	unit	*	0.1	SM 4500H B	KH	09/01/23
Total Dissolved Solids	440	mg/l		5	SM 2540C	AJS	09/05/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	77.6	mg/l	D	2	EPA 300.0	AY	09/06/23
Sulfate	63.0	mg/l	D	2	EPA 300.0	AY	09/06/23

AMTEST Identification Number **23-A014846**
Client Identification **B18**
Sampling Date **08/17/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.23	unit	*	0.1	SM 4500H B	KH	09/01/23
Total Dissolved Solids	340	mg/l		5	SM 2540C	AJS	09/05/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	87.8	mg/l	D	2	EPA 300.0	AY	09/06/23
Sulfate	61.1	mg/l	D	2	EPA 300.0	AY	09/06/23

GN NORTHERN, INC.
Project Name: Atlas Agro Pacific Green Fert Plant
AmTest ID: 23-A014847

AMTEST Identification Number	**23-A014847**
Client Identification	**B40**
Sampling Date	**08/17/23**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	7.35	unit	*	0.1	SM 4500H B	KH	09/01/23
Total Dissolved Solids	320	mg/l		5	SM 2540C	AJS	09/05/23

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	74.8	mg/l	D	2	EPA 300.0	AY	09/06/23
Sulfate	55.7	mg/l	D	2	EPA 300.0	AY	09/06/23

* = The method specifies the test is to be performed in the field; therefore the result is an estimate.
D = The reported value is from a dilution.

Kathy Fugiel
President

Am Test Inc.
13600 NE 126th PL
Suite C
Kirkland, WA, 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

QC Summary for sample numbers: 23-A014843 to 23-A014847

DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	DUP VALUE	RPD
23-A014778	pH	unit	6.52	6.48	0.62
23-A014823	pH	unit	7.18	7.28	1.4
23-A015096	Chloride	mg/l	1.73	1.72	0.58
23-A014844	Total Dissolved Solids	mg/l	350	340	2.9
23-A014845	Total Dissolved Solids	mg/l	440	450	2.2
23-A015096	Sulfate	mg/l	6.12	6.07	0.82

MATRIX SPIKES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	SMPL+ SPK	SPK AMT	RECOVERY
23-A015096	Chloride	mg/l	1.73	3.62	2.00	94.50 %
23-A015096	Sulfate	mg/l	6.12	8.14	2.00	101.00 %

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
pH	unit	6.86	6.85	99.9 %
Chloride	mg/l	2.00	1.95	97.5 %
Chloride	mg/l	2.00	2.02	101. %
Chloride	mg/l	2.00	2.05	102. %
Total Dissolved Solids	mg/l	350	350	100. %
Sulfate	mg/l	2.00	2.01	100. %
Sulfate	mg/l	2.00	1.97	98.5 %
Sulfate	mg/l	2.00	1.95	97.5 %

BLANKS

ANALYTE	UNITS	RESULT
Chloride	mg/l	< 0.1
Chloride	mg/l	< 0.1
Chloride	mg/l	< 0.1
Total Dissolved Solids	mg/l	< 5
Sulfate	mg/l	< 0.1
Sulfate	mg/l	< 0.1
Sulfate	mg/l	< 0.1

AmTest Chain of Custody Record

AMTEST LABORATORIES

13600 NE 126th PL, Suite C, Kirkland, WA 98034
Ph (425) 885-1664 Fx (425) 820-0245
www.amtestlab.com

Chain of Custody No. [illegible]

Client Name & Address: GN Northern, Inc.	Invoice To:
Contact Person:	Invoice Contact:
Phone No:	PO Number:
Fax No:	Invoice Ph/Fax:
E-mail:	Invoice E-mail:
Report Delivery: (Choose all that apply) Mail / Fax / Email / Posted Online	Data posted to online account: YES / NO Web Login ID:
Special Instructions:	
Requested TAT: **(Rush must be pre-approved by lab)** Standard RUSH (5 Day / 3 Day / 48 HR / 24 HR)	Temperature upon Receipt: 21.2°C

Project Name:

Project Number:

AmTest ID	Client ID (35 characters max)	Date Sampled	Time Sampled	Matrix	No. of containers	pH	Chloride	TDS	Sulfate						QA/QC
14843	B9	8/16/23		GW	2										
14844	B12	8/16/23		GW	2										
14845	B17	8/15/23		GW	2										
14846	B18	8/17/23		GW	2										
14847	B40	8/17/23		GW	2										

Collected/Relinquished By:	Date	Time	Received By:	Date	Time
			KH	8/31/23	10:05
Relinquished By:	Date	Time	Received By:	Date	Time
Relinquished By:	Date	Time	Received By:	Date	Time

COMMENTS: Received out of hold for pH, TDS
KL 8/31/23

13600 NE 126th Pl., Suite C
Kirkland, WA 98034
425-885-1664

AMTEST LABORATORIES

DRINKING WATER SAMPLE INFORMATION (WSI)
For Chemical Analysis

Report To: GN Northern, Inc.	Bill To: GN Northern
Address: 722 N. 16th Ave #31	Address:
City: Yakima State: WA Zip: 98902	City: State: Zip:
Phone: 509-248-9798	**SEND REPORT BY:**
Email: rebecca@gnnorthern.com	☐ MAIL ☐ WEB ☑ EMAIL

Sampling Information REQUIRED

1. ☐ **Investigative** ☐ **Compliance** – for State regulations for Public Water Systems. (Results will be sent to you and the State.)
2. Date Collected: Time Collected: AM ☐ PM ☐
3. Collected By: AC Telephone: 509-248-9798
4. Specific Location where sample was taken:

Water System Information REQUIRED

5. System Name: System ID #:
6. DOH Source #: ☐ Check here if this is a New Source
(Without a source number DOH will not accept samples. If sample is blended from more than one source, list all)
7. Group: ☐ A ☐ B 8. County:
9. Source Type: ☐ Surface ☐ Well/Ground Water ☐ Well Field ☐ Spring ☐ Purchased
10. Sample Taken: ☐ Before Treatment ☐ After Treatment ☐ No Treatment ☐ In Distribution
11. Treatment Type: ☐ None ☐ Aeration ☐ Filtration ☐ Chlorination ☐ Softener ☐ Other:

Analysis to Perform (FREQUENTLY REQUESTED TESTS). FOR OTHERS, PLEASE LIST UNDER **OTHER ANALYSIS**

Organic Compounds	Inorganic Compounds	OTHER ANALYSIS, Please List:
☐ 524.2 - VOC	☐ Complete Inorganics (IOC)	groundwater samples
☐ 552.2 - Haloacetic Acids (HAA)	☐ Plumbing	See attached for tests
☐ 524.2 - Trihalomethanes (THM)	☐ Arsenic	to run.
	☐ Nitrates in Drinking Water	
Synthetic Organic Compounds (SOC)	☐ Snohomish County List	
☐ 515 - Herbicides		
☐ 525 - Insecticides/Pesticides	☐ 531 - Carbamates	

Relinquished By	Date	Time	Received By	Date	Time
			KH	8/31/23	1005

FOR LABORATORY USE ONLY	YES	NO	N/A
SAMPLE TEMP. 21.2 °C SATISFACTORY	☐	☐	☐
CHAIN OF CUSTODY & LABELS AGREE	☐	☐	☐

LABORATORY ID#	REQUESTED TAT:	PAYMENT:
	☐ NORM ☐ 2-DAY	
	☐ 5-DAY ☐ 24-HOURS	

Helpful Hints to fill out form on reverse

Fed Ex

Received out of hold for pH and TDS. KL 8/31/23

Imran Magsi

To: Rebecca Larsen; 'Amethyst Larsen'
Subject: Atlas Agro Richland - Lab Tests for water samples

Project: Atlas Agro Pacific Green Fertilizer Plant Richland WA
GNN Job No. 223-1672

Tests to perform for water samples

pH in water; ASTM D1293
Chlorides in water; ASTM D1411
Solids dissolved in water
Sulfate ion in water; ASTM D516.

Appendix IX

Liquefaction Analysis

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-06 Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 5.5 7.5
PGA, g: 0.2 0.09
MSF: 2.21
GWT: 29 feet
Calc GWT: 29 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.50 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

Threshold Acceler., g: 0.40

Total (ft) Liquefied Thickness: 0
Total (in.) Induced Subsidence: 0.0
Required SF: 1.25
Minimum Calculated SF: 1.98

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)
4.0		50	1	125	10	3.5	6.5
6.5		13	1	110	10	6.0	9.0
9.0		50	1	130	10	8.5	11.5
11.5		50	1	130	8	11.0	14.0
14.0		50	1	130	8	13.5	16.5
16.5		50	1	130	8	16.0	19.0
21.5		30	1	125	5	21.0	24.0
26.5		23	1	125	5	26.0	29.0
31.5		10	1	110	5	31.0	34.0
36.5		11	1	110	5	36.0	39.0
41.5		50	1	130	5	41.0	44.0
46.5		25	1	125	5	46.0	49.0
51.5		15	1	110	5	51.0	54.0

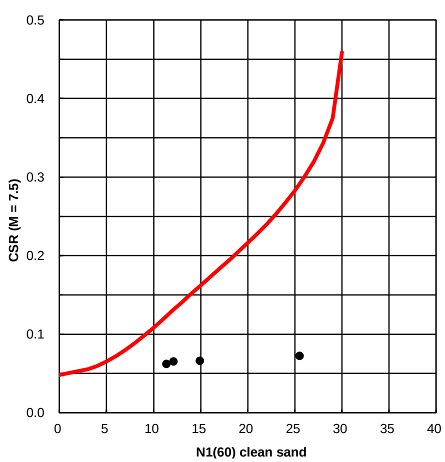
Base Depth (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	Trigger FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	Liquefac. Safety Factor	Post FC Adj. $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric Strain (%)	Induced Subsidence (in.)
	0.000																	
4.0	0.219	0.219	0.99	1.70	0.75	1.00	95.6	100	2.9	98.6	1.00	1.200	0.058	Non-Liq.	2.9	98.6	0.00	0.00
6.5	0.360	0.360	0.99	1.70	0.75	1.00	24.9	60	1.4	26.3	1.00	0.305	0.058	Non-Liq.	1.4	26.3	0.01	0.00
9.0	0.518	0.518	0.98	1.43	0.75	1.00	80.4	100	2.6	83.0	1.00	1.200	0.058	Non-Liq.	2.6	83.0	0.00	0.00
11.5	0.680	0.680	0.98	1.25	0.78	1.00	73.3	100	1.2	74.5	1.00	1.200	0.057	Non-Liq.	1.2	74.5	0.00	0.00
14.0	0.843	0.843	0.97	1.12	0.84	1.00	70.4	100	1.2	71.6	1.00	1.200	0.057	Non-Liq.	1.2	71.6	0.00	0.00
16.5	1.005	1.005	0.97	1.03	0.88	1.00	67.7	98	1.2	68.9	1.02	1.200	0.056	Non-Liq.	1.2	68.9	0.00	0.00
21.5	1.319	1.319	0.95	0.90	0.94	1.00	38.1	74	0.0	38.1	0.92	1.200	0.061	Non-Liq.	0.0	38.1	0.01	0.00
26.5	1.631	1.631	0.94	0.81	0.99	1.00	27.6	63	0.0	27.6	0.88	0.332	0.063	Non-Liq.	0.0	27.6	0.01	0.01
31.5	1.910	1.848	0.92	0.76	1.00	1.00	11.4	40	0.0	11.4	0.89	0.123	0.062	1.98	0.0	11.4	0.00	0.00
36.5	2.185	1.967	0.88	0.73	1.00	1.00	12.1	42	0.0	12.1	0.88	0.131	0.065	2.01	0.0	12.1	0.00	0.00
41.5	2.505	2.131	0.84	0.70	1.00	1.00	52.9	87	0.0	52.9	0.76	1.200	0.077	15.58	0.0	52.9	0.00	0.00
46.5	2.819	2.288	0.79	0.68	1.00	1.00	25.5	60	0.0	25.5	0.79	0.291	0.072	4.02	0.0	25.5	0.00	0.00
51.5	3.098	2.411	0.74	0.66	1.00	1.00	14.9	46	0.0	14.9	0.85	0.161	0.066	2.44	0.0	14.9	0.00	0.00

SETTLEMENT (SUBSIDENCE) OF DRY SANDS

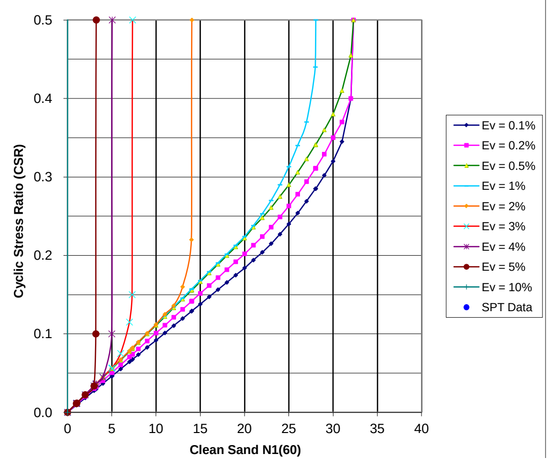
Nc = 2.4

Base Depth (feet)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
4.0	0.147	790	0.028	4.0E-05	5.9E-06	2.6E-06	0.00
6.5	0.241	653	0.046	8.7E-05	6.2E-05	2.7E-05	0.00
9.0	0.347	1,148	0.066	6.5E-05	1.2E-05	5.1E-06	0.00
11.5	0.456	1,270	0.086	7.7E-05	1.6E-05	6.9E-06	0.00
14.0	0.564	1,394	0.106	8.6E-05	1.9E-05	8.2E-06	0.00
16.5	0.673	1,504	0.126	9.5E-05	2.1E-05	9.4E-06	0.00
21.5	0.884	1,414	0.164	1.4E-04	6.2E-05	2.7E-05	0.00
26.5	1.093	1,412	0.199	1.7E-04	1.1E-04	5.0E-05	0.01
31.5	1.280	1,137	0.227	2.6E-04			
36.5	1.464	1,242	0.251	2.6E-04			
41.5	1.678	2,173	0.274	1.4E-04			
46.5	1.889	1,808	0.291	1.9E-04			
51.5	2.075	1,585	0.299	2.3E-04			

NCEER (1997) Curve of Liquefaction Resistance



Post-Liquefaction Volumetric Strain
Ref: Tokimatsu & Seed (1987)



$N_{1(60)} = C_N{*}C_E{*}C_B{*}C_R{*}C_S{*}N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

C_N = (1 atm/p'o)$^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

$G_{max} = 447{*}N_{1(60)CS}^{(1/3)}{*}p^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*(p/1)$^{(-0.6)}$

γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}/G_{max}]

$E_{15} = \gamma{*}(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}{*}E15$

Nc = (MAG-4)$^{2.17}$

$S = 2{*}H{*}E_{nc}$

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or (p'o/1.058)$^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

Dr = $(N_{1(60)}/70)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

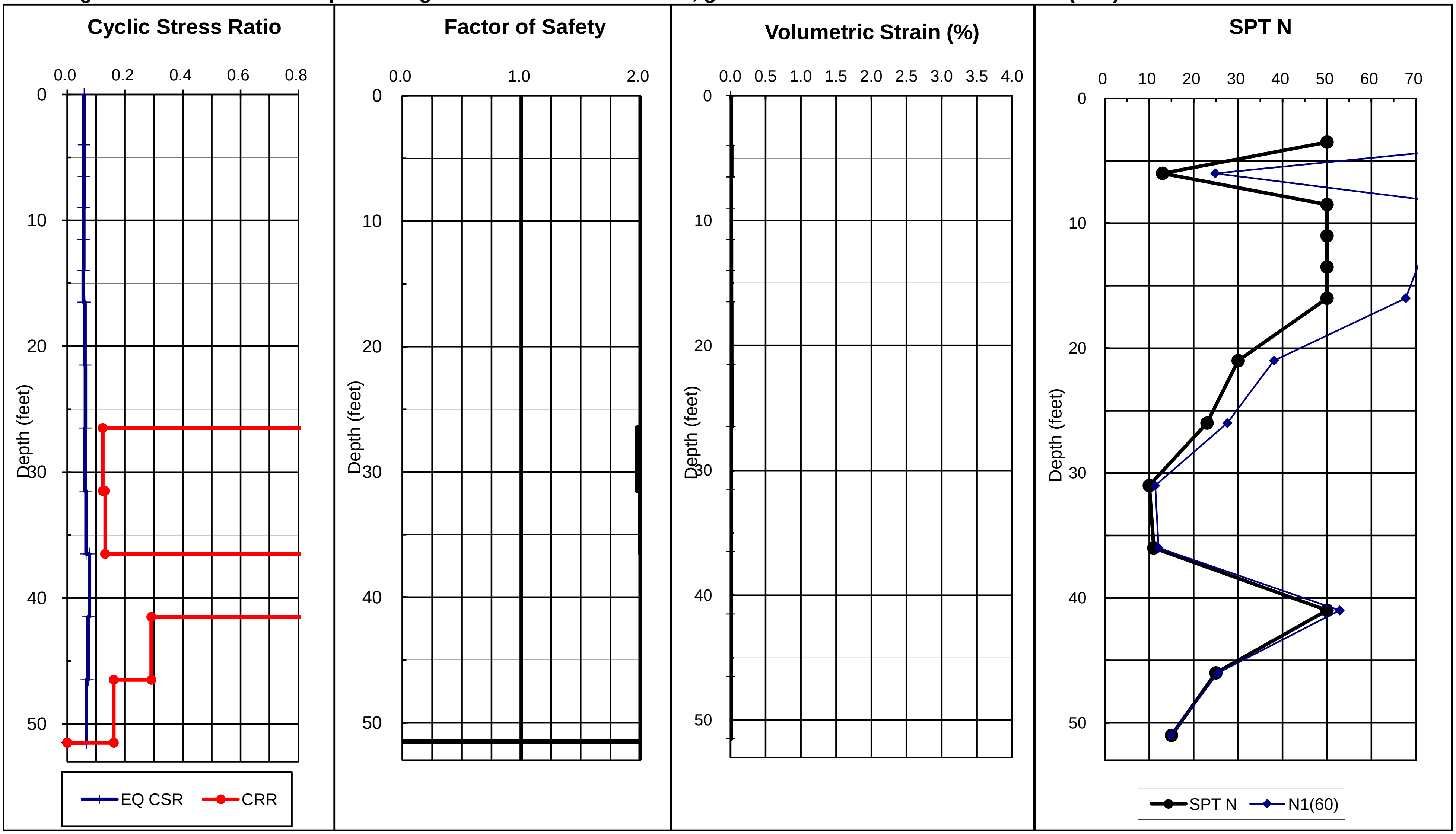
N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*

GN NORTHERN - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** 1996/1998 NCEER Method

Boring: BH-06 **Earthquake Magnitude: 5.5** **PGA, g: 0.20** **Calc GWT (feet): 29**



Total Thickness of Liquefiable Layers: 0.0 feet

Estimated Total Ground Subsidence: 0.0 inches

LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-06

Methods: **Liquefaction Analysis using Idriss & Boulanger Method (2004)**
Semi-empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, 11th SDEE and 3rd ICEGE, Univ. of California, Berkeley, 2004.
Settlement Analysis from Tokimatsu and Seed (1987),JGEE ,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude: 5.5 7.5
PGA, g: 0.20 0.12
MSF: 1.69
GWT: 29.0 feet
Calc GWT 29.0 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E): 1.50
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.00
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
0	0.0

Required SF: 1.25
Minimum SF: #N/A

ETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 2.4

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT σv (tsf)	Eff.Stress at SPT σ'v (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	$CRR_{7.5}$	CSR*	Liquefac. Safety Factor	Volumetric Strain (%)	Induced Subsidence (in.)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	E_{15}	Strain Enc	Dry Sand Subsidence (in.)
								0.000																						
4.0		50	1	125	10	3.5	6.5	0.219	0.219	0.99	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.076	Non-Liq.	0.03	0.01	0.147	354	0.028	1.2E-04	3.1E-04	1.4E-04	0.01
6.5		13	1	110	10	6.0	9.0	0.360	0.360	0.98	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.075	Non-Liq.	0.03	0.01	0.241	454	0.046	1.4E-04	3.8E-04	1.7E-04	0.01
9.0		50	1	130	10	8.5	11.5	0.518	0.518	0.96	1.45	0.75	1.00	11.5	50	1.1	12.6	1.00	0.137	0.074	Non-Liq.	0.02	0.01	0.347	613	0.065	1.4E-04	2.4E-04	1.1E-04	0.01
11.5		50	1	130	8	11.0	14.0	0.680	0.680	0.94	1.24	0.78	1.00	15.1	57	0.4	15.5	1.00	0.160	0.073	Non-Liq.	0.02	0.01	0.456	752	0.083	1.4E-04	1.9E-04	8.4E-05	0.01
14.0		50	1	130	8	13.5	16.5	0.843	0.843	0.93	1.07	0.84	1.00	39.3	92	0.4	39.7	1.00	3.711	0.071	Non-Liq.	0.00	0.00	0.564	1,145	0.101	1.0E-04	4.5E-05	2.0E-05	0.00
16.5		50	1	130	8	16.0	19.0	1.005	1.005	0.91	1.01	0.88	1.00	45.0	99	0.4	45.4	1.00	37.315	0.070	Non-Liq.	0.00	0.00	0.673	1,308	0.119	1.0E-04	3.9E-05	1.7E-05	0.00
21.5		30	1	125	5	21.0	24.0	1.319	1.319	0.87	0.94	0.94	1.00	53.7	100	0.0	53.7	0.93	11958.269	0.072	Non-Liq.	0.00	0.00	0.884	1,585	0.149	1.1E-04	3.2E-05	1.4E-05	0.00
26.5		23	1	125	5	26.0	29.0	1.631	1.631	0.83	0.88	0.99	1.00	41.3	95	0.0	41.3	0.87	6.473	0.073	Non-Liq.	0.00	0.00	1.093	1,615	0.175	1.2E-04	5.2E-05	2.3E-05	0.00
31.5		10	1	110	5	31.0	34.0	1.910	1.848	0.78	0.86	1.00	1.00	57.1	100	0.0	57.1	1.00	374322.917	0.063	>10	0.00	0.00	1.280	1,947	0.195	1.1E-04			
36.5		11	1	110	5	36.0	39.0	2.185	1.967	0.74	0.85	1.00	1.00	60.5	100	0.0	60.5	1.00	25752416.616	0.064	>10	0.00	0.00	1.464	2,123	0.211	1.1E-04			
41.5		50	1	130	5	41.0	44.0	2.505	2.131	0.70	0.83	1.00	1.00	79.0	100	0.0	79.0	1.00	550533072283157000000000000.0	0.064	>10	0.00	0.00	1.678	2,485	0.228	1.0E-04			
46.5		25	1	125	5	46.0	49.0	2.819	2.288	0.66	0.82	1.00	1.00	61.5	100	0.0	61.5	1.00	105576732.128	0.063	>10	0.00	0.00	1.889	2,425	0.242	1.1E-04			
51.5		15	1	110	5	51.0	54.0	3.098	2.411	0.62	0.81	1.00	1.00	54.0	100	0.0	54.0	0.75	15743.301	0.082	>10	0.00	0.00	2.075	2,434	0.251	1.1E-04			
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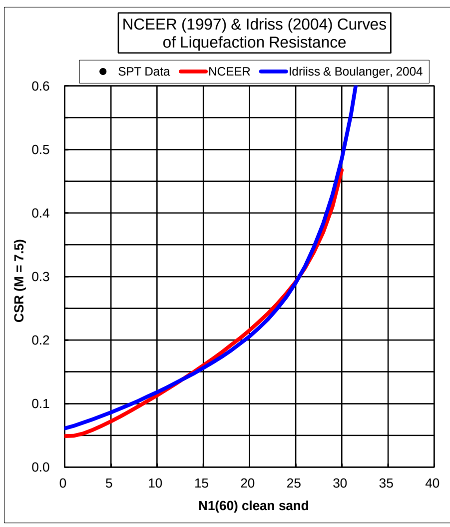
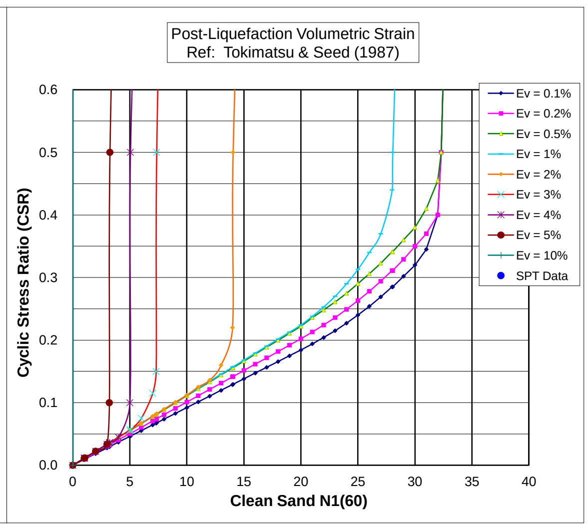




$N_{1(60)}$ = C_N*C_E*C_B*C_R*C_S*N
C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z)$^{0.5}$))
C_N = min(1.7,(pa/σ'v)^[0.784-0.0768*min(46,$N_{1(60)}$)$^{0.5}$]
C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners
MSF = min(1.8,6.9*exp(-M/4)-0.058)
z = Depth (m)
rd = exp[(-1.012-1.126sin(z/11.73+5.133))+(0.106+0.118sin(z/11.28+5.14
pa = 1 atm = 101 KPa = 1.058 tsf
$\Delta N_{1(60)}$ = exp[1.63+9.7/FC-(15.7/FC)^2]
$N_{1(60)CS}$ = $N_{1(60)CS}$ + $\Delta N_{1(60)}$
Kσ = min(1,1-min(0.3,1/(18.9-17.3Dr))*ln(p'o/1.058))
Dr = ($N_{1(60)}$/46)$^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ
$CRR_{7.5}$ = exp((N/14.1)+(N/126)^2-(N/23.6)^3+(N/25.4)^4-2.8)
N = $N_{1(60)CS}$

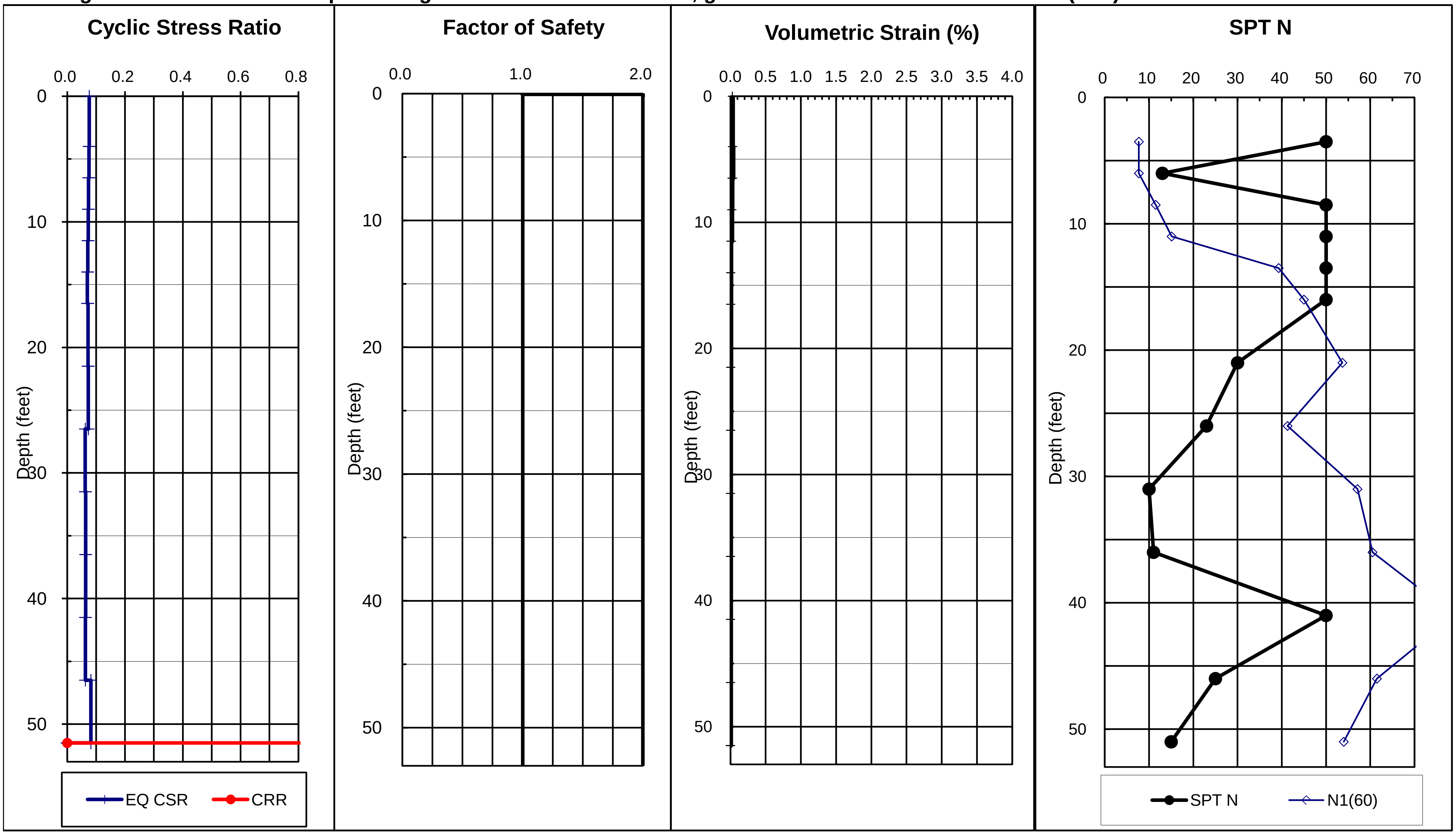
SF = $CRR_{7.5,1atm}$/CSR*

p = 0.67*po
τ_{av} = 0.65*PGA*po*rd
G_{max} = 447*$N_{1(60)CS}$$^{(1/3)}$*p$^{0.5}$ -sand, 10
r = g/g
Vso = (G/r)$^{0.5}$
a = 0.0389*(p/1)+0.124
b = 6400*(p/1)$^{(-0.6)}$
γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}
E_{15} = γ*($N_{1(60)CS}$/20)$^{-1.2}$
Nc = (MAG-4)$^{2.17}$
E_{nc} = (Nc/15)$^{0.45}$*E15
S = 2*H*E_{nc}

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** Idriss & Boulanger Method, 2004

Boring: BH-06 **Earthquake Magnitude: 5.5** **PGA, g: 0.20** **Calc GWT (feet): 29.0**



Total Thickness of Liquefiable Layers: 0.0 feet **#VALUE!** **Estimated Total Ground Subsidence: 0.0 inches**

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-06 Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 6.5 7.5
PGA, g: 0.20 0.14
MSF: 1.44
GWT: 29.0 feet
Calc GWT: 29.0 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.50 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

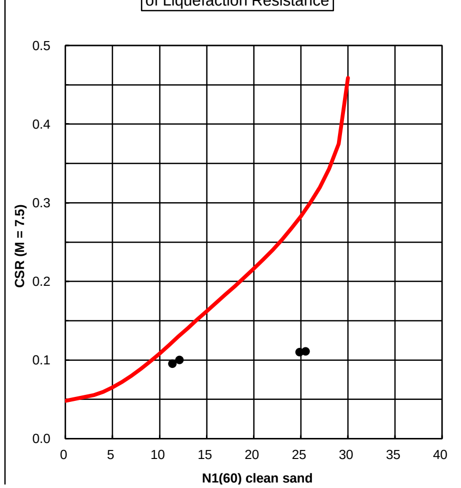
Threshold Acceler., g: 0.26

Total (ft) Liquefied Thickness: 0
Total (in.) Induced Subsidence: 0.0
Required SF: 1.25
Minimum Calculated SF: 1.29

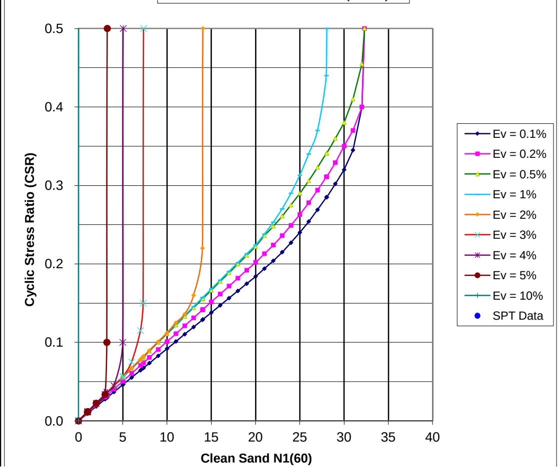
SETTLEMENT (SUBSIDENCE) OF DRY SANDS
Nc = 7.3

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	Trigger FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M = 7.5 Induced CSR*	Liquefac. Safety Factor	Post FC Adj. $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric Strain (%)	Induced Subsidence (in.)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
								0.000																								
4.0		**50**	1	125	10	3.5	6.5	0.219	0.219	0.99	1.70	0.75	1.00	95.6	100	2.9	98.6	1.00	1.200	0.090	**Non-Liq.**	2.9	98.6	0.00	**0.00**	0.147	790	0.028	4.0E-05	5.9E-06	4.3E-06	**0.00**
6.5		**13**	1	110	10	6.0	9.0	0.360	0.360	0.99	1.70	0.75	1.00	24.9	60	1.4	26.3	1.00	0.305	0.089	**Non-Liq.**	1.4	26.3	0.01	**0.00**	0.241	653	0.046	8.7E-05	6.2E-05	4.5E-05	**0.00**
9.0		50	1	130	10	8.5	11.5	0.518	0.518	0.98	1.43	0.75	1.00	80.4	100	2.6	83.0	1.00	1.200	0.089	**Non-Liq.**	2.6	83.0	0.00	**0.00**	0.347	1,148	0.066	6.5E-05	1.2E-05	8.5E-06	**0.00**
11.5		50	1	130	8	11.0	14.0	0.680	0.680	0.98	1.25	0.78	1.00	73.3	100	1.2	74.5	1.00	1.200	0.088	**Non-Liq.**	1.2	74.5	0.00	**0.00**	0.456	1,270	0.086	7.7E-05	1.6E-05	1.1E-05	**0.00**
14.0		50	1	130	10	13.5	16.5	0.843	0.843	0.97	1.12	0.84	1.00	70.4	100	2.4	72.8	1.00	1.200	0.088	**Non-Liq.**	2.4	72.8	0.00	**0.00**	0.564	1,402	0.106	8.5E-05	1.8E-05	1.3E-05	**0.00**
16.5		50	1	130	10	16.0	19.0	1.005	1.005	0.97	1.03	0.88	1.00	67.7	98	2.3	70.1	1.02	1.200	0.085	**Non-Liq.**	2.3	70.1	0.00	**0.00**	0.673	1,512	0.126	9.4E-05	2.1E-05	1.5E-05	**0.00**
21.5		30	1	125	5	21.0	24.0	1.319	1.319	0.95	0.90	0.94	1.00	38.1	74	0.0	38.1	0.92	1.200	0.094	**Non-Liq.**	0.0	38.1	0.01	**0.01**	0.884	1,414	0.164	1.4E-04	6.2E-05	4.5E-05	**0.01**
26.5		23	1	125	5	26.0	29.0	1.631	1.631	0.94	0.81	0.99	1.00	27.6	63	0.0	27.6	0.88	0.332	0.096	**Non-Liq.**	0.0	27.6	0.02	**0.01**	1.093	1,412	0.199	1.7E-04	1.1E-04	8.3E-05	**0.01**
31.5		10	1	110	5	31.0	34.0	1.910	1.848	0.92	0.76	1.00	1.00	11.4	40	0.0	11.4	0.89	0.123	0.095	**1.29**	0.0	11.4	0.00	**0.00**	1.280	1,137	0.227	2.6E-04			
36.5		11	1	110	5	36.0	39.0	2.185	1.967	0.88	0.73	1.00	1.00	12.1	42	0.0	12.1	0.88	0.131	0.100	**1.31**	0.0	12.1	0.00	**0.00**	1.464	1,242	0.251	2.6E-04			
41.5		50	1	130	5	41.0	44.0	2.505	2.131	0.84	0.70	1.00	1.00	52.9	87	0.0	52.9	0.76	1.200	0.118	**10.16**	0.0	52.9	0.00	**0.00**	1.678	2,173	0.274	1.4E-04			
46.0		25	1	125	5	46.0	49.0	2.819	2.288	0.79	0.68	1.00	1.00	25.5	60	0.0	25.5	0.79	0.291	0.111	**2.62**	0.0	25.5	0.00	**0.00**	1.889	1,808	0.291	1.9E-04			
51.0		25	1	110	5	51.0	54.0	3.094	2.407	0.74	0.66	1.00	1.00	24.9	60	0.0	24.9	0.78	0.280	0.110	**2.55**	0.0	24.9	0.00	**0.00**	2.073	1,878	0.299	1.8E-04			

NCEER (1997) Curve of Liquefaction Resistance



Post-Liquefaction Volumetric Strain
Ref: Tokimatsu & Seed (1987)



$N_{1(60)} = C_N * C_E * C_B * C_R * C_S * N$
C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))
C_N = (1 atm/p'o)$^{0.5}$, max 1.7
C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners
MSF = $10^{2.24}/M^{2.56}$
z = Depth (m)
pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po
τ_{av} = 0.65*PGA*po*rd
G_{max} = 447*$N_{1(60)CS}^{(1/3)}$*$p^{0.5}$
a = 0.0389*(p/1)+0.124
b = 6400*(p/1)$^{(-0.6)}$
γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}/G_{max}]
E_{15} = γ*($N_{1(60)CS}$/20)$^{-1.2}$
E_{nc} = (Nc/15)$^{0.45}$*E15
Nc = (MAG-4)$^{2.17}$
S = 2*H*E_{nc}

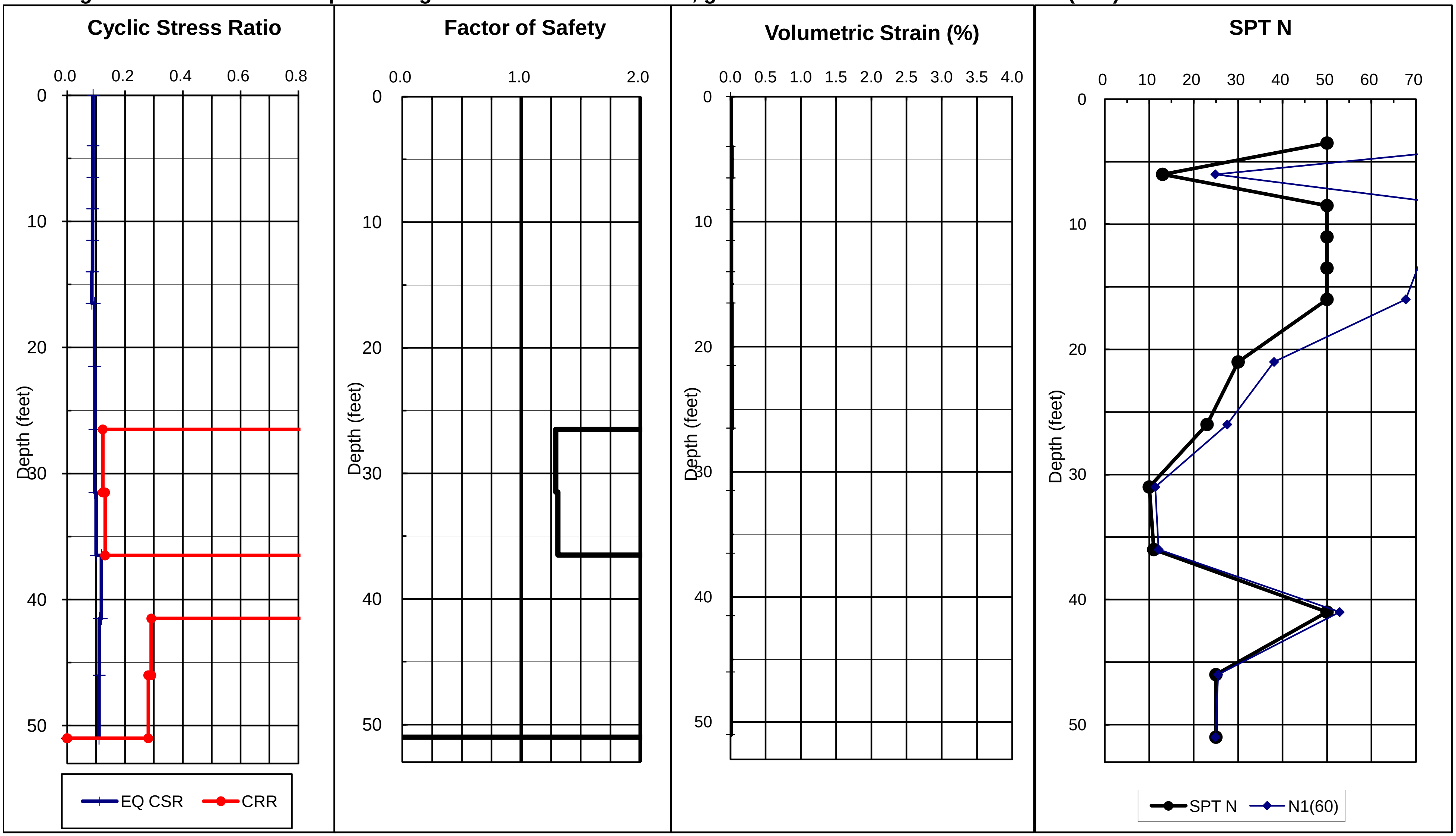
rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))
$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)
$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$
Kσ = min of 1.0 or (p'o/1.058)$^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$
Dr = ($N_{1(60)}$/70)$^{0.5}$
CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ
$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))
N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*

GN NORTHERN - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant Project No: 223-1672 1996/1998 NCEER Method

Boring: BH-06 Earthquake Magnitude: 6.5 PGA, g: 0.20 Calc GWT (feet): 29



Total Thickness of Liquefiable Layers: 0.0 feet

Estimated Total Ground Subsidence: 0.0 inches

LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE
Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-06

Methods: Liquefaction Analysis using Idriss & Boulanger Method (2004)
Semi-empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, 11th SDEE and 3rd ICEGE, Univ. of California, Berkeley, 2004.
Settlement Analysis from Tokimatsu and Seed (1987),JGEE ,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 6.5 7.5
PGA, g: 0.20 0.15
MSF: 1.30
GWT: 29.0 feet
Calc GWT 29.0 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.50
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.00
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
0	0.1

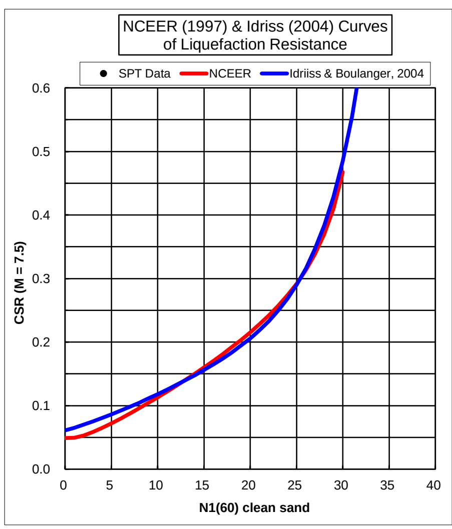
Required SF: 1.25
Minimum SF: #N/A

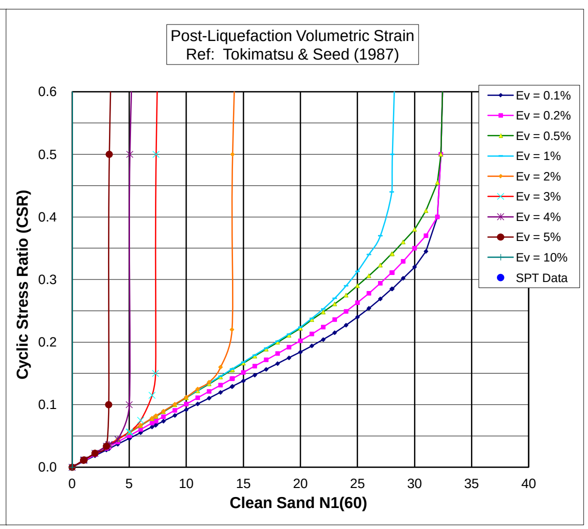
ETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 7.3

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT σv (tsf)	Eff.Stress at SPT σ'v (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ
								0.000										
4.0		50	1	125	10	3.5	6.5	0.219	0.219	0.99	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00
6.5		13	1	110	10	6.0	9.0	0.360	0.360	0.98	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00
9.0		50	1	130	10	8.5	11.5	0.518	0.518	0.97	1.45	0.75	1.00	11.5	50	1.1	12.6	1.00
11.5		50	1	130	8	11.0	14.0	0.680	0.680	0.96	1.24	0.78	1.00	15.1	57	0.4	15.5	1.00
14.0		50	1	130	10	13.5	16.5	0.843	0.843	0.95	1.07	0.84	1.00	39.3	92	1.1	40.4	1.00
16.5		50	1	130	10	16.0	19.0	1.005	1.005	0.93	1.01	0.88	1.00	45.0	99	1.1	46.1	1.00
21.5		30	1	125	5	21.0	24.0	1.319	1.319	0.91	0.94	0.94	1.00	53.7	100	0.0	53.7	0.93
26.5		23	1	125	5	26.0	29.0	1.631	1.631	0.87	0.88	0.99	1.00	41.3	95	0.0	41.3	0.87
31.5		10	1	110	5	31.0	34.0	1.910	1.848	0.84	0.86	1.00	1.00	57.1	100	0.0	57.1	1.00
36.5		11	1	110	5	36.0	39.0	2.185	1.967	0.81	0.85	1.00	1.00	60.5	100	0.0	60.5	1.00
41.5		50	1	130	5	41.0	44.0	2.505	2.131	0.78	0.83	1.00	1.00	79.0	100	0.0	79.0	1.00
46.0		25	1	125	5	46.0	49.0	2.819	2.288	0.74	0.82	1.00	1.00	61.5	100	0.0	61.5	1.00
51.0		25	1	110	5	51.0	54.0	3.094	2.407	0.71	0.81	1.00	1.00	54.0	100	0.0	54.0	0.75
														55.0				
														56.0				
														57.0				
														58.0				
														59.0				
														60.0				
														61.0				

Base Depth (feet)	$CRR_{7.5}$	CSR*	Liquefac. Safety Factor	Volumetric Strain (%)	Induced Subsidence (in.)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
4.0	0.110	0.099	Non-Liq.	0.05	0.02	0.147	354	0.028	1.2E-04	3.1E-04	2.3E-04	0.02
6.5	0.110	0.098	Non-Liq.	0.06	0.02	0.241	454	0.046	1.4E-04	3.8E-04	2.8E-04	0.02
9.0	0.137	0.097	Non-Liq.	0.04	0.01	0.347	613	0.065	1.4E-04	2.4E-04	1.8E-04	0.01
11.5	0.160	0.096	Non-Liq.	0.03	0.01	0.456	752	0.085	1.4E-04	2.0E-04	1.4E-04	0.01
14.0	4.791	0.095	Non-Liq.	0.01	0.00	0.564	1,153	0.104	1.0E-04	4.5E-05	3.2E-05	0.00
16.5	55.957	0.093	Non-Liq.	0.01	0.00	0.673	1,316	0.122	1.1E-04	3.9E-05	2.8E-05	0.00
21.5	11958.269	0.097	Non-Liq.	0.00	0.00	0.884	1,585	0.155	1.1E-04	3.4E-05	2.5E-05	0.00
26.5	6.473	0.100	Non-Liq.	0.01	0.00	1.093	1,615	0.185	1.3E-04	5.5E-05	4.0E-05	0.00
31.5	374322.917	0.087	>10	0.00	0.00	1.280	1,947	0.209	1.2E-04			
36.5	25752416.616	0.090	>10	0.00	0.00	1.464	2,123	0.230	1.2E-04			
41.5	5505330722831570000000000.0	0.091	>10	0.00	0.00	1.678	2,485	0.253	1.1E-04			
46.0	105576732.128	0.092	>10	0.00	0.00	1.889	2,425	0.273	1.2E-04			
51.0	15743.301	0.121	>10	0.00	0.00	2.073	2,433	0.287	1.3E-04			





$N_{1(60)}$ = C_N*C_E*C_B*C_R*C_S*N
C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z)$^{0.5}$))
C_N = min(1.7,(pa/σ'v)^[0.784-0.0768*min(46,$N_{1(60)}$)$^{0.5}$]
C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners
MSF = min(1.8,6.9*exp(-M/4)-0.058)
z = Depth (m)
rd = exp[(-1.012-1.126sin(z/11.73+5.133))+(0.106+0.118sin(z/11.28+5.14
pa = 1 atm = 101 KPa = 1.058 tsf
$\Delta N_{1(60)}$ = exp[1.63+9.7/FC-(15.7/FC)^2]
$N_{1(60)CS}$ = $N_{1(60)CS}$ + $\Delta N_{1(60)}$
Kσ = min(1,1-min(0.3,1/(18.9-17.3Dr))*ln(p'o/1.058))
Dr = ($N_{1(60)}$/46)$^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ
$CRR_{7.5}$ = exp((N/14.1)+(N/126)^2-(N/23.6)^3+(N/25.4)^4-2.8)
N = $N_{1(60)CS}$

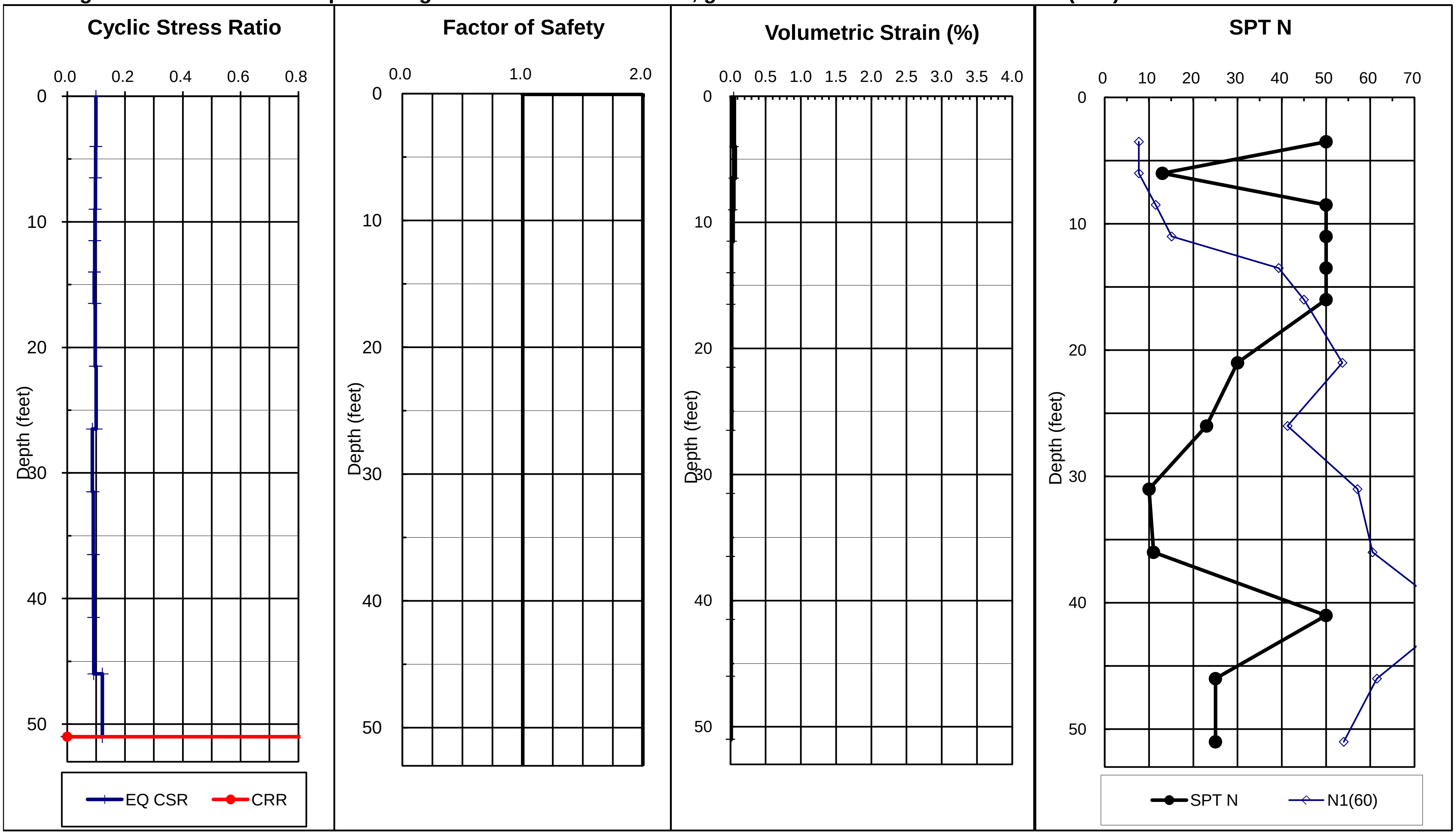
SF = $CRR_{7.5,1atm}$/CSR*

p = 0.67*po
τ_{av} = 0.65*PGA*po*rd
G_{max} = 447*$N_{1(60)CS}$$^{(1/3)}$*p$^{0.5}$ -sand, 10
r = g/g
Vso = (G/r)$^{0.5}$
a = 0.0389*(p/1)+0.124
b = 6400*(p/1)$^{(-0.6)}$
γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}
E_{15} = γ*($N_{1(60)CS}$/20)$^{-1.2}$
Nc = (MAG-4)$^{2.17}$
E_{nc} = (Nc/15)$^{0.45}$*E15
S = 2*H*E_{nc}

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** Idriss & Boulanger Method, 2004

Boring: BH-06 **Earthquake Magnitude: 6.5** **PGA, g: 0.20** **Calc GWT (feet): 29.0**



Total Thickness of Liquefiable Layers: 0.0 feet **#VALUE!** **Estimated Total Ground Subsidence: 0.1 inches**

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-40   Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 5.5   7.5
PGA, g: 0.2   0.09
MSF: 2.21
GWT: 39 feet
Calc GWT: 29 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.50 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

Threshold Acceler., g: 0.37

Total (ft) Liquefied Thickness: 0
Total (in.) Induced Subsidence: 0.0

Required SF: 1.25
Minimum Calculated SF: 1.85

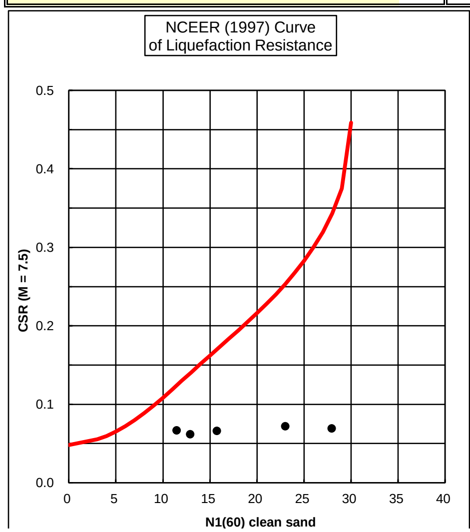
SETTLEMENT (SUBSIDENCE) OF DRY SANDS

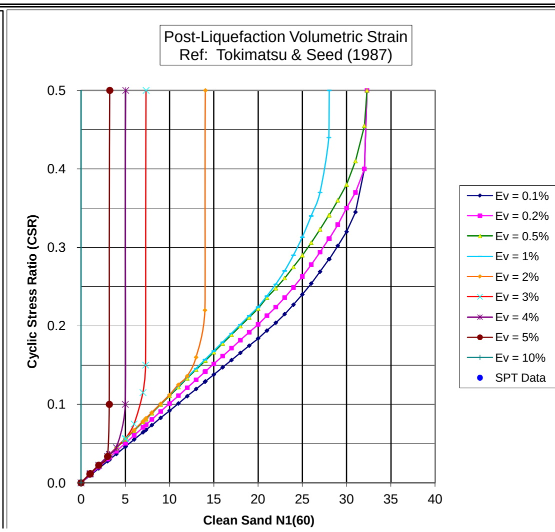
Nc = 2.4

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	Trigger FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$
								0.000									
4.0		30	1	120	10	3.5	6.5	0.210	0.210	0.99	1.70	0.75	1.00	57.4	91	2.1	59.5
6.5		30	1	120	10	6.0	9.0	0.360	0.360	0.99	1.70	0.75	1.00	57.4	91	2.1	59.5
9.0		60	1	130	10	8.5	11.5	0.520	0.520	0.98	1.43	0.75	1.00	96.3	100	3.0	99.2
11.5		29	1	120	8	11.0	14.0	0.673	0.673	0.98	1.25	0.78	1.00	42.7	78	0.8	43.6
14.0		30	1	120	8	13.5	16.5	0.823	0.823	0.97	1.13	0.84	1.00	42.7	78	0.8	43.6
16.5		50	1	130	8	16.0	19.0	0.983	0.983	0.97	1.04	0.88	1.00	68.5	99	1.2	69.7
21.5		50	1	130	8	21.0	24.0	1.308	1.308	0.95	0.90	0.94	1.00	63.7	95	1.1	64.8
26.5		16	1	110	6	26.0	29.0	1.588	1.588	0.94	0.82	0.99	1.00	19.4	53	0.1	19.6
31.5		11	1	110	8	31.0	34.0	1.863	1.863	0.92	0.75	1.00	1.00	12.4	42	0.5	12.9
36.5		26	1	120	8	36.0	39.0	2.160	2.160	0.88	0.70	1.00	1.00	27.3	62	0.6	27.9
41.5		11	1	110	8	41.0	44.0	2.438	2.375	0.84	0.67	1.00	1.00	11.0	40	0.4	11.5
46.5		23	1	115	8	46.0	49.0	2.724	2.505	0.79	0.65	1.00	1.00	22.4	57	0.6	23.0
51.5		16	1	110	8	51.0	54.0	3.000	2.626	0.74	0.63	1.00	1.00	15.2	47	0.5	15.7

Base Depth (feet)	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	Liquefac. Safety Factor	Post FC Adj. $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric Strain (%)	Induced Subsidence (in.)
4.0	1.00	1.200	0.058	**Non-Liq.**	2.1	59.5	0.00	**0.00**
6.5	1.00	1.200	0.058	**Non-Liq.**	2.1	59.5	0.00	**0.00**
9.0	1.00	1.200	0.058	**Non-Liq.**	3.0	99.2	0.00	**0.00**
11.5	1.00	1.200	0.057	**Non-Liq.**	0.8	43.6	0.00	**0.00**
14.0	1.00	1.200	0.057	**Non-Liq.**	0.8	43.6	0.00	**0.00**
16.5	1.00	1.200	0.057	**Non-Liq.**	1.2	69.7	0.00	**0.00**
21.5	0.92	1.200	0.061	**Non-Liq.**	1.1	64.8	0.00	**0.00**
26.5	0.89	0.211	0.062	**Non-Liq.**	0.1	19.6	0.02	**0.01**
31.5	0.90	0.140	0.062	**2.25**	0.5	12.9	0.00	**0.00**
36.5	0.83	0.341	0.069	**4.92**	0.6	27.9	0.00	**0.00**
41.5	0.87	0.124	0.067	**1.85**	0.4	11.5	0.00	**0.00**
46.5	0.80	0.253	0.072	**3.51**	0.6	23.0	0.00	**0.00**
51.5	0.86	0.170	0.066	**2.57**	0.5	15.7	0.00	**0.00**

Base Depth (feet)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
4.0	0.141	655	0.027	4.8E-05	1.3E-05	5.7E-06	**0.00**
6.5	0.241	857	0.046	6.2E-05	1.7E-05	7.3E-06	**0.00**
9.0	0.348	1,222	0.066	6.0E-05	8.8E-06	3.9E-06	**0.00**
11.5	0.451	1,056	0.085	9.4E-05	3.7E-05	1.6E-05	**0.00**
14.0	0.551	1,168	0.104	1.0E-04	4.1E-05	1.8E-05	**0.00**
16.5	0.658	1,492	0.123	9.3E-05	2.1E-05	9.2E-06	**0.00**
21.5	0.876	1,681	0.162	1.1E-04	2.7E-05	1.2E-05	**0.00**
26.5	1.064	1,242	0.194	1.9E-04	2.0E-04	8.6E-05	**0.01**
31.5	1.248	1,171	0.222	2.4E-04			
36.5	1.447	1,632	0.248	1.8E-04			
41.5	1.633	1,288	0.267	2.6E-04			
46.5	1.825	1,717	0.281	1.9E-04			
51.5	2.010	1,588	0.290	2.2E-04			





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

C_N = (1 atm/p'o)$^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

$G_{max} = 447*N_{1(60)CS}^{(1/3)}*p^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*(p/1)$^{(-0.6)}$

$\gamma = [1+a*EXP(b*\tau_{av}/G_{max})]/[(1+a)*\tau_{av}/G_{max}]$

$E_{15} = \gamma*(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}*E15$

Nc = (MAG-4)$^{2.17}$

$S = 2*H*E_{nc}$

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or (p'o/1.058)$^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

$Dr = (N_{1(60)}/70)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

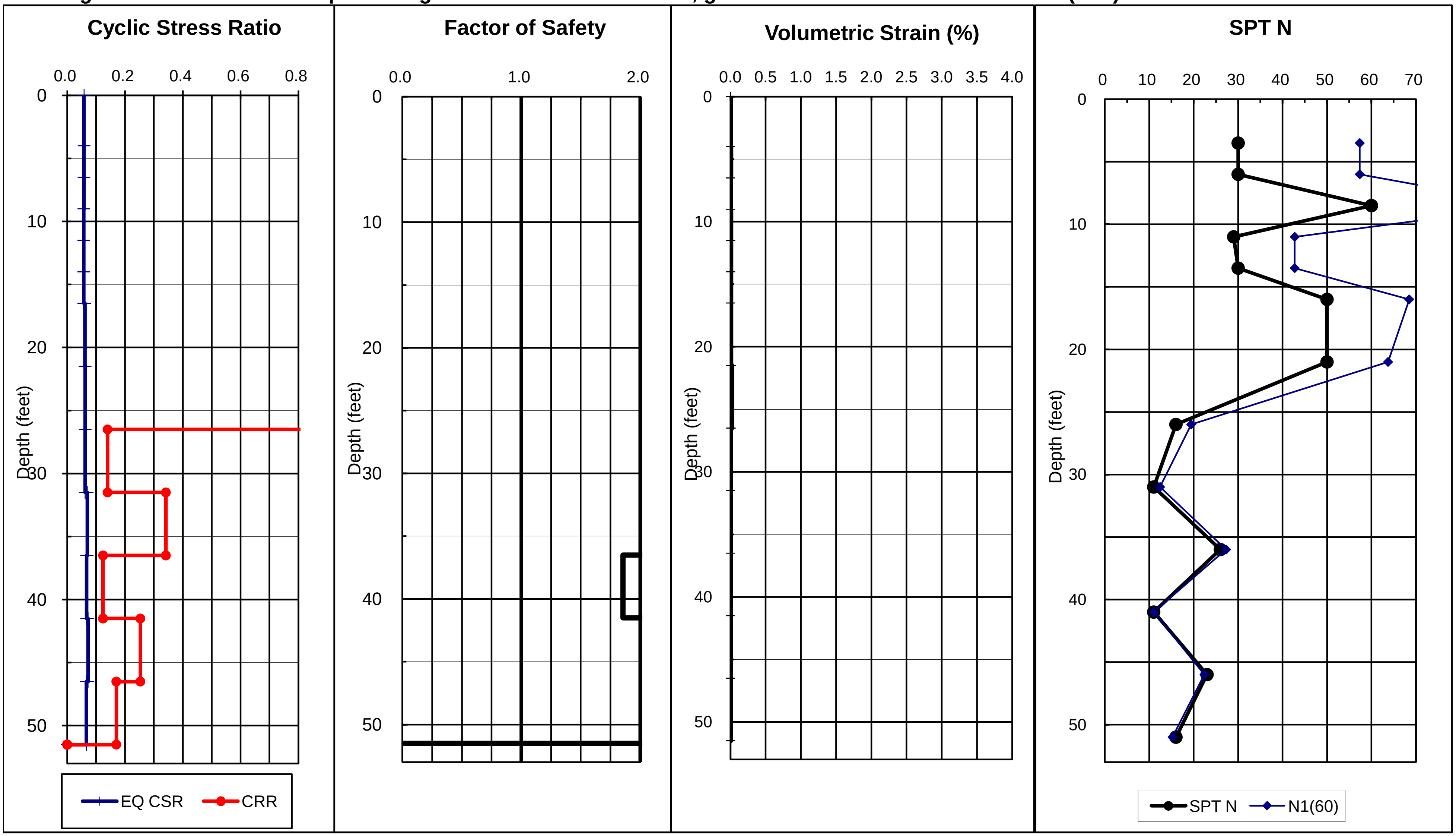
$N = N_{1(60)CS}$

$SF = CRR_{7.5,1atm}/CSR*$

GN NORTHERN - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** 1996/1998 NCEER Method

Boring: BH-40 **Earthquake Magnitude: 5.5** **PGA, g: 0.20** **Calc GWT (feet): 29**



Total Thickness of Liquefiable Layers: 0.0 feet **Estimated Total Ground Subsidence: 0.0 inches**

LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-40

Methods: **Liquefaction Analysis using Idriss & Boulanger Method (2004)**
Semi-empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, 11th SDEE and 3rd ICEGE, Univ. of California, Berkeley, 2004.
Settlement Analysis from Tokimatsu and Seed (1987),JGEE ,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude:	5.5	7.5
PGA, g:	0.20	0.12
MSF:	1.69	
GWT:	39.0	feet
Calc GWT	29.0	feet
Remediate to:	0.0	feet

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E):	1.50	
Drive Rod Corr. (C_R):	1	Default
Rod Length above ground (feet):	3.00	
Borehole Dia. Corr. (C_B):	1.00	
Sampler Liner Correction for SPT?:	0	No
Cal Mod/ SPT Ratio:	0.63	

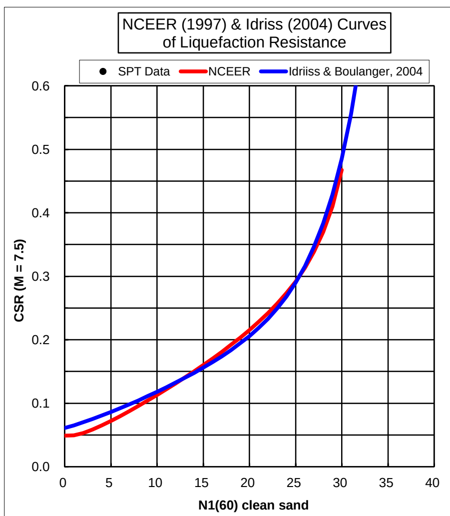
Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
0	0.0

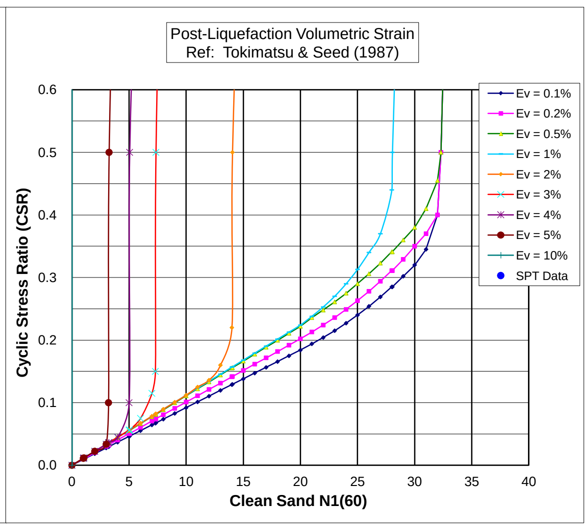
Required SF: 1.25
Minimum SF: #N/A

ETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 2.4

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT σv (tsf)	Eff.Stress at SPT σ'v (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	$CRR_{7.5}$	CSR*	Liquefac. Safety Factor	Volumetric Strain (%)	Induced Subsidence (in.)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
								0.000																						
4.0		30	1	120	10	3.5	6.5	0.210	0.210	0.99	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.076	Non-Liq.	0.03	0.01	0.141	347	0.027	1.1E-04	3.0E-04	1.3E-04	0.01
6.5		30	1	120	10	6.0	9.0	0.360	0.360	0.98	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.075	Non-Liq.	0.03	0.01	0.241	454	0.046	1.4E-04	3.8E-04	1.7E-04	0.01
9.0		60	1	130	10	8.5	11.5	0.520	0.520	0.96	1.45	0.75	1.00	11.5	50	1.1	12.6	1.00	0.137	0.074	Non-Liq.	0.02	0.01	0.348	615	0.065	1.4E-04	2.4E-04	1.1E-04	0.01
11.5		29	1	120	8	11.0	14.0	0.673	0.673	0.94	1.25	0.78	1.00	15.1	57	0.4	15.5	1.00	0.160	0.073	Non-Liq.	0.02	0.01	0.451	748	0.083	1.4E-04	1.9E-04	8.3E-05	0.01
14.0		30	1	120	8	13.5	16.5	0.823	0.823	0.93	1.08	0.84	1.00	39.3	92	0.4	39.7	1.00	3.711	0.071	Non-Liq.	0.00	0.00	0.551	1,132	0.099	1.0E-04	4.4E-05	2.0E-05	0.00
16.5		50	1	130	8	16.0	19.0	0.983	0.983	0.91	1.02	0.88	1.00	45.0	99	0.4	45.4	1.00	37.315	0.070	Non-Liq.	0.00	0.00	0.658	1,293	0.116	1.0E-04	3.8E-05	1.7E-05	0.00
21.5		50	1	130	8	21.0	24.0	1.308	1.308	0.87	0.95	0.94	1.00	53.7	100	0.4	54.1	0.94	16686.844	0.071	Non-Liq.	0.00	0.00	0.876	1,582	0.148	1.0E-04	3.2E-05	1.4E-05	0.00
26.5		16	1	110	6	26.0	29.0	1.588	1.588	0.83	0.89	0.99	1.00	41.3	95	0.0	41.3	0.88	6.533	0.073	Non-Liq.	0.00	0.00	1.064	1,594	0.171	1.2E-04	5.1E-05	2.2E-05	0.00
31.5		11	1	110	8	31.0	34.0	1.863	1.863	0.78	0.86	1.00	1.00	57.1	100	0.4	57.5	1.00	565138.808	0.060	>10	0.00	0.00	1.248	1,927	0.190	1.1E-04			
36.5		26	1	120	8	36.0	39.0	2.160	2.160	0.74	0.83	1.00	1.00	60.5	100	0.4	60.9	1.00	42570978.317	0.057	>10	0.00	0.00	1.447	2,115	0.208	1.1E-04			
41.5		11	1	110	8	41.0	44.0	2.438	2.375	0.70	0.81	1.00	1.00	79.0	100	0.4	79.4	1.00	19043843098073100000000000.0	0.055	>10	0.00	0.00	1.633	2,455	0.222	9.8E-05			
46.5		23	1	115	8	46.0	49.0	2.724	2.505	0.66	0.80	1.00	1.00	61.5	100	0.4	61.9	1.00	179674647.810	0.055	>10	0.00	0.00	1.825	2,388	0.234	1.1E-04			
51.5		16	1	110	8	51.0	54.0	3.000	2.626	0.62	0.79	1.00	1.00	54.0	100	0.4	54.4	0.73	22111.602	0.075	>10	0.00	0.00	2.010	2,401	0.243	1.1E-04			
														55.0																
														56.0																
														57.0																
														58.0																
														59.0																
														60.0																
														61.0																





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z)$^{0.5}$))

C_N = min(1.7,(pa/σ'v)^[0.784-0.0768*min(46,$N_{1(60)}$)]$^{0.5}$]

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

MSF = min(1.8,6.9*exp(-M/4)-0.058)

z = Depth (m)

rd = exp[(-1.012-1.126sin(z/11.73+5.133))+(0.106+0.118sin(z/11.28+5.142

pa = 1 atm = 101 KPa = 1.058 tsf

$\Delta N_{1(60)}$ = exp[1.63+9.7/FC-(15.7/FC)^2]

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min(1,1-min(0.3,1/(18.9-17.3Dr))*ln(p'o/1.058))

Dr = $(N_{1(60)}/46)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = exp((N/14.1)+(N/126)^2-(N/23.6)^3+(N/25.4)^4-2.8)

N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

G_{max} = 447*$N_{1(60)CS}^{(1/3)}$*$p^{0.5}$ -sand, 10

r = g/g

Vso = $(G/r)^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*(p/1)$^{(-0.6)}$

γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}

E_{15} = γ*$(N_{1(60)CS}/20)^{-1.2}$

Nc = $(MAG-4)^{2.17}$

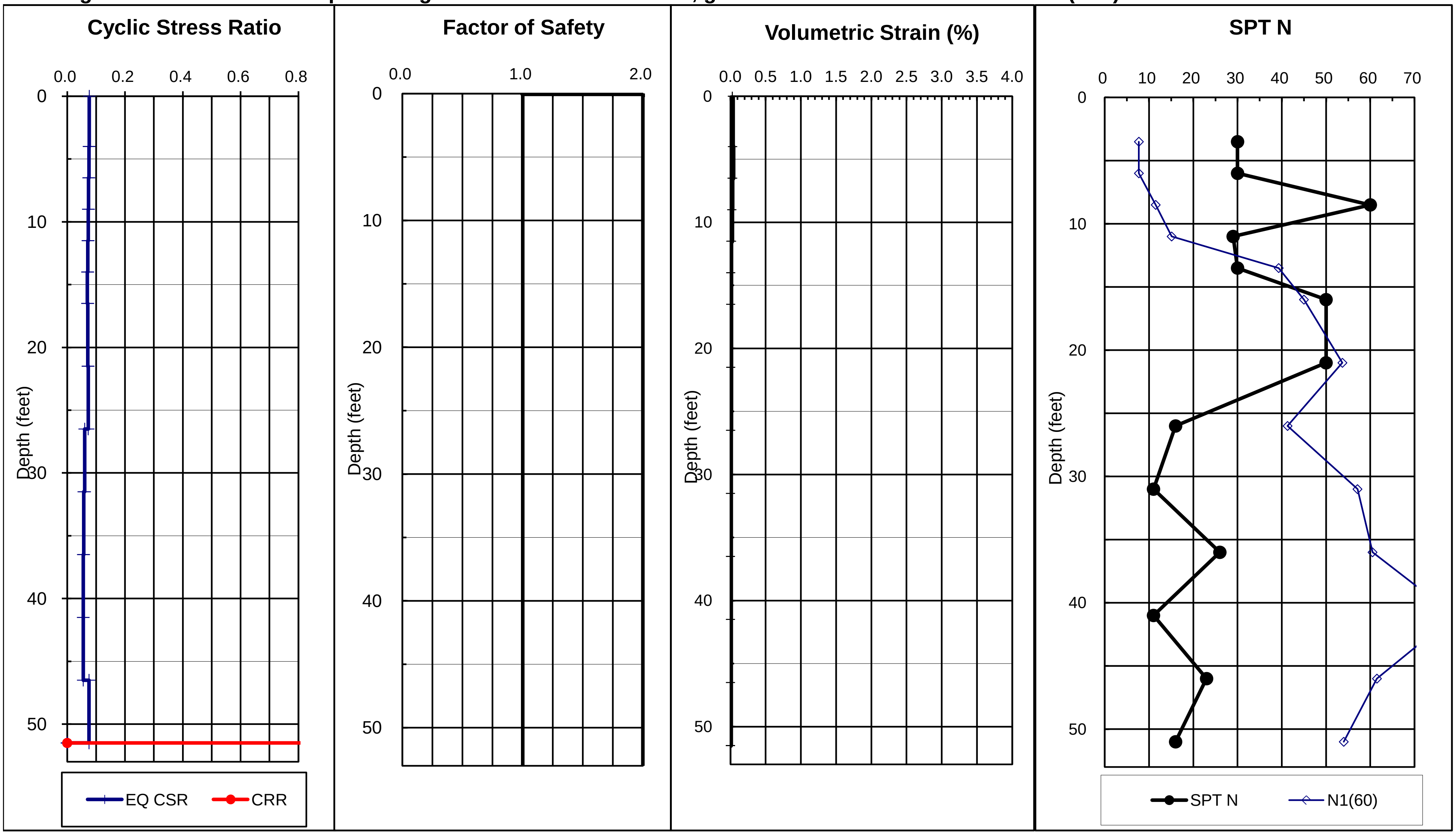
E_{nc} = $(Nc/15)^{0.45}$*E_{15}

S = 2*H*E_{nc}

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** Idriss & Boulanger Method, 2004

Boring: BH-40 **Earthquake Magnitude: 5.5** **PGA, g: 0.20** **Calc GWT (feet): 29.0**



Total Thickness of Liquefiable Layers: 0.0 feet **#VALUE!** **Estimated Total Ground Subsidence: 0.0 inches**

[redacted]

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-40 Data Set: 1

Methods: Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 6.5 7.5
PGA, g: 0.20 0.14
MSF: 1.44
GWT: 39.0 feet
Calc GWT: 29.0 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.50 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 0 No
Cal Mod/ SPT Ratio: 0.63

Threshold Acceler., g: 0.24

Required SF: 1.25
Minimum Calculated SF: 1.21

Total (ft) Liquefied Thickness: 5

Total (in.) Induced Subsidence: 0.1

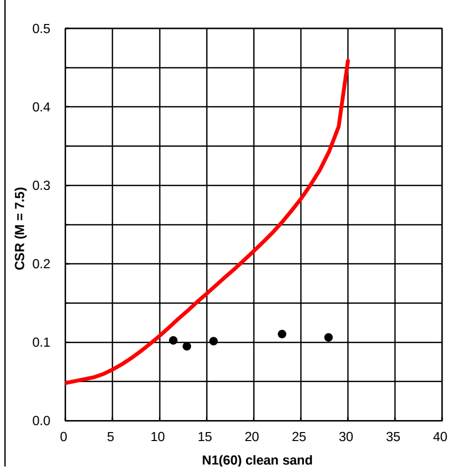
SETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 7.3

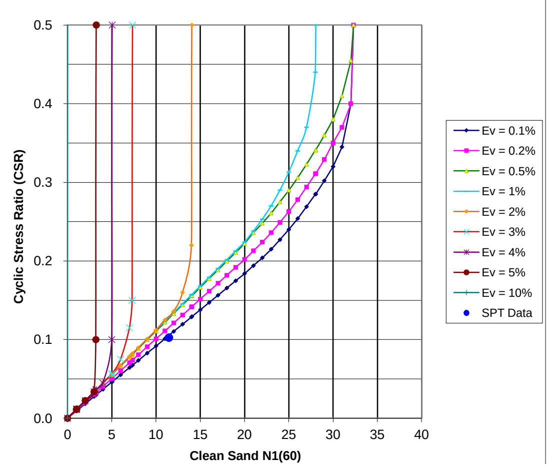
Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	Trigger FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M = 7.5 Induced CSR*	Liquefac. Safety Factor	Post FC Adj. $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric Strain (%)	Induced Subsidence (in.)
								0.000																	
4.0		30	1	120	10	3.5	6.5	0.210	0.210	0.99	1.70	0.75	1.00	57.4	91	2.1	59.5	1.00	1.200	0.090	Non-Liq.	2.1	59.5	0.00	0.00
6.5		30	1	120	10	6.0	9.0	0.360	0.360	0.99	1.70	0.75	1.00	57.4	91	2.1	59.5	1.00	1.200	0.089	Non-Liq.	2.1	59.5	0.00	0.00
9.0		60	1	130	10	8.5	11.5	0.520	0.520	0.98	1.43	0.75	1.00	96.3	100	3.0	99.2	1.00	1.200	0.089	Non-Liq.	3.0	99.2	0.00	0.00
11.5		29	1	120	8	11.0	14.0	0.673	0.673	0.98	1.25	0.78	1.00	42.7	78	0.8	43.6	1.00	1.200	0.088	Non-Liq.	0.8	43.6	0.01	0.00
14.0		30	1	120	8	13.5	16.5	0.823	0.823	0.97	1.13	0.84	1.00	42.7	78	0.8	43.6	1.00	1.200	0.088	Non-Liq.	0.8	43.6	0.01	0.00
16.5		50	1	130	8	16.0	19.0	0.983	0.983	0.97	1.04	0.88	1.00	68.5	99	1.2	69.7	1.00	1.200	0.087	Non-Liq.	1.2	69.7	0.00	0.00
21.5		50	1	130	8	21.0	24.0	1.308	1.308	0.95	0.90	0.94	1.00	63.7	95	1.1	64.8	0.92	1.200	0.094	Non-Liq.	1.1	64.8	0.00	0.00
26.5		16	1	110	6	26.0	29.0	1.588	1.588	0.94	0.82	0.99	1.00	19.4	53	0.1	19.6	0.89	0.211	0.096	Non-Liq.	0.1	19.6	0.03	0.02
31.5		11	1	110	8	31.0	34.0	1.863	1.863	0.92	0.75	1.00	1.00	12.4	42	0.5	12.9	0.90	0.140	0.095	1.47	0.5	12.9	0.00	0.00
36.5		26	1	120	8	36.0	39.0	2.160	2.160	0.88	0.70	1.00	1.00	27.3	62	0.6	27.9	0.83	0.341	0.106	3.21	0.6	27.9	0.00	0.00
41.5		11	1	110	8	41.0	44.0	2.438	2.375	0.84	0.67	1.00	1.00	11.0	40	0.4	11.5	0.87	0.124	0.103	1.21	0.4	11.5	0.07	0.04
46.5		23	1	115	8	46.0	49.0	2.724	2.505	0.79	0.65	1.00	1.00	22.4	57	0.6	23.0	0.80	0.253	0.111	2.29	0.6	23.0	0.00	0.00
51.5		16	1	110	8	51.0	54.0	3.000	2.626	0.74	0.63	1.00	1.00	15.2	47	0.5	15.7	0.86	0.170	0.102	1.67	0.5	15.7	0.00	0.00

Base Depth (feet)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
4.0	0.141	655	0.027	4.8E-05	1.3E-05	9.4E-06	0.00
6.5	0.241	857	0.046	6.2E-05	1.7E-05	1.2E-05	0.00
9.0	0.348	1,222	0.066	6.0E-05	8.8E-06	6.4E-06	0.00
11.5	0.451	1,056	0.085	9.4E-05	3.7E-05	2.7E-05	0.00
14.0	0.551	1,168	0.104	1.0E-04	4.1E-05	2.9E-05	0.00
16.5	0.658	1,492	0.123	9.3E-05	2.1E-05	1.5E-05	0.00
21.5	0.876	1,681	0.162	1.1E-04	2.7E-05	1.9E-05	0.00
26.5	1.064	1,242	0.194	1.9E-04	2.0E-04	1.4E-04	0.02
31.5	1.248	1,171	0.222	2.4E-04			
36.5	1.447	1,632	0.248	1.8E-04			
41.5	1.633	1,288	0.267	2.6E-04			
46.5	1.825	1,717	0.281	1.9E-04			
51.5	2.010	1,588	0.290	2.2E-04			

NCEER (1997) Curve of Liquefaction Resistance



Post-Liquefaction Volumetric Strain
Ref: Tokimatsu & Seed (1987)



$N_{1(60)} = C_N{*}C_E{*}C_B{*}C_R{*}C_S{*}N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

$C_N = (1\ atm/p'o)^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

$p = 0.67{*}po$

$\tau_{av} = 0.65{*}PGA{*}po{*}rd$

$G_{max} = 447{*}N_{1(60)CS}^{(1/3)}{*}p^{0.5}$

$a = 0.0389{*}(p/1)+0.124$

$b = 6400{*}(p/1)^{(-0.6)}$

$\gamma = [1+a{*}EXP(b{*}\tau_{av}/G_{max})]/[(1+a){*}\tau_{av}/G_{max}]$

$E_{15} = \gamma{*}(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}{*}E15$

$Nc = (MAG-4)^{2.17}$

$S = 2{*}H{*}E_{nc}$

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or $(p'o/1.058)^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

$Dr = (N_{1(60)}/70)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

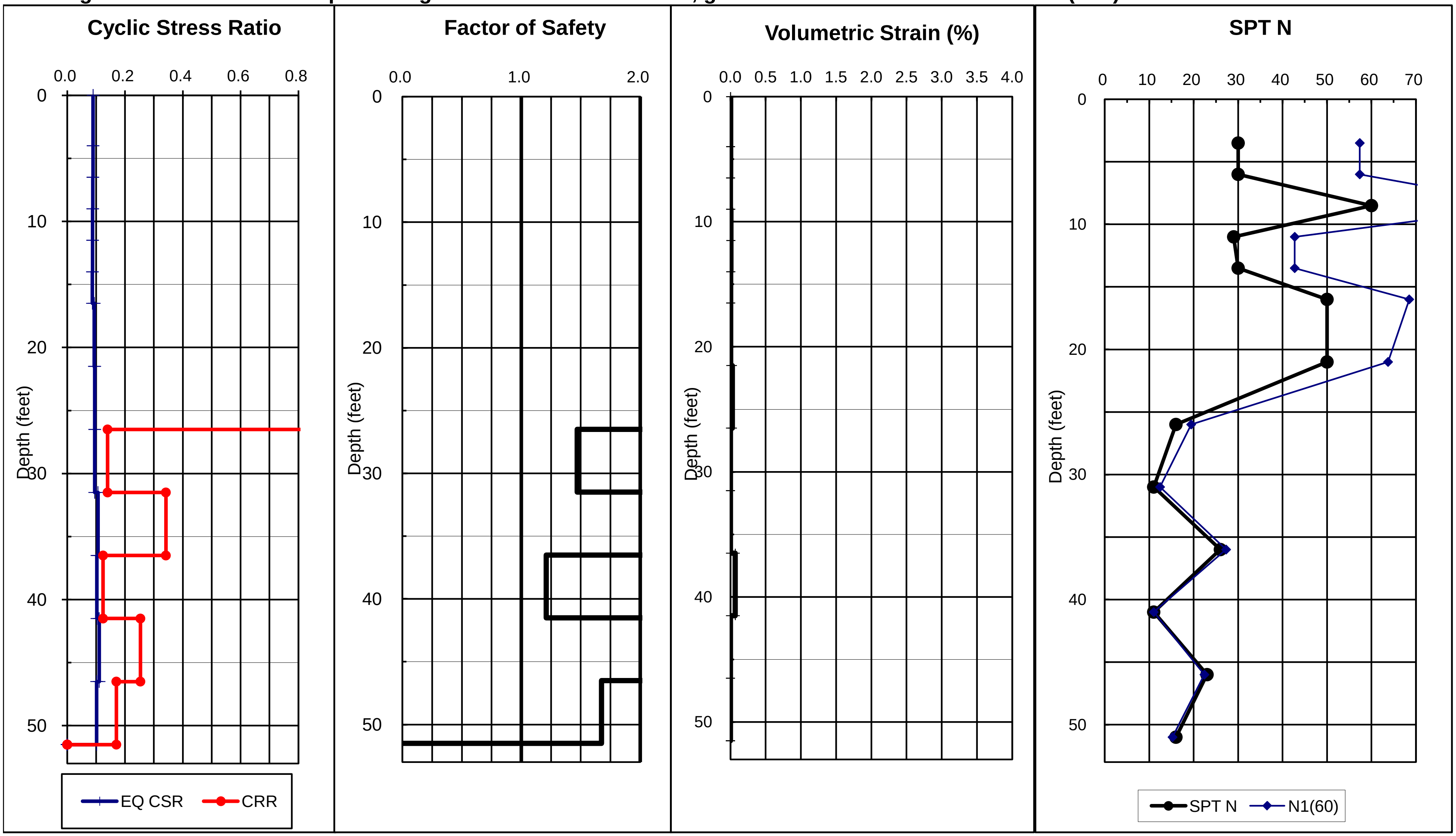
$N = N_{1(60)CS}$

$SF = CRR_{7.5,1atm}/CSR^*$

GN NORTHERN - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant   Project No: 223-1672   1996/1998 NCEER Method

Boring: BH-40   Earthquake Magnitude: 6.5   PGA, g: 0.20   Calc GWT (feet): 29



Total Thickness of Liquefiable Layers: 5.0 feet   Estimated Total Ground Subsidence: 0.1 inches

LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Atlas Agro - Pacific Green Fertilizer Plant
Job No: 223-1672
Date: 9/30/2023
Boring: BH-40

Methods: Liquefaction Analysis using Idriss & Boulanger Method (2004)
Semi-empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, 11th SDEE and 3rd ICEGE, Univ. of California, Berkeley, 2004.
Settlement Analysis from Tokimatsu and Seed (1987),JGEE ,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude:	6.5	7.5
PGA, g:	0.20	0.15
MSF:	1.30	
GWT:	39.0	feet
Calc GWT	29.0	feet
Remediate to:	0.0	feet

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E):	1.50	
Drive Rod Corr. (C_R):	1	Default
Rod Length above ground (feet):	3.00	
Borehole Dia. Corr. (C_B):	1.00	
Sampler Liner Correction for SPT?:	0	No
Cal Mod/ SPT Ratio:	0.63	

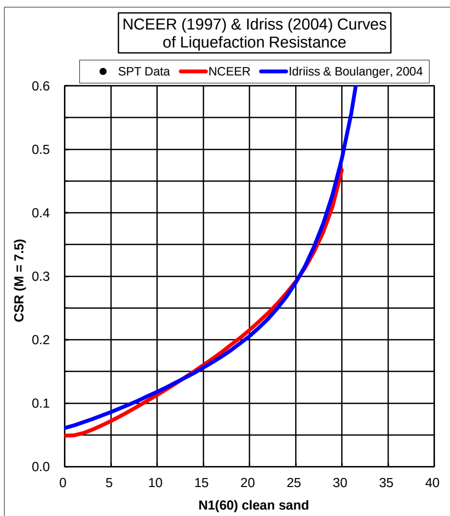
Required SF: 1.25
Minimum SF: #N/A

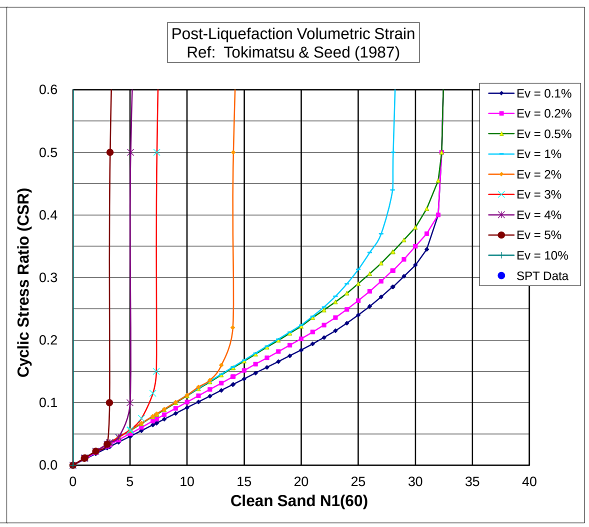
Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
0	0.1

ETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 7.3

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT σv (tsf)	Eff.Stress at SPT σ'v (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	FC Adj. $\Delta N_{1(60)}$	Equiv. Sand $N_{1(60)CS}$	Kσ	$CRR_{7.5}$	CSR*	Liquefac. Safety Factor	Volumetric Strain (%)	Induced Subsidence (in.)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	Dry Sand Subsidence (in.)
								0.000																						
4.0		30	1	120	10	3.5	6.5	0.210	0.210	0.99	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.099	Non-Liq.	0.04	0.02	0.141	347	0.027	1.1E-04	3.1E-04	2.2E-04	0.02
6.5		30	1	120	10	6.0	9.0	0.360	0.360	0.98	1.70	0.75	1.00	7.7	41	1.1	8.8	1.00	0.110	0.098	Non-Liq.	0.06	0.02	0.241	454	0.046	1.4E-04	3.8E-04	2.8E-04	0.02
9.0		60	1	130	10	8.5	11.5	0.520	0.520	0.97	1.45	0.75	1.00	11.5	50	1.1	12.6	1.00	0.137	0.097	Non-Liq.	0.04	0.01	0.348	615	0.066	1.4E-04	2.4E-04	1.8E-04	0.01
11.5		29	1	120	8	11.0	14.0	0.673	0.673	0.96	1.25	0.78	1.00	15.1	57	0.4	15.5	1.00	0.160	0.096	Non-Liq.	0.03	0.01	0.451	748	0.084	1.4E-04	1.9E-04	1.4E-04	0.01
14.0		30	1	120	8	13.5	16.5	0.823	0.823	0.95	1.08	0.84	1.00	39.3	92	0.4	39.7	1.00	3.711	0.095	Non-Liq.	0.01	0.00	0.551	1,132	0.101	1.0E-04	4.6E-05	3.3E-05	0.00
16.5		50	1	130	8	16.0	19.0	0.983	0.983	0.93	1.02	0.88	1.00	45.0	99	0.4	45.4	1.00	37.315	0.093	Non-Liq.	0.01	0.00	0.658	1,293	0.119	1.1E-04	4.0E-05	2.9E-05	0.00
21.5		50	1	130	8	21.0	24.0	1.308	1.308	0.91	0.95	0.94	1.00	53.7	100	0.4	54.1	0.94	16686.844	0.097	Non-Liq.	0.00	0.00	0.876	1,582	0.154	1.1E-04	3.3E-05	2.4E-05	0.00
26.5		16	1	110	6	26.0	29.0	1.588	1.588	0.87	0.89	0.99	1.00	41.3	95	0.0	41.3	0.88	6.533	0.100	Non-Liq.	0.01	0.00	1.064	1,594	0.180	1.3E-04	5.4E-05	3.9E-05	0.00
31.5		11	1	110	8	31.0	34.0	1.863	1.863	0.84	0.86	1.00	1.00	57.1	100	0.4	57.5	1.00	565138.808	0.084	>10	0.00	0.00	1.248	1,927	0.204	1.2E-04			
36.5		26	1	120	8	36.0	39.0	2.160	2.160	0.81	0.83	1.00	1.00	60.5	100	0.4	60.9	1.00	42570978.317	0.081	>10	0.00	0.00	1.447	2,115	0.227	1.2E-04			
41.5		11	1	110	8	41.0	44.0	2.438	2.375	0.78	0.81	1.00	1.00	79.0	100	0.4	79.4	1.00	190438430980731000000000000.0	0.080	>10	0.00	0.00	1.633	2,455	0.246	1.1E-04			
46.5		23	1	115	8	46.0	49.0	2.724	2.505	0.74	0.80	1.00	1.00	61.5	100	0.4	61.9	1.00	179674647.810	0.081	>10	0.00	0.00	1.825	2,388	0.263	1.2E-04			
51.5		16	1	110	8	51.0	54.0	3.000	2.626	0.71	0.79	1.00	1.00	54.0	100	0.4	54.4	0.73	22111.602	0.112	>10	0.00	0.00	2.010	2,401	0.278	1.3E-04			
														55.0																
														56.0																
														57.0																
														58.0																
														59.0																
														60.0																
														61.0																





$N_{1(60)}$ = C_N*C_E*C_B*C_R*C_S*N
C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z)$^{0.5}$))
C_N = min(1.7,(pa/σ'v)^[0.784-0.0768*min(46,$N_{1(60)}$)$^{0.5}$]
C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners
MSF = min(1.8,6.9*exp(-M/4)-0.058)
z = Depth (m)
rd = exp[(-1.012-1.126sin(z/11.73+5.133))+(0.106+0.118sin(z/11.28+5.14
pa = 1 atm = 101 KPa = 1.058 tsf
$\Delta N_{1(60)}$ = exp[1.63+9.7/FC-(15.7/FC)^2]
$N_{1(60)CS}$ = $N_{1(60)CS}$ + $\Delta N_{1(60)}$
Kσ = min(1,1-min(0.3,1/(18.9-17.3Dr))*ln(p'o/1.058))
Dr = ($N_{1(60)}$/46)$^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ
$CRR_{7.5}$ = exp((N/14.1)+(N/126)^2-(N/23.6)^3+(N/25.4)^4-2.8)
N = $N_{1(60)CS}$

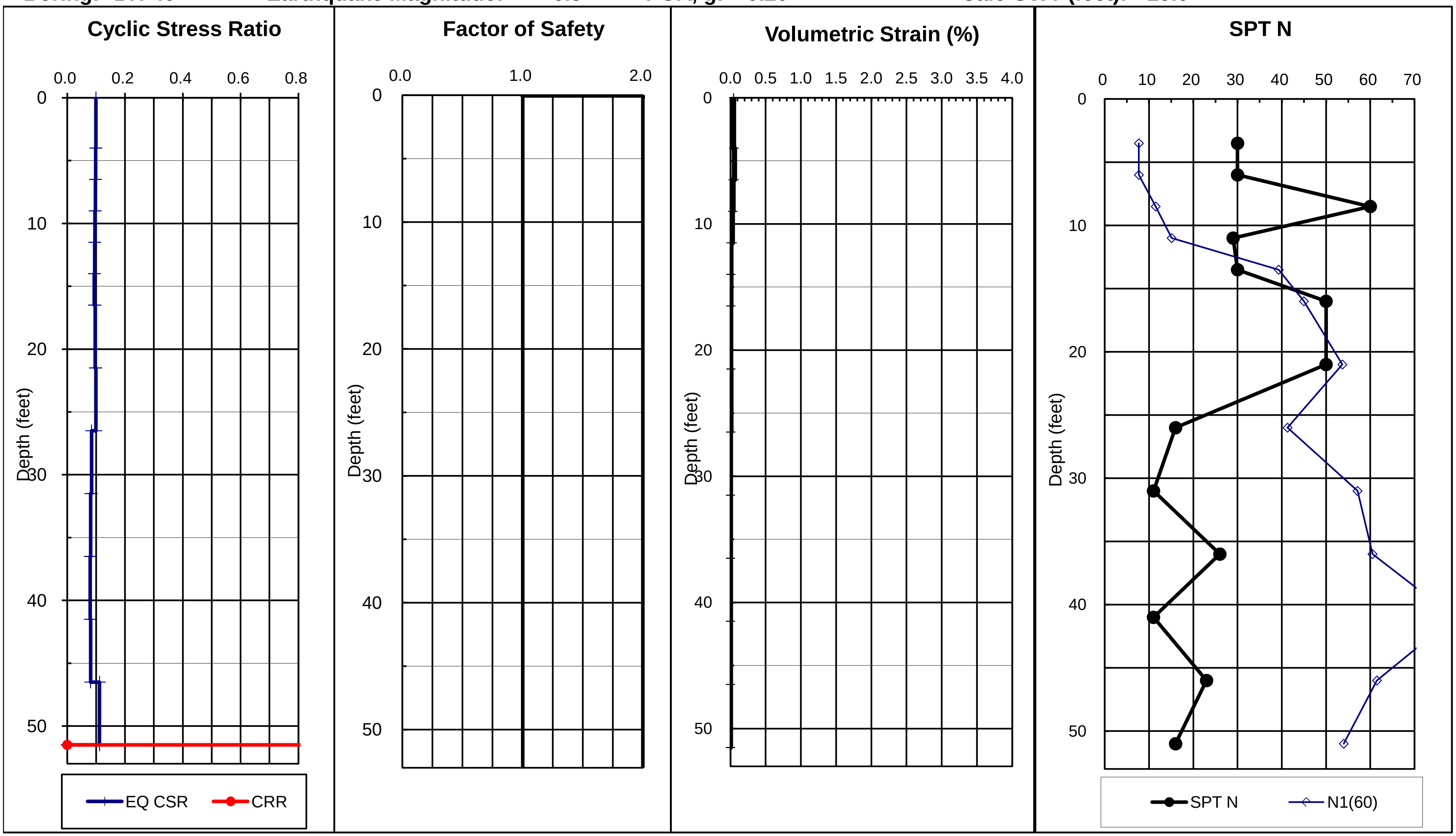
SF = $CRR_{7.5,1atm}$/CSR*

p = 0.67*po
τ_{av} = 0.65*PGA*po*rd
G_{max} = 447*$N_{1(60)CS}$$^{(1/3)}$*p$^{0.5}$ -sand, 10
r = g/g
Vso = (G/r)$^{0.5}$
a = 0.0389*(p/1)+0.124
b = 6400*(p/1)$^{(-0.6)}$
γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}
E_{15} = γ*($N_{1(60)CS}$/20)$^{-1.2}$
Nc = (MAG-4)$^{2.17}$
E_{nc} = (Nc/15)$^{0.45}$*E15
S = 2*H*E_{nc}

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Atlas Agro - Pacific Green Fertilizer Plant **Project No: 223-1672** Idriss & Boulanger Method, 2004

Boring: BH-40 **Earthquake Magnitude: 6.5** **PGA, g: 0.20** **Calc GWT (feet): 29.0**



Total Thickness of Liquefiable Layers: 0.0 feet **#VALUE!** **Estimated Total Ground Subsidence: 0.1 inches**

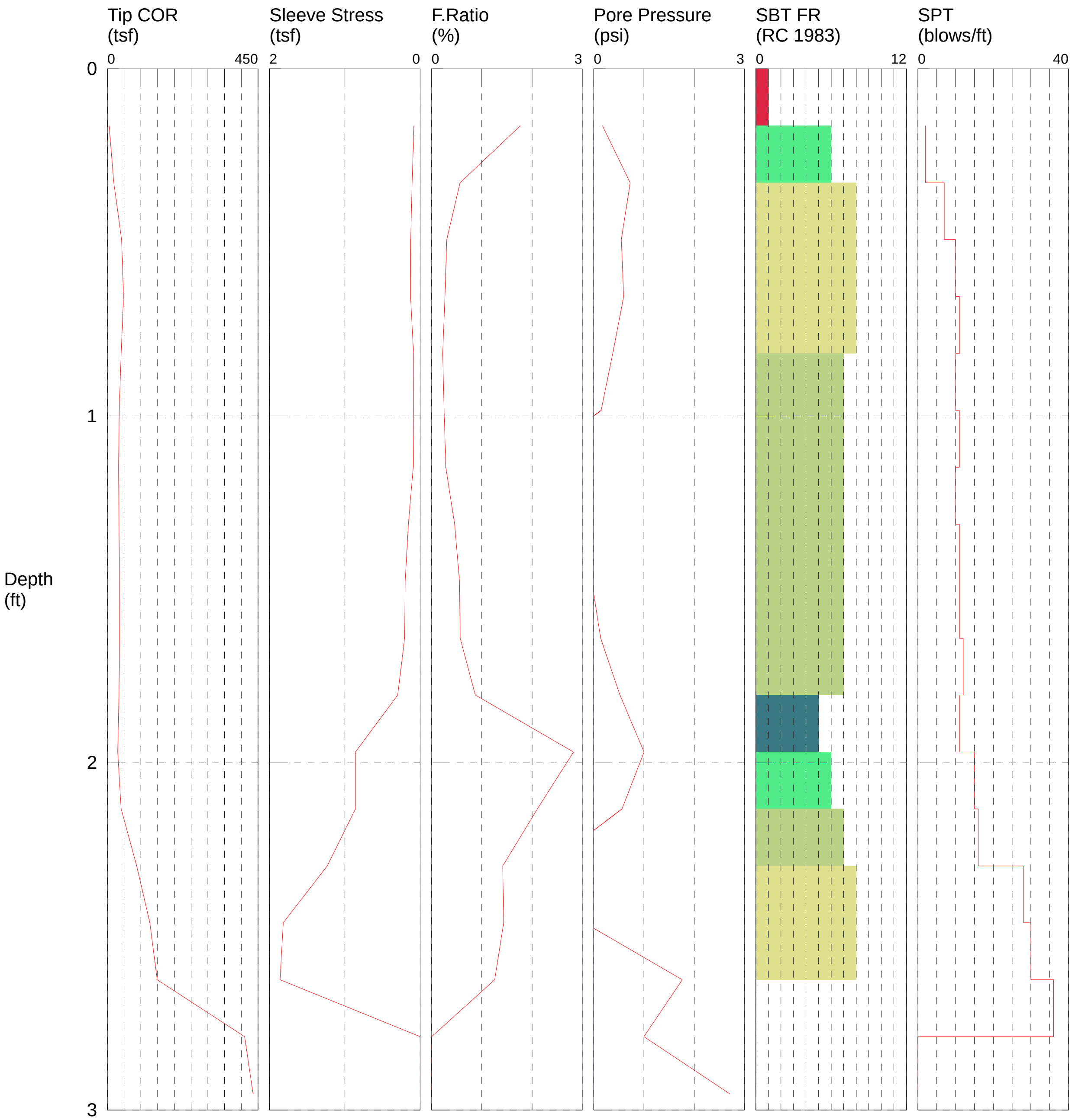
Appendix X

Cone Penetr**ometer** Test (CPT) Data

CPT-01

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 10:29:07 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.953 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

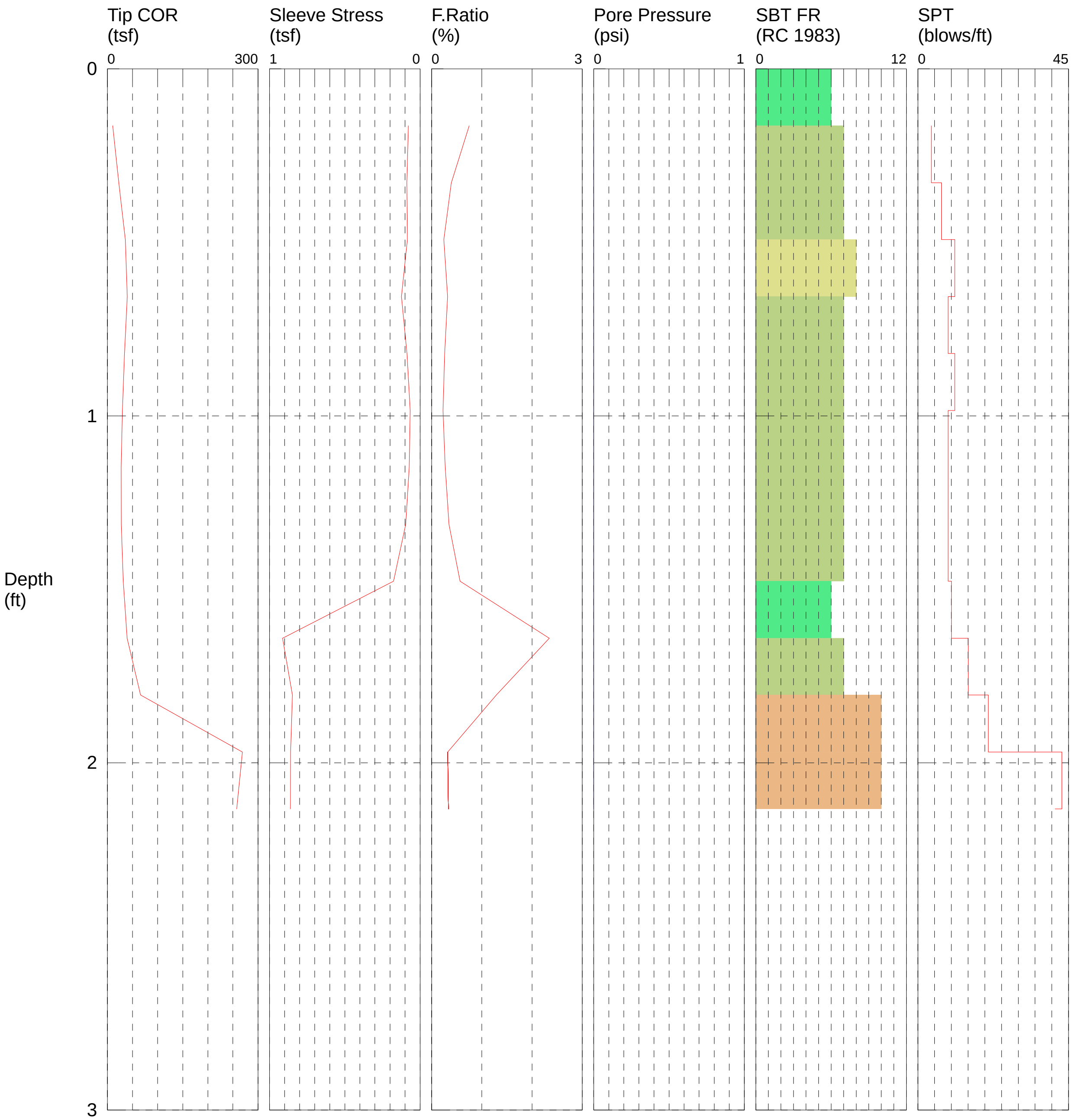
FILE: GNNorthern_AtlasAgro_CPT01.cpt
TEST DATE / TIME: 7/27/2023 10:29:07 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-01
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	4.70	0.0828	1.764	0.173	1	sensitive fine grained	2
0.328	18.88	0.1067	0.565	0.724	6	sandy silt to clayey silt	7
0.492	42.20	0.1258	0.298	0.548	8	sand to silty sand	10
0.656	47.99	0.1267	0.264	0.596	8	sand to silty sand	11
0.820	40.81	0.0890	0.218	0.378	8	sand to silty sand	10
0.984	34.74	0.0867	0.249	0.145	7	silty sand to sandy silt	11
1.148	32.68	0.0918	0.281	-0.015	7	silty sand to sandy silt	10
1.312	34.04	0.1559	0.458	-0.020	7	silty sand to sandy silt	11
1.476	35.85	0.1990	0.555	-0.040	7	silty sand to sandy silt	11
1.640	36.13	0.2052	0.568	0.138	7	silty sand to sandy silt	12
1.804	34.19	0.2969	0.868	0.521	7	silty sand to sandy silt	11
1.969	30.47	0.8605	2.824	1.002	5	clayey silt to silty clay	15
2.133	40.89	0.8611	2.106	0.561	6	sandy silt to clayey silt	16
2.297	87.20	1.2346	1.416	-0.338	7	silty sand to sandy silt	28
2.461	126.74	1.8188	1.435	-0.190	8	sand to silty sand	30
2.625	148.36	1.8611	1.254	1.763	8	sand to silty sand	36
2.789	409.93	0.0000	0.000	0.999	0	<out of range>	0
2.953	435.31	0.0000	0.000	2.702	0	<out of range>	0

CPT-01A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 11:00:15 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.133 ft

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

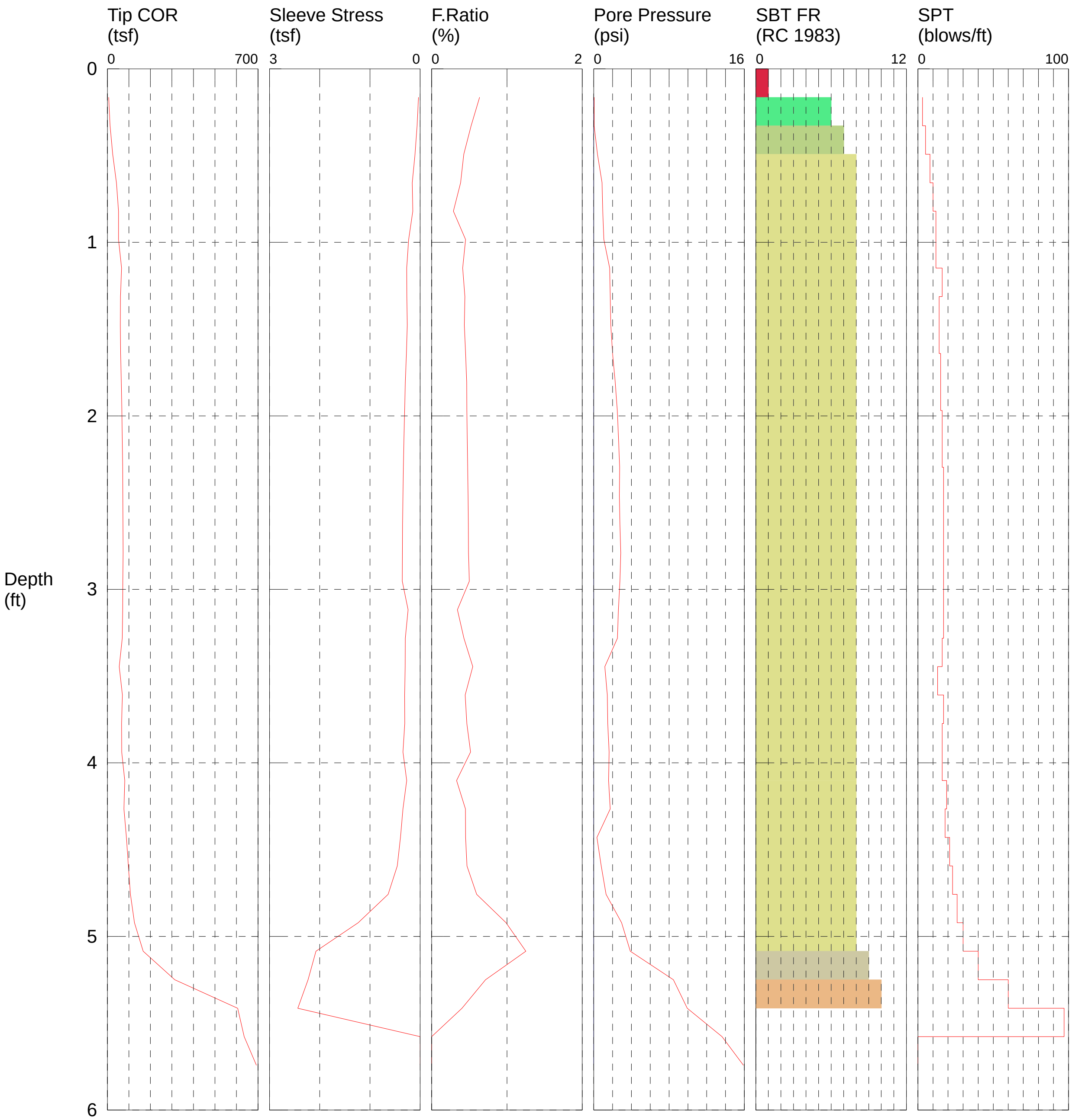
FILE: GNNorthern_AtlasAgro_CPT01A.cpt
TEST DATE / TIME: 7/27/2023 11:00:15 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-01A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	10.47	0.0783	0.748	-0.015	6	sandy silt to clayey silt	4
0.328	22.56	0.0885	0.392	-0.020	7	silty sand to sandy silt	7
0.492	35.38	0.0854	0.241	-0.240	7	silty sand to sandy silt	11
0.656	39.28	0.1241	0.316	-0.038	8	sand to silty sand	9
0.820	33.91	0.0872	0.257	-0.098	7	silty sand to sandy silt	11
0.984	29.61	0.0666	0.225	-0.103	7	silty sand to sandy silt	9
1.148	27.08	0.0728	0.269	-0.135	7	silty sand to sandy silt	9
1.312	27.69	0.0956	0.345	-0.145	7	silty sand to sandy silt	9
1.476	31.31	0.1766	0.564	-0.128	7	silty sand to sandy silt	10
1.640	39.02	0.9140	2.342	-0.148	6	sandy silt to clayey silt	15
1.804	65.91	0.8489	1.288	-0.040	7	silty sand to sandy silt	21
1.969	268.75	0.8605	0.320	-1.686	10	gravelly sand to sand	43
2.133	257.33	0.8611	0.335	-1.876	10	gravelly sand to sand	41

CPT-02

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 11:56:52 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 5.741 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

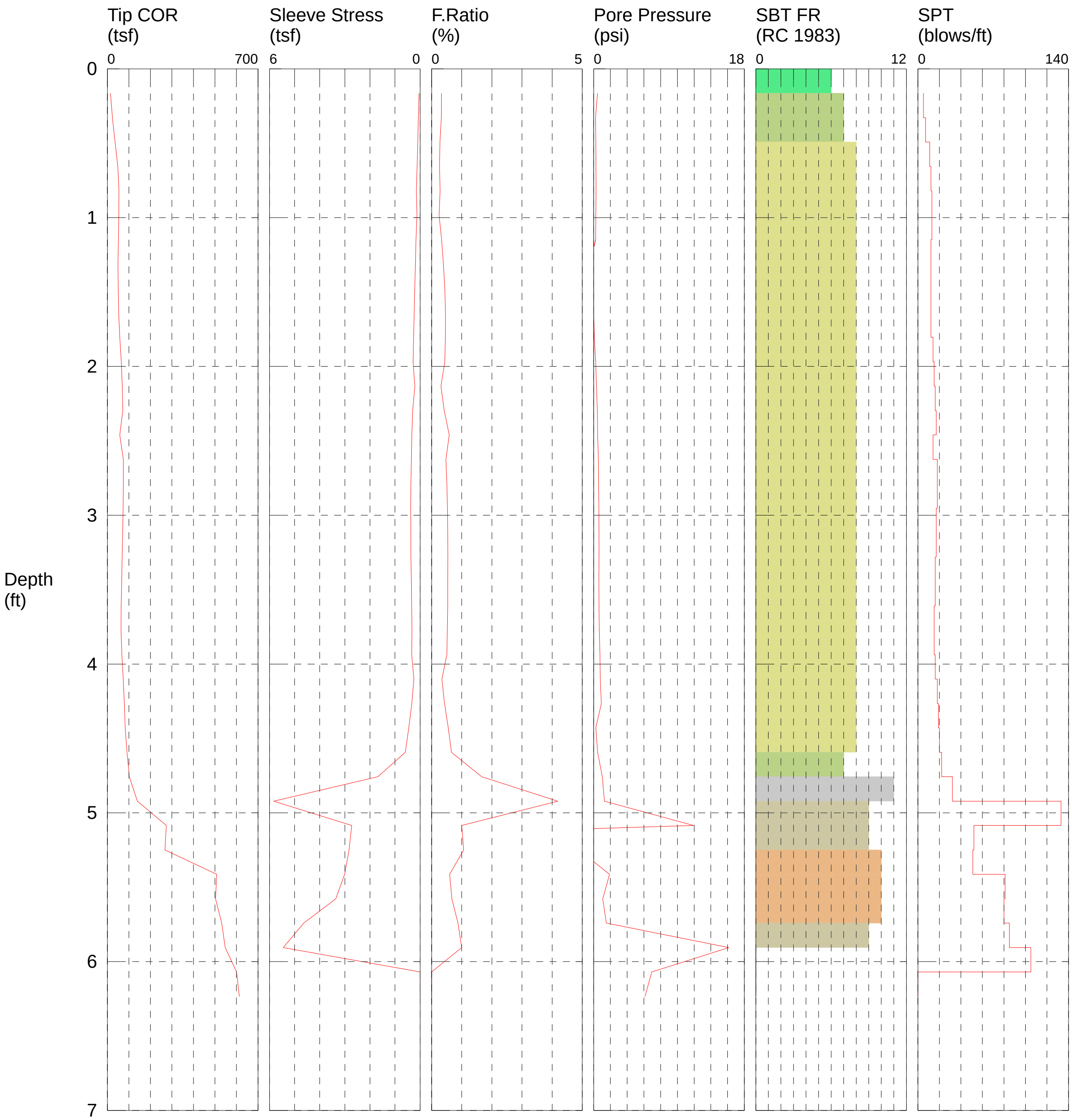
FILE: GNNorthern_AtlasAgro_CPT02.cpt
TEST DATE / TIME: 7/27/2023 11:56:52 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-02
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	5.33	0.0340	0.637	0.040	1	sensitive fine grained	3
0.328	11.78	0.0617	0.524	0.040	6	sandy silt to clayey silt	5
0.492	23.91	0.1019	0.426	0.388	7	silty sand to sandy silt	8
0.656	41.48	0.1589	0.383	0.867	8	sand to silty sand	10
0.820	50.82	0.1466	0.289	0.952	8	sand to silty sand	12
0.984	51.38	0.2307	0.449	1.064	8	sand to silty sand	12
1.148	65.66	0.2699	0.411	1.678	8	sand to silty sand	16
1.312	60.24	0.2657	0.441	1.743	8	sand to silty sand	14
1.476	59.51	0.2583	0.434	1.803	8	sand to silty sand	14
1.640	61.04	0.2741	0.449	1.996	8	sand to silty sand	15
1.804	63.66	0.2957	0.464	2.282	8	sand to silty sand	15
1.969	66.48	0.3096	0.466	2.497	8	sand to silty sand	16
2.133	68.52	0.3240	0.473	2.622	8	sand to silty sand	16
2.297	70.23	0.3345	0.476	2.745	8	sand to silty sand	17
2.461	71.15	0.3437	0.483	2.730	8	sand to silty sand	17
2.625	71.75	0.3488	0.486	2.777	8	sand to silty sand	17
2.789	72.37	0.3539	0.489	2.860	8	sand to silty sand	17
2.953	71.57	0.3575	0.500	2.767	8	sand to silty sand	17
3.117	70.52	0.2415	0.342	2.615	8	sand to silty sand	17
3.281	68.64	0.2942	0.429	2.519	8	sand to silty sand	16
3.445	54.96	0.3000	0.546	1.177	8	sand to silty sand	13
3.609	69.05	0.3075	0.445	1.433	8	sand to silty sand	17
3.773	65.44	0.3053	0.467	1.480	8	sand to silty sand	16
3.937	66.14	0.3418	0.517	1.638	8	sand to silty sand	16
4.101	80.57	0.2674	0.332	1.573	8	sand to silty sand	19
4.265	76.36	0.3425	0.448	1.741	8	sand to silty sand	18
4.429	87.77	0.3939	0.449	0.336	8	sand to silty sand	21
4.593	97.23	0.4562	0.469	0.789	8	sand to silty sand	23
4.757	106.72	0.6376	0.597	1.300	8	sand to silty sand	26
4.921	125.09	1.2365	0.988	2.953	8	sand to silty sand	30
5.085	165.78	2.0755	1.252	3.879	8	sand to silty sand	40
5.249	312.87	2.2350	0.714	8.453	9	sand	60
5.413	605.64	2.4383	0.403	9.925	10	gravelly sand to sand	97
5.577	635.36	0.0000	0.000	13.627	0	<out of range>	0
5.741	692.10	0.0000	0.000	15.891	0	<out of range>	0

CPT-02A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 12:14:19 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 6.234 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

FILE: GNNorthern_AtlasAgro_CPT02A.cpt
TEST DATE / TIME: 7/27/2023 12:14:19 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-02A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

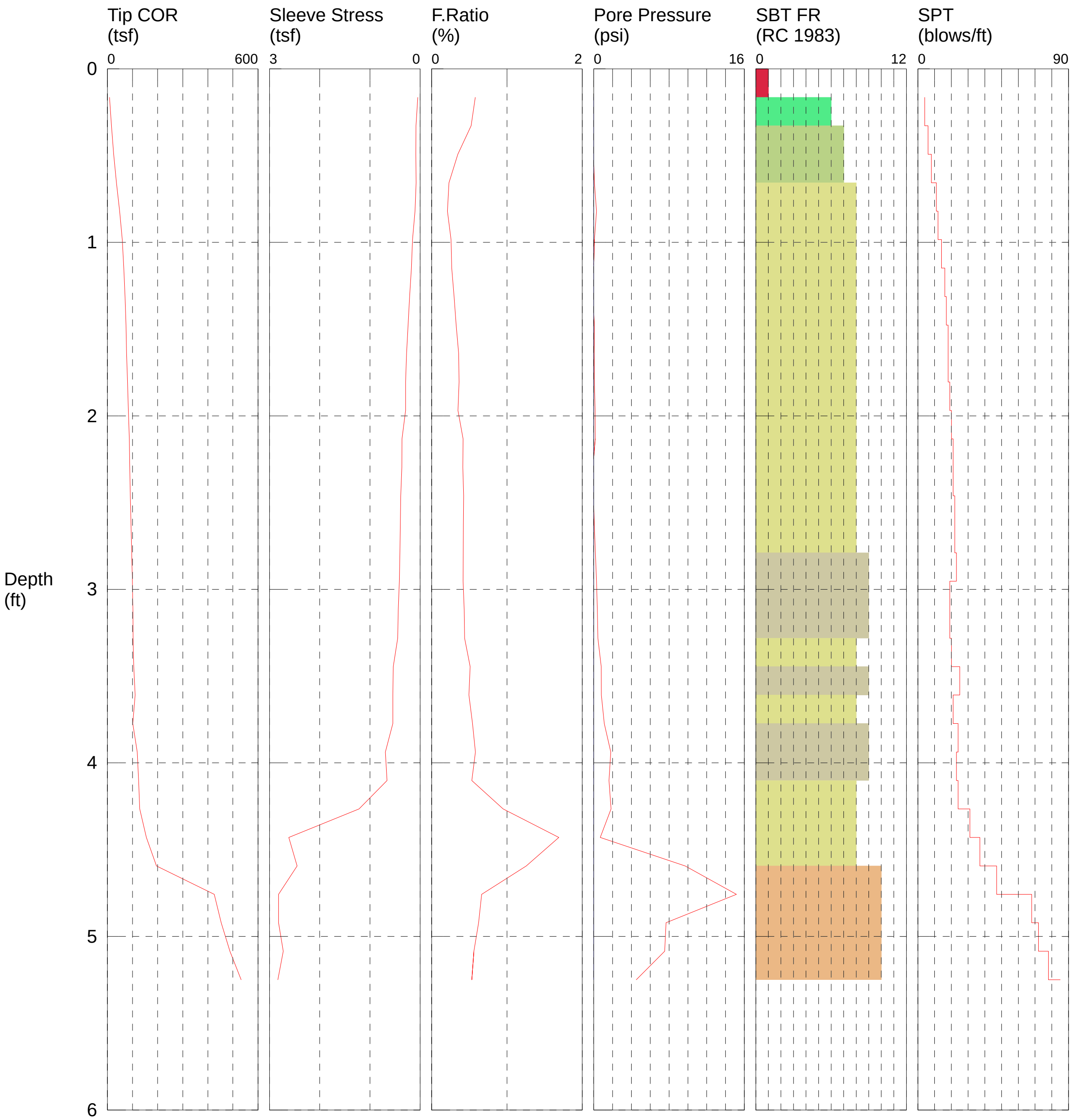
Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	14.05	0.0459	0.327	0.438	6	sandy silt to clayey silt	5
0.328	23.14	0.0739	0.319	0.205	7	silty sand to sandy silt	7
0.492	35.13	0.0969	0.276	0.235	7	silty sand to sandy silt	11
0.656	48.25	0.1264	0.262	0.255	8	sand to silty sand	12
0.820	53.41	0.1499	0.281	0.273	8	sand to silty sand	13
0.984	52.60	0.1283	0.244	0.253	8	sand to silty sand	13
1.148	50.57	0.1659	0.328	0.223	8	sand to silty sand	12
1.312	48.97	0.1893	0.387	-0.098	8	sand to silty sand	12
1.476	49.96	0.2167	0.434	-0.068	8	sand to silty sand	12
1.640	51.91	0.2371	0.457	0.000	8	sand to silty sand	12
1.804	57.04	0.2588	0.454	0.058	8	sand to silty sand	14
1.969	64.06	0.2802	0.437	0.215	8	sand to silty sand	15
2.133	68.68	0.2097	0.305	0.323	8	sand to silty sand	16
2.297	71.40	0.2982	0.418	0.433	8	sand to silty sand	17
2.461	56.94	0.3315	0.582	0.461	8	sand to silty sand	14
2.625	73.90	0.3488	0.472	0.548	8	sand to silty sand	18
2.789	74.10	0.3720	0.502	0.569	8	sand to silty sand	18
2.953	72.50	0.3775	0.521	0.606	8	sand to silty sand	17
3.117	70.36	0.3738	0.531	0.624	8	sand to silty sand	17
3.281	68.09	0.3662	0.538	0.621	8	sand to silty sand	16
3.445	65.79	0.3502	0.532	0.609	8	sand to silty sand	16
3.609	63.17	0.3379	0.535	0.621	8	sand to silty sand	15
3.773	62.92	0.3262	0.518	0.664	8	sand to silty sand	15
3.937	66.81	0.3349	0.501	0.726	8	sand to silty sand	16
4.101	73.14	0.2466	0.337	0.771	8	sand to silty sand	18
4.265	78.60	0.3335	0.424	0.899	8	sand to silty sand	19
4.429	81.98	0.4491	0.548	0.235	8	sand to silty sand	20
4.593	90.65	0.5931	0.654	0.451	8	sand to silty sand	22
4.757	101.35	1.6846	1.662	1.027	7	silty sand to sandy silt	32
4.921	139.27	5.8333	4.188	1.270	11	very stiff fine grained (*)	133
5.085	273.72	2.7289	0.997	11.916	9	sand	52
5.249	266.91	2.8366	1.063	-1.751	9	sand	51
5.413	507.70	3.0099	0.593	1.883	10	gravelly sand to sand	81
5.577	502.32	3.3641	0.670	1.067	10	gravelly sand to sand	80
5.741	531.00	4.6366	0.873	1.505	10	gravelly sand to sand	85

5.906	546.95	5.4577	0.998	16.141	9	sand	105
6.070	600.15	0.0000	0.000	6.935	0	<out of range>	0
6.234	612.93	0.0000	0.000	6.128	0	<out of range>	0

CPT-03

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 12:51:28 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 5.249 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

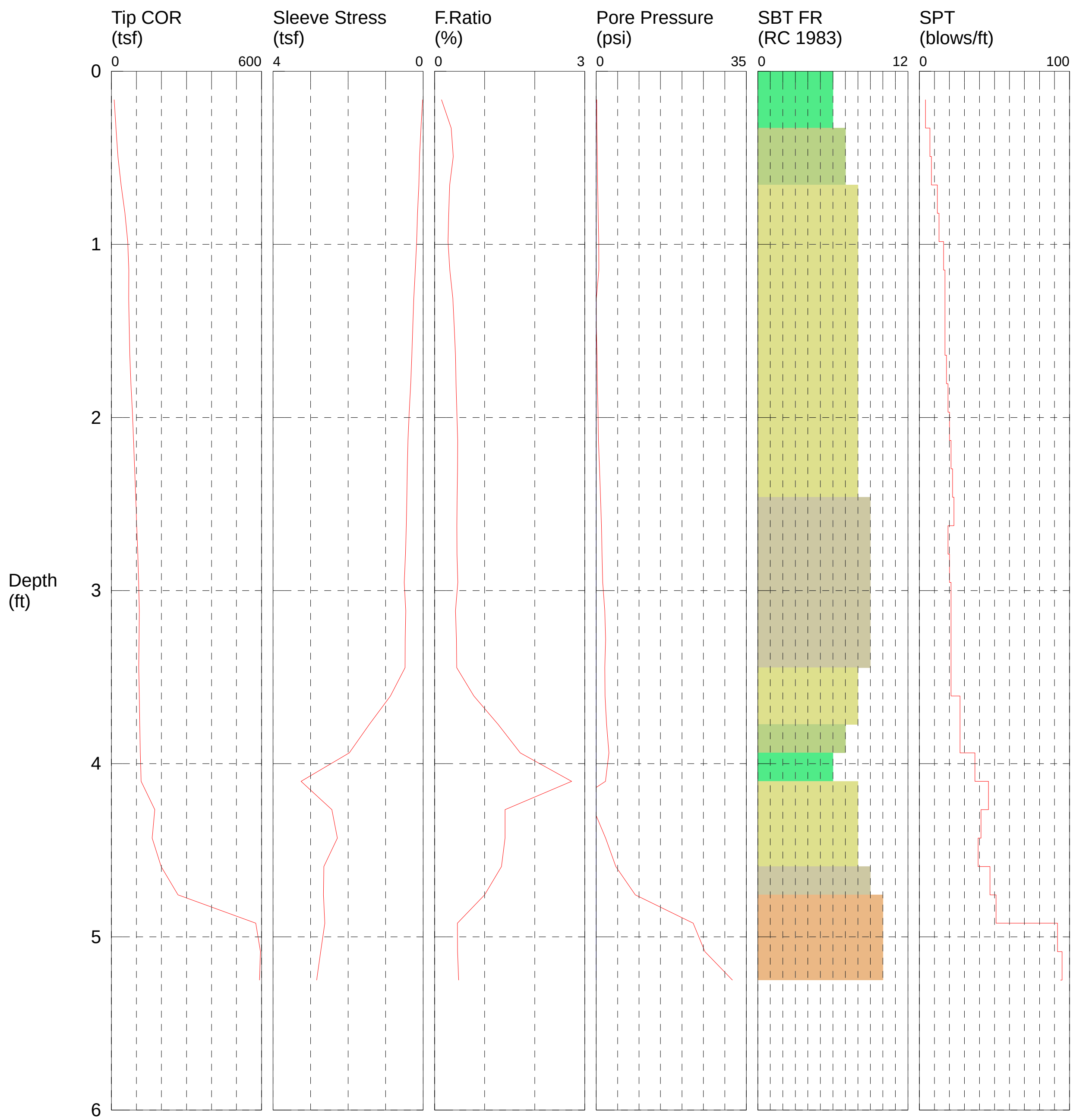
FILE: GNNorthern_AtlasAgro_CPT03.cpt
TEST DATE / TIME: 7/27/2023 12:51:28 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-03
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	8.16	0.0472	0.579	-0.003	1	sensitive fine grained	4
0.328	15.70	0.0821	0.523	-0.023	6	sandy silt to clayey silt	6
0.492	24.33	0.0842	0.346	-0.030	7	silty sand to sandy silt	8
0.656	35.45	0.0816	0.230	0.075	7	silty sand to sandy silt	11
0.820	48.09	0.1004	0.209	0.281	8	sand to silty sand	12
0.984	58.79	0.1514	0.257	0.060	8	sand to silty sand	14
1.148	64.98	0.1739	0.268	-0.428	8	sand to silty sand	16
1.312	69.97	0.2087	0.298	-0.113	8	sand to silty sand	17
1.476	73.54	0.2390	0.325	0.075	8	sand to silty sand	18
1.640	75.91	0.2710	0.357	0.035	8	sand to silty sand	18
1.804	79.54	0.2897	0.364	0.073	8	sand to silty sand	19
1.969	83.20	0.2901	0.349	0.140	8	sand to silty sand	20
2.133	86.89	0.3622	0.417	0.155	8	sand to silty sand	21
2.297	88.65	0.3663	0.413	-0.280	8	sand to silty sand	21
2.461	91.01	0.3868	0.425	-0.025	8	sand to silty sand	22
2.625	93.78	0.3946	0.421	0.045	8	sand to silty sand	22
2.789	96.23	0.4030	0.419	0.173	8	sand to silty sand	23
2.953	99.36	0.4153	0.418	0.291	9	sand	19
3.117	101.20	0.4366	0.431	0.378	9	sand	19
3.281	101.92	0.4458	0.437	0.446	9	sand	20
3.445	105.13	0.5369	0.511	0.781	8	sand to silty sand	25
3.609	110.00	0.5436	0.494	0.809	9	sand	21
3.773	100.75	0.5450	0.541	1.112	8	sand to silty sand	24
3.937	118.88	0.6916	0.582	1.801	9	sand	23
4.101	123.60	0.6596	0.534	1.613	9	sand	24
4.265	128.25	1.2180	0.950	1.831	8	sand to silty sand	31
4.429	155.04	2.6190	1.689	0.684	8	sand to silty sand	37
4.593	195.07	2.4516	1.257	9.700	8	sand to silty sand	47
4.757	425.46	2.8232	0.664	15.155	10	gravelly sand to sand	68
4.921	453.19	2.8209	0.622	7.686	10	gravelly sand to sand	72
5.085	487.59	2.7289	0.560	7.538	10	gravelly sand to sand	78
5.249	532.84	2.8366	0.532	4.513	10	gravelly sand to sand	85

CPT-03A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/27/2023 1:08:37 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 5.249 ft

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

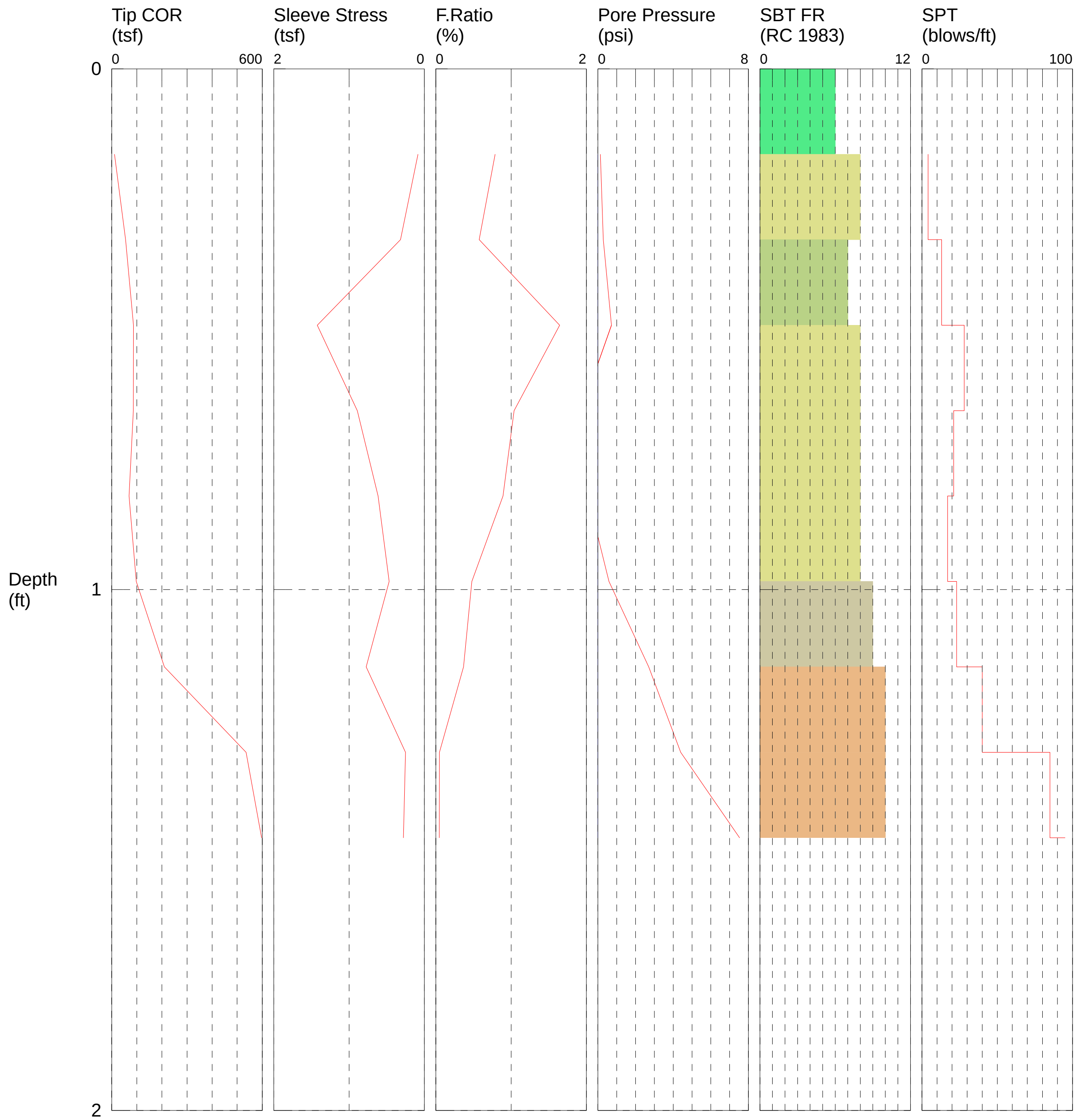
FILE: GNNorthern_AtlasAgro_CPT03A.cpt
TEST DATE / TIME: 7/27/2023 1:08:37 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-03A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	10.68	0.0144	0.135	0.120	6	sandy silt to clayey silt	4
0.328	17.88	0.0592	0.331	0.145	6	sandy silt to clayey silt	7
0.492	25.62	0.0949	0.370	0.230	7	silty sand to sandy silt	8
0.656	38.13	0.1141	0.299	0.323	7	silty sand to sandy silt	12
0.820	53.75	0.1510	0.281	0.433	8	sand to silty sand	13
0.984	64.77	0.1736	0.268	0.556	8	sand to silty sand	16
1.148	69.52	0.2106	0.303	0.579	8	sand to silty sand	17
1.312	69.08	0.2506	0.363	0.033	8	sand to silty sand	17
1.476	70.90	0.2770	0.391	0.020	8	sand to silty sand	17
1.640	73.37	0.3050	0.416	0.190	8	sand to silty sand	18
1.804	77.65	0.3326	0.428	0.230	8	sand to silty sand	19
1.969	83.66	0.3711	0.444	0.403	8	sand to silty sand	20
2.133	88.18	0.4059	0.460	0.511	8	sand to silty sand	21
2.297	92.61	0.4246	0.458	0.739	8	sand to silty sand	22
2.461	97.12	0.4354	0.448	1.002	8	sand to silty sand	23
2.625	100.67	0.4475	0.445	1.210	9	sand	19
2.789	105.37	0.4710	0.447	1.347	9	sand	20
2.953	108.65	0.5029	0.463	1.508	9	sand	21
3.117	111.51	0.4647	0.417	1.974	9	sand	21
3.281	110.10	0.4785	0.435	2.176	9	sand	21
3.445	109.03	0.4828	0.443	1.974	9	sand	21
3.609	111.31	0.8699	0.782	2.051	8	sand to silty sand	27
3.773	113.04	1.4343	1.269	2.402	8	sand to silty sand	27
3.937	115.00	1.9684	1.712	2.965	7	silty sand to sandy silt	37
4.101	118.82	3.2541	2.739	2.141	6	sandy silt to clayey silt	46
4.265	173.02	2.4318	1.405	-0.586	8	sand to silty sand	41
4.429	162.51	2.2852	1.406	2.184	8	sand to silty sand	39
4.593	198.15	2.6462	1.335	4.558	8	sand to silty sand	47
4.757	266.17	2.6606	1.000	9.111	9	sand	51
4.921	576.68	2.6208	0.454	22.595	10	gravelly sand to sand	92
5.085	595.41	2.7289	0.458	25.325	10	gravelly sand to sand	95
5.249	591.82	2.8366	0.479	31.754	10	gravelly sand to sand	94

CPT-04

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 9:50:04 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 1.476 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

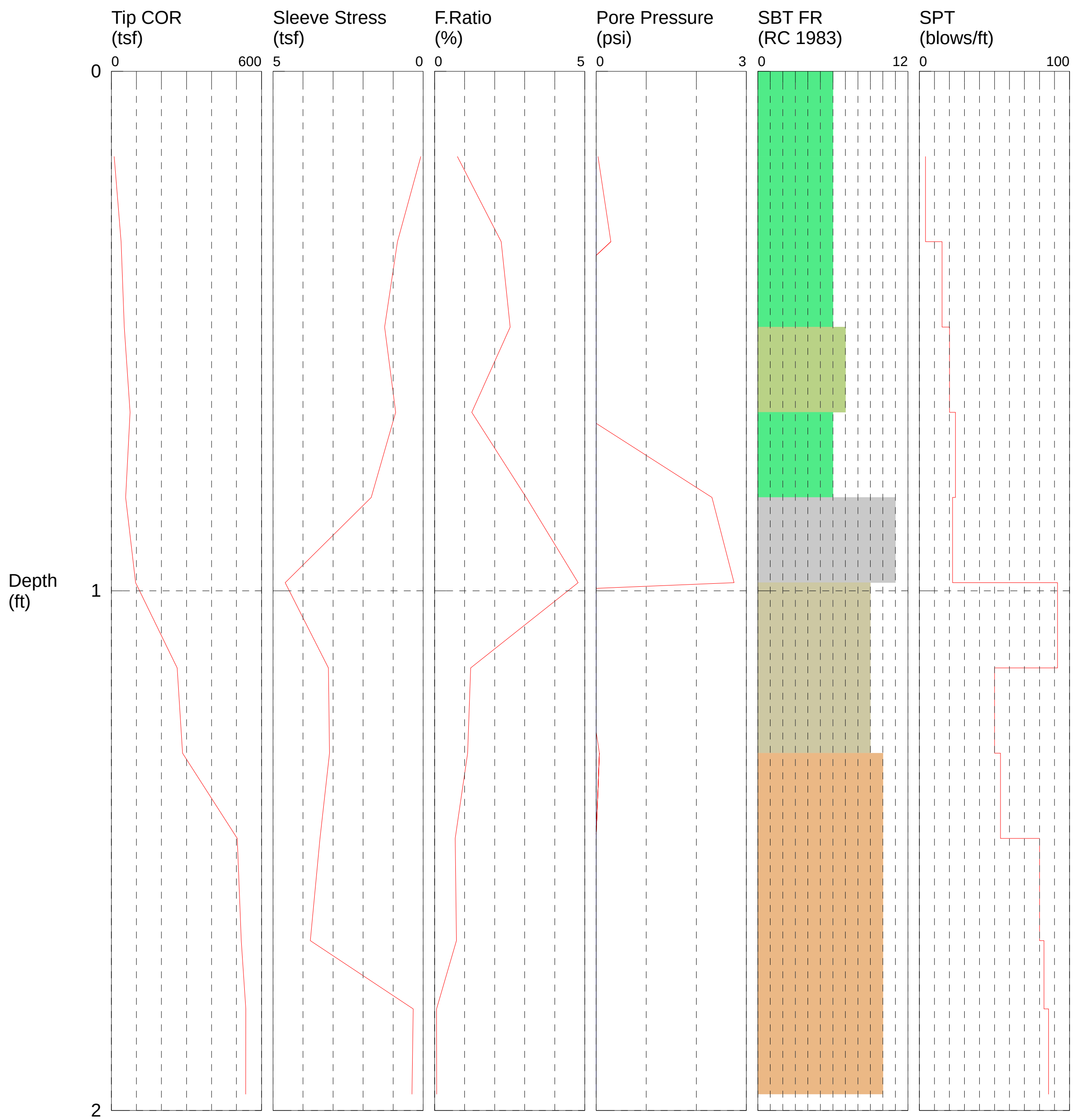
FILE: GNNorthern_AtlasAgro_CPT04.cpt
TEST DATE / TIME: 7/28/2023 9:50:04 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-04
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Soil Behavior Type Zone	UBC-1983	SPT (blows/ft)
0.164	10.75	0.0846	0.787	0.130	6	sandy silt to clayey silt	4
0.328	55.21	0.3172	0.575	0.281	8	sand to silty sand	13
0.492	86.54	1.4231	1.644	0.716	7	silty sand to sandy silt	28
0.656	85.82	0.8907	1.038	-0.589	8	sand to silty sand	21
0.820	69.06	0.6151	0.891	-0.533	8	sand to silty sand	17
0.984	97.70	0.4680	0.479	0.591	8	sand to silty sand	23
1.148	210.04	0.7732	0.368	2.700	9	sand	40
1.312	534.92	0.2506	0.047	4.400	10	gravelly sand to sand	85
1.476	597.11	0.2770	0.046	7.526	10	gravelly sand to sand	95

CPT-04A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 9:56:25 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 1.969 ft

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

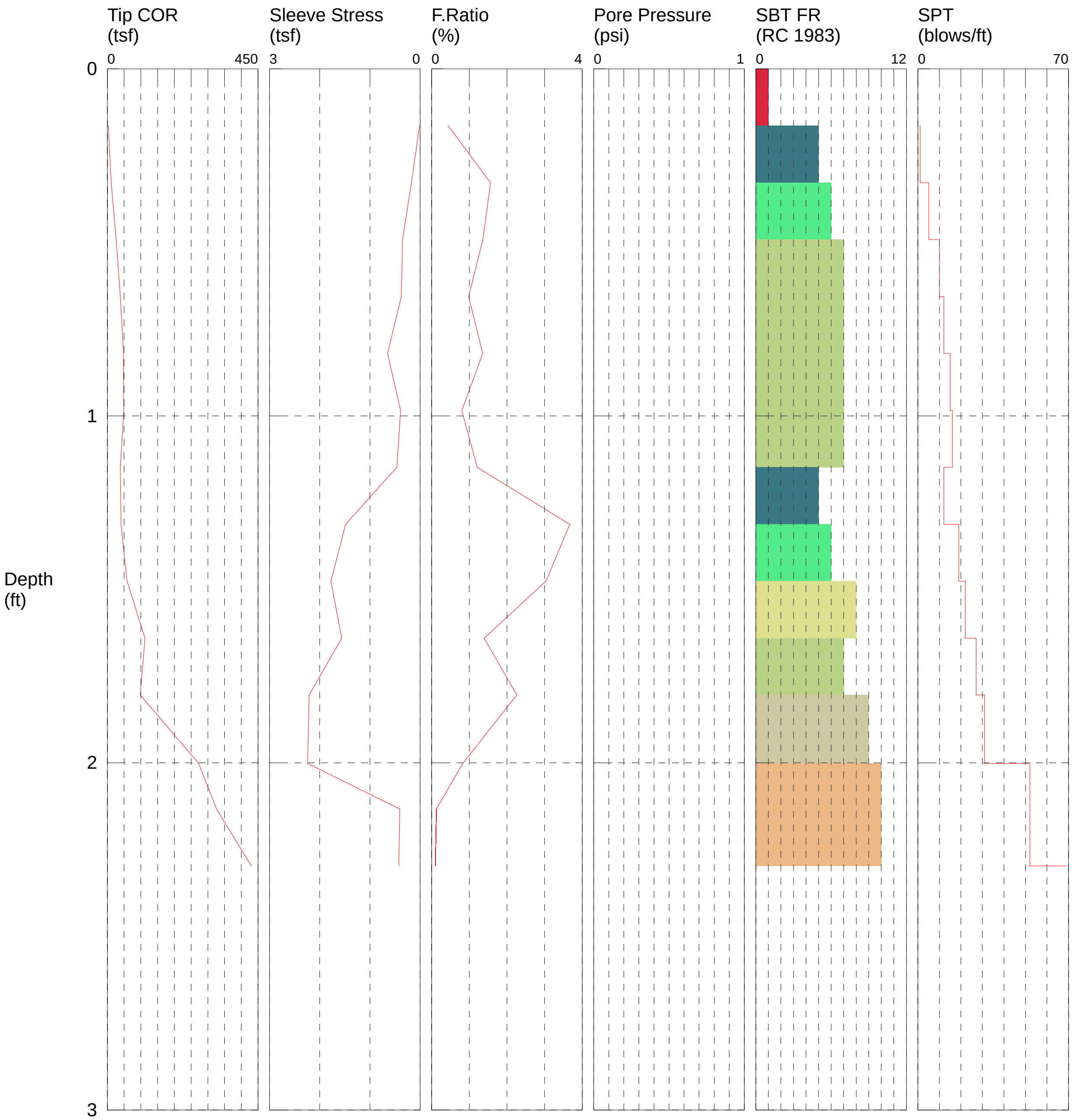
FILE: GNNorthern_AtlasAgro_CPT04A.cpt
TEST DATE / TIME: 7/28/2023 9:56:25 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-04A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Soil Behavior Type Zone	UBC-1983	SPT (blows/ft)
0.164	10.54	0.0801	0.760	0.035	6	sandy silt to clayey silt	4
0.328	38.67	0.8565	2.215	0.293	6	sandy silt to clayey silt	15
0.492	51.10	1.2848	2.514	-0.055	6	sandy silt to clayey silt	20
0.656	74.30	0.9163	1.233	-0.343	7	silty sand to sandy silt	24
0.820	56.73	1.7282	3.046	2.312	6	sandy silt to clayey silt	22
0.984	96.22	4.5982	4.779	2.755	11	very stiff fine grained (*)	92
1.148	262.76	3.1566	1.201	-0.193	9	sand	50
1.312	284.13	3.1209	1.098	0.063	9	sand	54
1.476	503.09	3.4389	0.684	-1.225	10	gravelly sand to sand	80
1.673	519.23	3.7579	0.724	-1.019	10	gravelly sand to sand	83
1.804	537.09	0.3326	0.062	-1.588	10	gravelly sand to sand	86
1.969	536.39	0.3711	0.069	-2.031	10	gravelly sand to sand	86

CPT-05

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 10:15:21 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.297 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

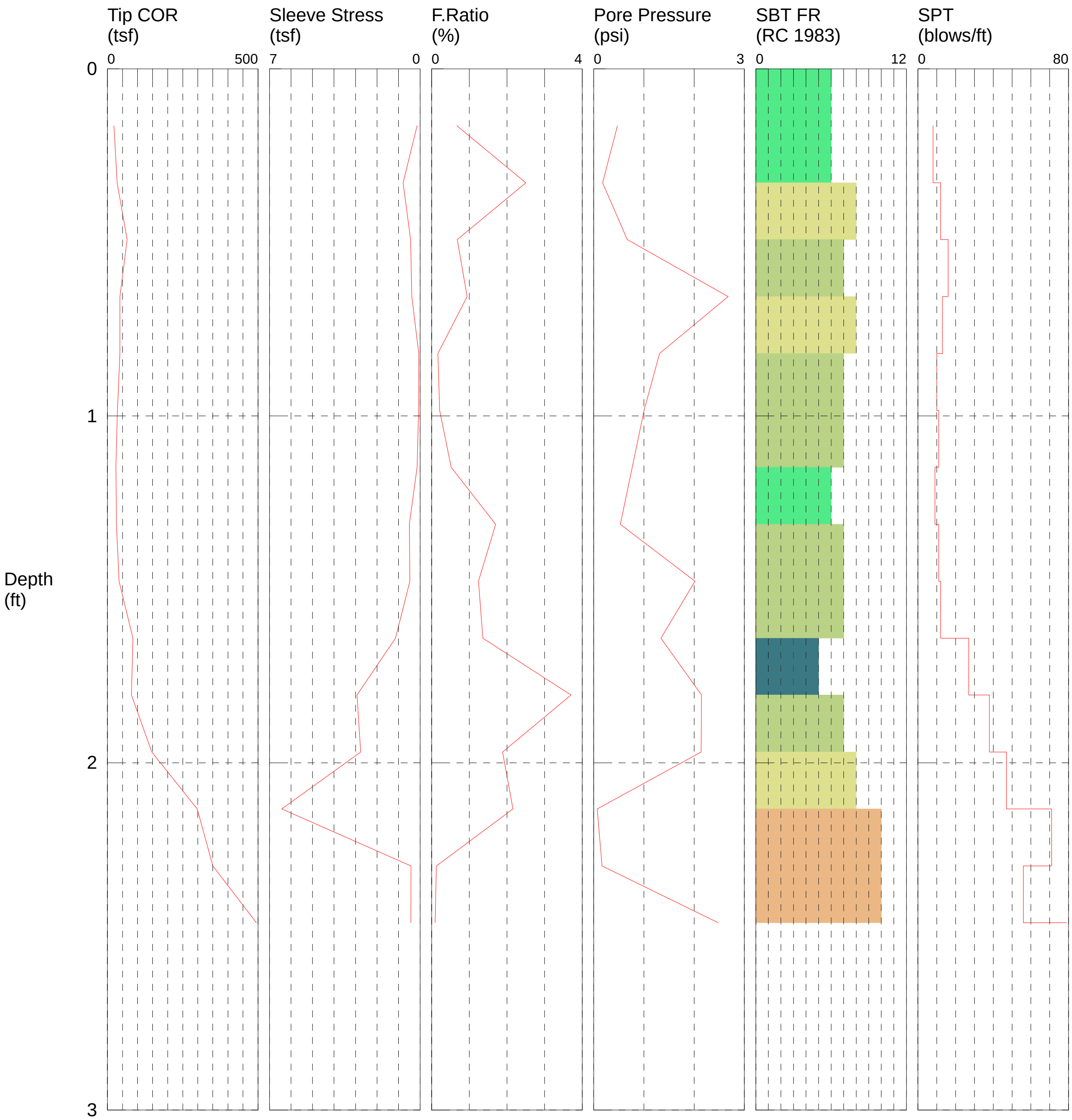
FILE: GNNorthern_AtlasAgro_CPT05.cpt
TEST DATE / TIME: 7/28/2023 10:15:21 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-05
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth	Tip COR	Sleeve Stress	F.Ratio	Pore Pressure	Soil Behavior Type		SPT
ft	(tsf)	(tsf)	(%)	(psi)	Zone	UBC-1983	(blows/ft)
0.164	2.59	0.0115	0.442	-0.030	1	sensitive fine grained	1
0.328	11.17	0.1743	1.561	-0.088	5	clayey silt to silty clay	5
0.492	25.82	0.3515	1.362	-0.200	6	sandy silt to clayey silt	10
0.656	38.25	0.3755	0.982	-0.423	7	silty sand to sandy silt	12
0.820	47.94	0.6498	1.355	-0.543	7	silty sand to sandy silt	15
0.984	48.74	0.3898	0.800	-0.296	7	silty sand to sandy silt	16
1.148	38.40	0.4641	1.209	-0.170	7	silty sand to sandy silt	12
1.312	40.54	1.4873	3.669	-0.158	5	clayey silt to silty clay	19
1.476	58.57	1.7793	3.038	-0.175	6	sandy silt to clayey silt	22
1.640	112.20	1.5618	1.392	-0.972	8	sand to silty sand	27
1.804	97.85	2.2108	2.259	-1.686	7	silty sand to sandy silt	31
2.001	272.67	2.2417	0.822	-1.833	9	sand	52
2.133	325.93	0.4059	0.125	-1.610	10	gravelly sand to sand	52
2.297	430.03	0.4246	0.099	-1.235	10	gravelly sand to sand	69

CPT-05A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 10:24:41 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.461 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

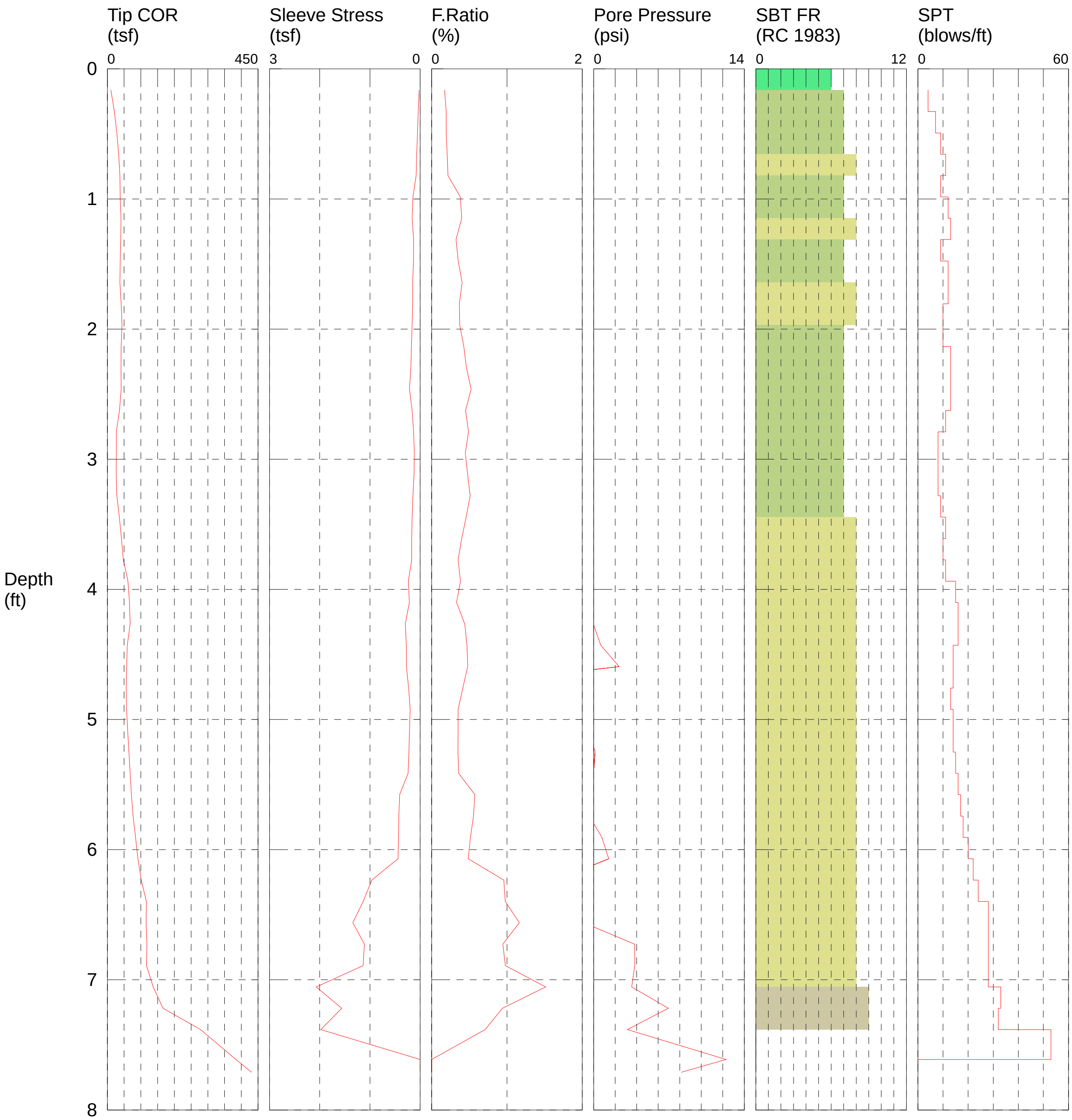
FILE: GNNorthern_AtlasAgro_CPT05A.cpt
TEST DATE / TIME: 7/28/2023 10:24:41 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-05A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Soil Behavior Type Zone	UBC-1983	SPT (blows/ft)
0.164	21.33	0.1429	0.670	0.471	6	sandy silt to clayey silt	8
0.328	31.65	0.7918	2.502	0.175	6	sandy silt to clayey silt	12
0.492	65.30	0.4445	0.681	0.666	8	sand to silty sand	16
0.656	40.98	0.3864	0.943	2.675	7	silty sand to sandy silt	13
0.820	41.29	0.0669	0.162	1.312	8	sand to silty sand	10
0.984	33.15	0.0703	0.212	1.002	7	silty sand to sandy silt	11
1.148	28.15	0.1459	0.518	0.766	7	silty sand to sandy silt	9
1.312	29.64	0.5039	1.700	0.528	6	sandy silt to clayey silt	11
1.476	38.27	0.4759	1.244	2.019	7	silty sand to sandy silt	12
1.640	84.21	1.1470	1.362	1.340	7	silty sand to sandy silt	27
1.804	79.30	2.9362	3.703	2.146	5	clayey silt to silty clay	38
1.969	146.73	2.7644	1.884	2.136	7	silty sand to sandy silt	47
2.133	298.07	6.4358	2.159	0.070	8	sand to silty sand	71
2.297	350.26	0.4246	0.121	0.165	10	gravelly sand to sand	56
2.461	494.19	0.4354	0.088	2.477	10	gravelly sand to sand	79

CPT-06

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 10:42:26 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 7.710 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

FILE: GNNorthern_AtlasAgro_CPT06.cpt
TEST DATE / TIME: 7/28/2023 10:42:26 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-06
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

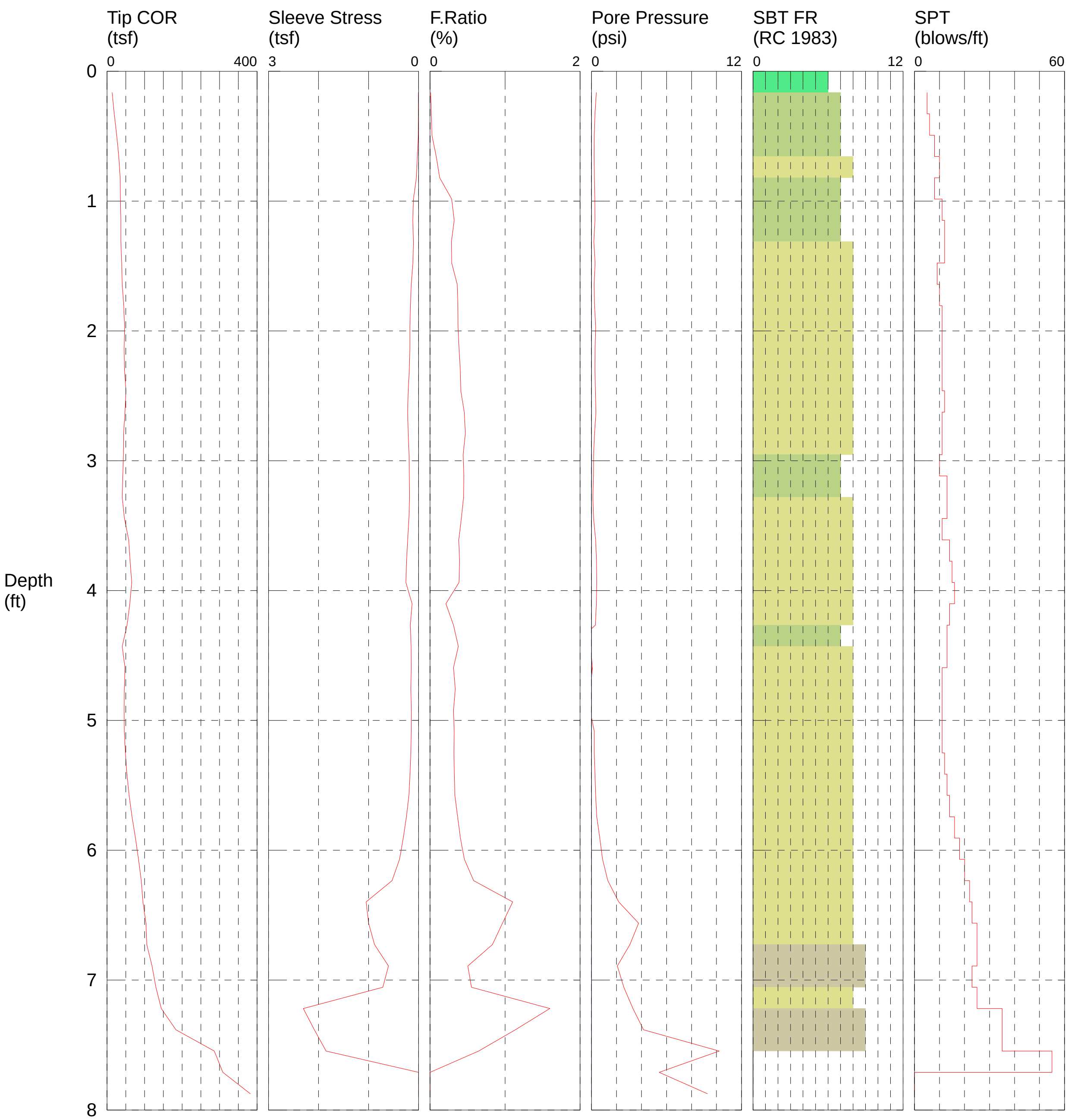
Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	10.28	0.0175	0.170	-0.210	6	sandy silt to clayey silt	4
0.328	20.46	0.0391	0.191	-0.381	7	silty sand to sandy silt	7
0.492	27.86	0.0540	0.194	-0.518	7	silty sand to sandy silt	9
0.656	33.34	0.0684	0.205	-0.594	7	silty sand to sandy silt	11
0.820	36.86	0.0795	0.216	-0.631	8	sand to silty sand	9
0.984	37.93	0.1445	0.381	-0.579	7	silty sand to sandy silt	12
1.148	40.35	0.1607	0.398	-0.561	7	silty sand to sandy silt	13
1.312	39.53	0.1280	0.324	-0.406	8	sand to silty sand	9
1.476	37.84	0.1337	0.353	-0.446	7	silty sand to sandy silt	12
1.640	37.03	0.1500	0.405	-0.646	7	silty sand to sandy silt	12
1.804	40.75	0.1496	0.367	-0.759	8	sand to silty sand	10
1.969	43.55	0.1622	0.372	-0.821	8	sand to silty sand	10
2.133	40.89	0.1744	0.426	-0.791	7	silty sand to sandy silt	13
2.297	40.52	0.1870	0.462	-0.784	7	silty sand to sandy silt	13
2.461	40.76	0.2136	0.524	-0.766	7	silty sand to sandy silt	13
2.625	35.95	0.1614	0.449	-0.641	7	silty sand to sandy silt	11
2.789	26.31	0.1287	0.489	-0.488	7	silty sand to sandy silt	8
2.953	26.29	0.1173	0.446	-0.561	7	silty sand to sandy silt	8
3.117	25.76	0.1230	0.478	-0.584	7	silty sand to sandy silt	8
3.281	28.12	0.1435	0.510	-0.584	7	silty sand to sandy silt	9
3.445	35.40	0.1619	0.457	-0.626	7	silty sand to sandy silt	11
3.609	41.85	0.1669	0.399	-0.569	8	sand to silty sand	10
3.773	47.63	0.1675	0.352	-0.591	8	sand to silty sand	11
3.937	61.25	0.2344	0.383	-0.666	8	sand to silty sand	15
4.101	65.52	0.2161	0.330	-0.609	8	sand to silty sand	16
4.265	67.77	0.2976	0.439	-0.035	8	sand to silty sand	16
4.429	58.93	0.2766	0.469	0.656	8	sand to silty sand	14
4.593	57.19	0.2733	0.478	2.349	8	sand to silty sand	14
4.757	55.66	0.2293	0.412	-0.381	8	sand to silty sand	13
4.921	57.02	0.2005	0.352	-0.443	8	sand to silty sand	14
5.085	60.42	0.2119	0.351	-0.413	8	sand to silty sand	14
5.249	63.99	0.2236	0.350	0.123	8	sand to silty sand	15
5.413	67.67	0.2416	0.357	-0.581	8	sand to silty sand	16
5.577	71.46	0.4101	0.574	-0.508	8	sand to silty sand	17
5.741	76.62	0.4255	0.555	-0.401	8	sand to silty sand	18

5.906	83.77	0.4308	0.514	0.746	8	sand to silty sand	20
6.070	91.28	0.4419	0.484	1.385	8	sand to silty sand	22
6.234	100.64	0.9640	0.958	-0.548	8	sand to silty sand	24
6.398	116.13	1.1343	0.977	-1.262	8	sand to silty sand	28
6.562	115.14	1.3402	1.164	-0.937	8	sand to silty sand	28
6.726	117.67	1.1116	0.945	3.787	8	sand to silty sand	28
6.890	116.47	1.1392	0.978	3.807	8	sand to silty sand	28
7.054	136.82	2.0710	1.514	3.521	8	sand to silty sand	33
7.218	166.13	1.5620	0.940	6.920	9	sand	32
7.382	278.22	1.9775	0.711	3.126	9	sand	53
7.612	383.60	0.0000	0.000	12.297	0	<out of range>	0
7.710	430.84	0.0000	0.000	8.152	0	<out of range>	0

CPT-06A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 10:55:42 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 7.874 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

FILE: GNNorthern_AtlasAgro_CPT06A.cpt
TEST DATE / TIME: 7/28/2023 10:55:42 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-06A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

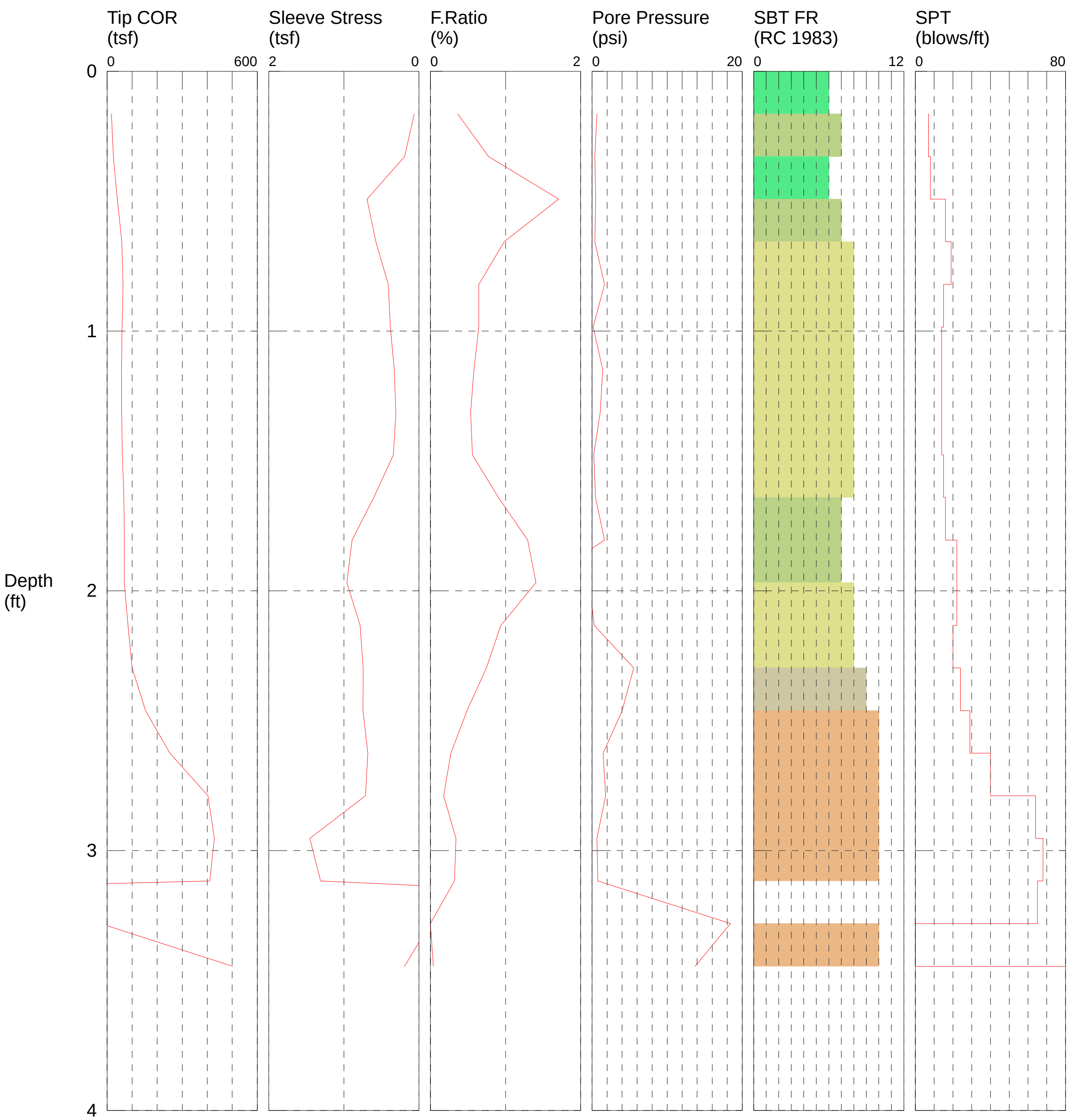
Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	13.59	0.0013	0.009	0.391	6	sandy silt to clayey silt	5
0.328	19.02	0.0031	0.016	0.270	7	silty sand to sandy silt	6
0.492	25.42	0.0062	0.024	0.210	7	silty sand to sandy silt	8
0.656	31.06	0.0254	0.082	0.205	7	silty sand to sandy silt	10
0.820	34.88	0.0445	0.128	0.230	8	sand to silty sand	8
0.984	35.52	0.1023	0.288	0.258	7	silty sand to sandy silt	11
1.148	36.41	0.1173	0.322	0.263	7	silty sand to sandy silt	12
1.312	36.61	0.1044	0.285	0.185	7	silty sand to sandy silt	12
1.476	39.06	0.1125	0.288	0.286	8	sand to silty sand	9
1.640	40.41	0.1464	0.362	0.205	8	sand to silty sand	10
1.804	44.38	0.1644	0.370	0.240	8	sand to silty sand	11
1.969	46.76	0.1743	0.373	0.323	8	sand to silty sand	11
2.133	45.39	0.1755	0.387	0.286	8	sand to silty sand	11
2.297	46.33	0.1859	0.401	0.270	8	sand to silty sand	11
2.461	50.45	0.2062	0.409	0.301	8	sand to silty sand	12
2.625	47.75	0.2176	0.456	0.353	8	sand to silty sand	11
2.789	43.96	0.2071	0.471	0.238	8	sand to silty sand	11
2.953	43.49	0.1919	0.441	0.160	8	sand to silty sand	10
3.117	41.58	0.1870	0.450	0.143	7	silty sand to sandy silt	13
3.281	40.07	0.1791	0.447	0.108	7	silty sand to sandy silt	13
3.445	46.17	0.1929	0.418	0.155	8	sand to silty sand	11
3.609	57.60	0.2197	0.381	0.336	8	sand to silty sand	14
3.773	61.44	0.2415	0.393	0.393	8	sand to silty sand	15
3.937	65.50	0.2534	0.387	0.411	8	sand to silty sand	16
4.101	60.56	0.1281	0.212	0.383	8	sand to silty sand	14
4.265	53.24	0.1657	0.311	0.306	8	sand to silty sand	13
4.429	40.04	0.1506	0.376	-0.063	7	silty sand to sandy silt	13
4.593	47.56	0.1480	0.311	0.063	8	sand to silty sand	11
4.757	45.67	0.1531	0.335	-0.043	8	sand to silty sand	11
4.921	45.32	0.1420	0.313	-0.115	8	sand to silty sand	11
5.085	46.00	0.1475	0.321	0.220	8	sand to silty sand	11
5.249	48.72	0.1545	0.317	0.215	8	sand to silty sand	12
5.413	52.77	0.1705	0.323	0.281	8	sand to silty sand	13
5.577	58.94	0.1939	0.329	0.321	8	sand to silty sand	14
5.741	66.68	0.2444	0.367	0.413	8	sand to silty sand	16

5.906	75.62	0.3057	0.404	0.659	8	sand to silty sand	18
6.070	83.87	0.3827	0.456	0.887	8	sand to silty sand	20
6.234	91.14	0.5303	0.582	1.295	8	sand to silty sand	22
6.398	95.38	1.0499	1.101	2.174	8	sand to silty sand	23
6.562	103.62	0.9994	0.964	3.767	8	sand to silty sand	25
6.726	105.90	0.8804	0.831	3.060	8	sand to silty sand	25
6.890	119.82	0.6022	0.503	2.059	9	sand	23
7.054	130.05	0.7164	0.551	2.575	9	sand	25
7.218	144.37	2.3060	1.597	3.316	8	sand to silty sand	35
7.382	183.58	2.0853	1.136	4.160	9	sand	35
7.546	285.83	1.8505	0.647	10.218	9	sand	55
7.710	308.73	0.0000	0.000	5.407	0	<out of range>	0
7.874	381.98	0.0000	0.000	9.274	0	<out of range>	0

CPT-07

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 11:14:32 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 3.445 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

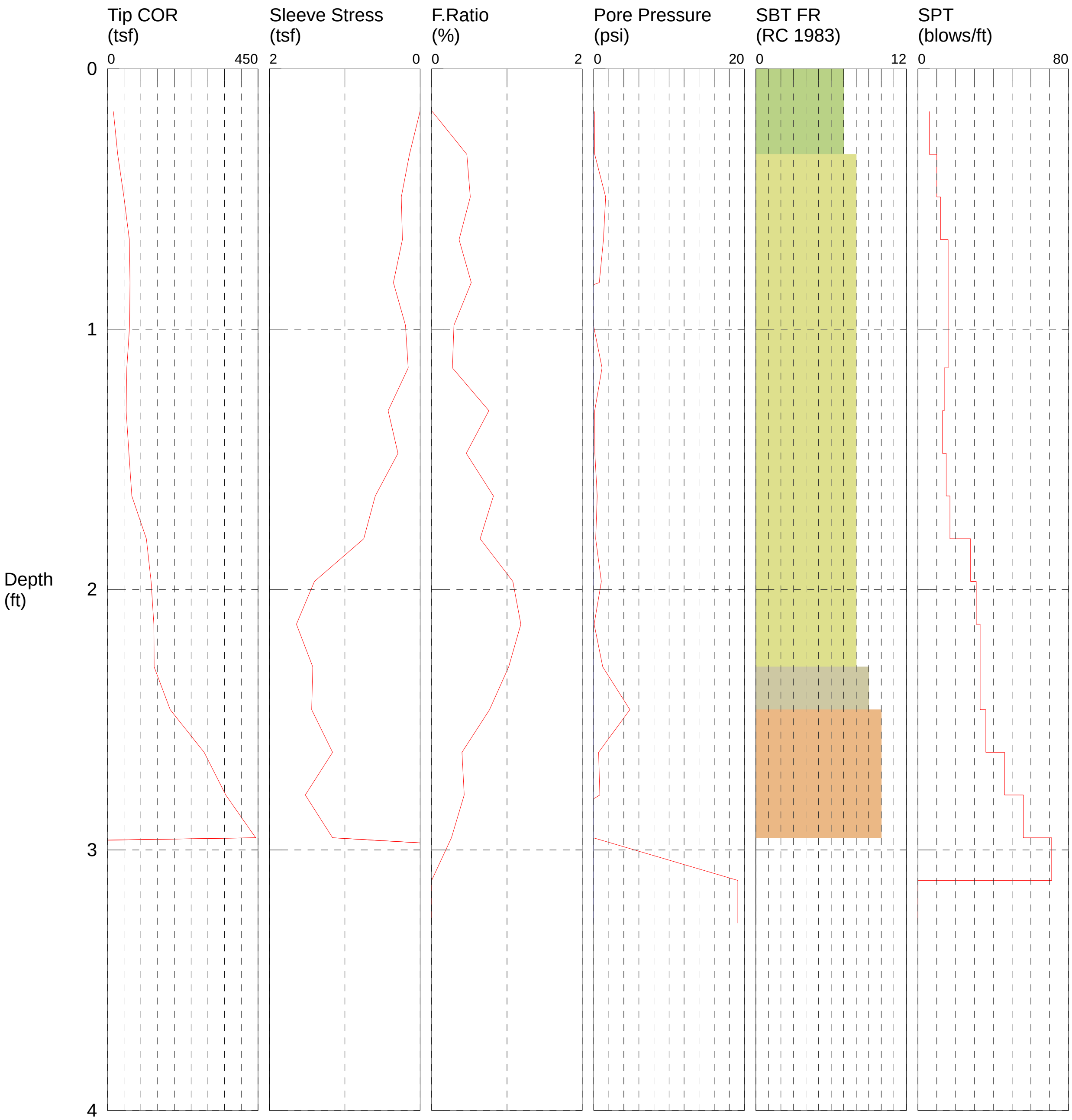
FILE: GNNorthern_AtlasAgro_CPT07.cpt
TEST DATE / TIME: 7/28/2023 11:14:32 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-07
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	17.22	0.0624	0.363	0.639	6	sandy silt to clayey silt	7
0.328	24.73	0.1917	0.775	0.371	7	silty sand to sandy silt	8
0.492	40.50	0.6912	1.707	0.481	6	sandy silt to clayey silt	16
0.656	58.45	0.5733	0.981	0.368	7	silty sand to sandy silt	19
0.820	63.72	0.4093	0.642	1.660	8	sand to silty sand	15
0.984	59.33	0.3820	0.644	0.138	8	sand to silty sand	14
1.148	57.13	0.3304	0.578	1.418	8	sand to silty sand	14
1.312	57.44	0.3076	0.536	1.074	8	sand to silty sand	14
1.476	60.95	0.3407	0.559	0.220	8	sand to silty sand	15
1.640	66.65	0.6028	0.905	0.456	8	sand to silty sand	16
1.804	68.79	0.8906	1.295	1.655	7	silty sand to sandy silt	22
1.969	68.29	0.9599	1.406	-0.398	7	silty sand to sandy silt	22
2.133	83.43	0.7831	0.939	0.286	8	sand to silty sand	20
2.297	99.65	0.7431	0.746	5.537	8	sand to silty sand	24
2.461	153.37	0.7459	0.486	4.002	9	sand	29
2.625	250.43	0.6810	0.272	1.470	10	gravelly sand to sand	40
2.789	402.69	0.7122	0.177	1.788	10	gravelly sand to sand	64
2.953	428.32	1.4536	0.339	0.636	10	gravelly sand to sand	68
3.117	410.16	1.3096	0.319	0.766	10	gravelly sand to sand	65
3.281	-26.26	-0.1520	0.000	18.440	0	<out of range>	0
3.445	501.95	0.1929	0.038	13.699	10	gravelly sand to sand	80

CPT-07A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 11:22:11 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 3.281 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

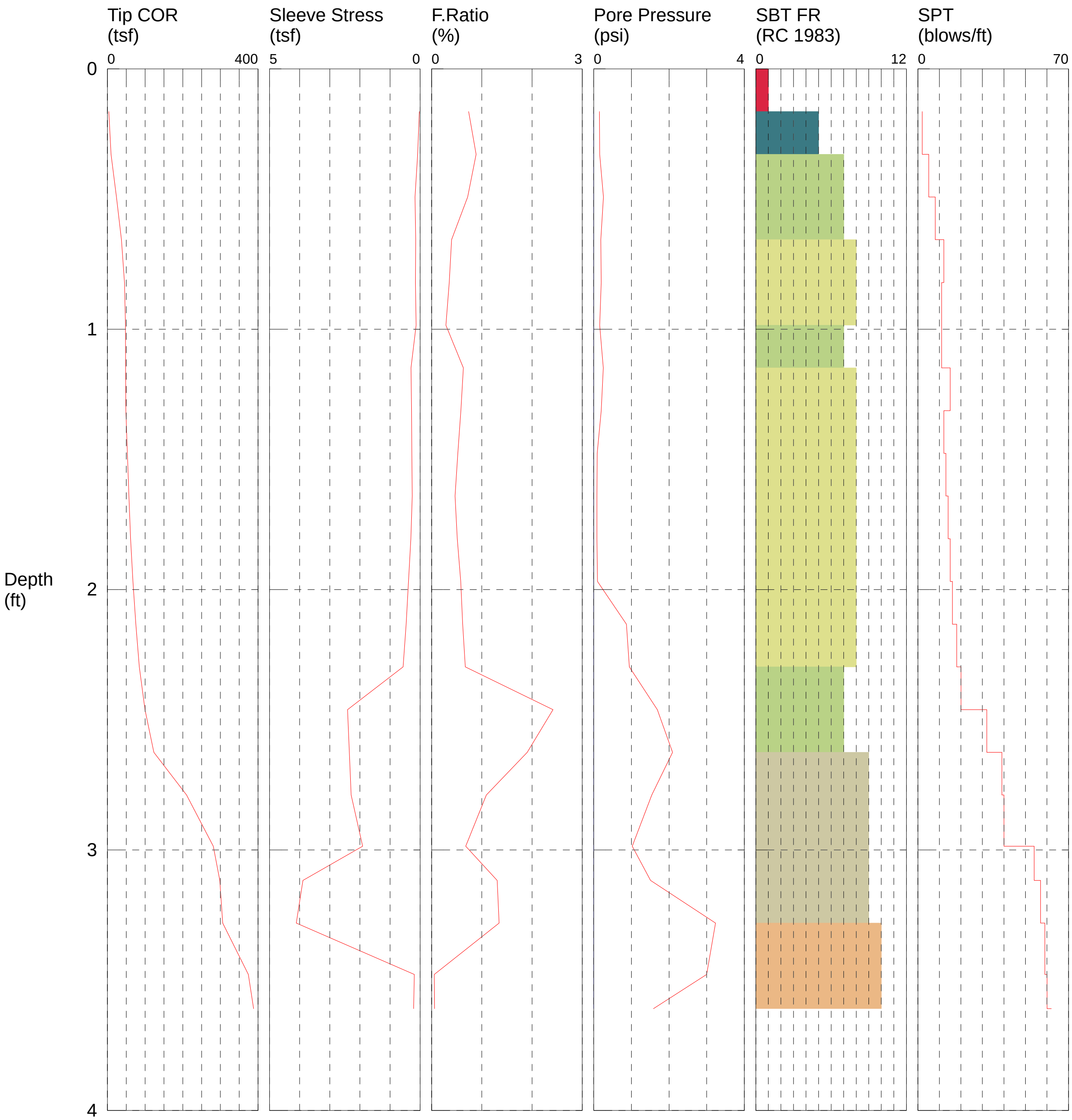
FILE: GNNorthern_AtlasAgro_CPT07A.cpt
TEST DATE / TIME: 7/28/2023 11:22:11 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-07A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	17.56	0.0016	0.009	0.085	7	silty sand to sandy silt	6
0.328	30.49	0.1421	0.466	0.130	7	silty sand to sandy silt	10
0.492	48.87	0.2507	0.513	1.573	8	sand to silty sand	12
0.656	65.23	0.2366	0.363	1.282	8	sand to silty sand	16
0.820	67.44	0.3551	0.527	0.729	8	sand to silty sand	16
0.984	66.10	0.1954	0.296	-0.040	8	sand to silty sand	16
1.148	57.54	0.1586	0.276	1.102	8	sand to silty sand	14
1.312	55.93	0.4248	0.760	0.128	8	sand to silty sand	13
1.476	63.96	0.2948	0.461	0.140	8	sand to silty sand	15
1.640	72.72	0.5971	0.821	0.451	8	sand to silty sand	17
1.804	116.16	0.7489	0.645	0.250	8	sand to silty sand	28
1.969	130.25	1.4046	1.078	1.004	8	sand to silty sand	31
2.133	138.84	1.6440	1.184	0.040	8	sand to silty sand	33
2.297	139.26	1.4256	1.024	1.187	8	sand to silty sand	33
2.461	187.53	1.4414	0.769	4.806	9	sand	36
2.625	288.99	1.1623	0.402	0.641	10	gravelly sand to sand	46
2.789	353.30	1.5259	0.432	0.796	10	gravelly sand to sand	56
2.953	443.06	1.1629	0.262	-0.075	10	gravelly sand to sand	71
3.117	-25.90	-0.1604	0.000	19.134	0	<out of range>	0
3.281	-25.90	-0.1604	0.000	19.134	0	<out of range>	0

CPT-08

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 11:40:42 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 3.609 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

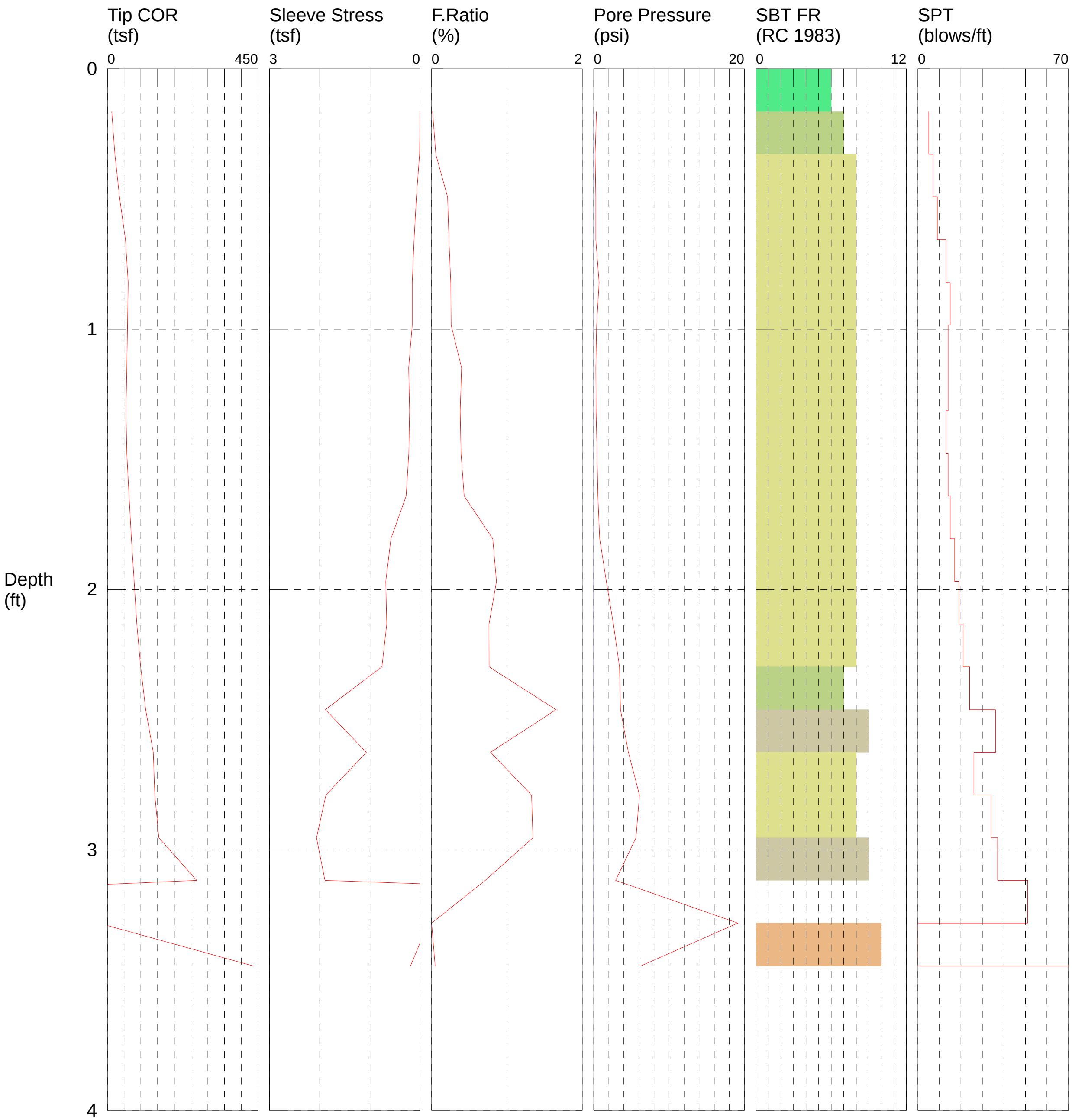
FILE: GNNorthern_AtlasAgro_CPT08.cpt
TEST DATE / TIME: 7/28/2023 11:40:42 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-08
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Soil Behavior Type Zone	UBC-1983	SPT (blows/ft)
0.164	3.44	0.0253	0.737	0.150	1	sensitive fine grained	2
0.328	9.59	0.0849	0.886	0.155	5	clayey silt to silty clay	5
0.492	23.55	0.1688	0.717	0.258	7	silty sand to sandy silt	8
0.656	37.18	0.1472	0.396	0.188	7	silty sand to sandy silt	12
0.820	45.24	0.1580	0.349	0.198	8	sand to silty sand	11
0.984	47.40	0.1343	0.283	0.158	8	sand to silty sand	11
1.148	48.13	0.3036	0.631	0.250	7	silty sand to sandy silt	15
1.312	48.77	0.2835	0.581	0.195	8	sand to silty sand	12
1.476	52.78	0.2742	0.519	0.088	8	sand to silty sand	13
1.640	57.09	0.2647	0.464	0.083	8	sand to silty sand	14
1.804	61.23	0.3107	0.508	0.083	8	sand to silty sand	15
1.969	67.35	0.3886	0.577	0.098	8	sand to silty sand	16
2.133	75.15	0.4638	0.617	0.869	8	sand to silty sand	18
2.297	84.77	0.5667	0.669	0.944	8	sand to silty sand	20
2.461	99.71	2.4119	2.419	1.688	7	silty sand to sandy silt	32
2.625	123.33	2.3492	1.905	2.091	7	silty sand to sandy silt	39
2.789	210.02	2.2923	1.091	1.540	9	sand	40
2.986	281.03	1.9105	0.680	1.022	9	sand	54
3.117	298.46	3.8909	1.304	1.508	9	sand	57
3.281	306.23	4.1132	1.343	3.233	9	sand	59
3.478	374.25	0.1929	0.052	3.000	10	gravelly sand to sand	60
3.609	387.98	0.2197	0.057	1.585	10	gravelly sand to sand	62

CPT-08A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 11:53:09 AM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 3.445 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

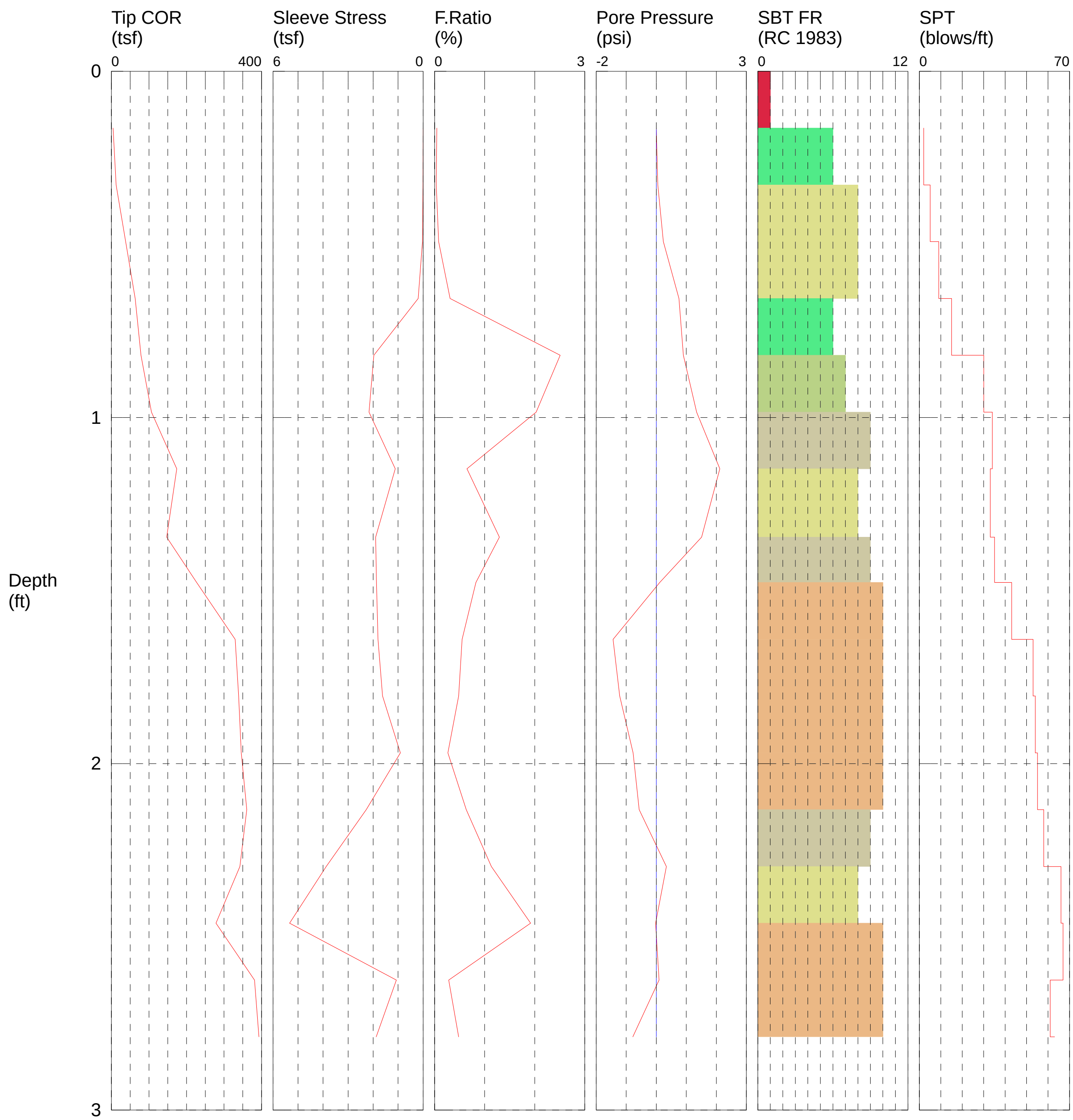
FILE: GNNorthern_AtlasAgro_CPT08A.cpt
TEST DATE / TIME: 7/28/2023 11:53:09 AM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-08A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	12.83	0.0016	0.013	0.351	6	sandy silt to clayey silt	5
0.328	21.95	0.0121	0.055	0.168	7	silty sand to sandy silt	7
0.492	35.73	0.0749	0.210	0.263	8	sand to silty sand	9
0.656	53.54	0.1223	0.228	0.270	8	sand to silty sand	13
0.820	61.62	0.1556	0.253	0.711	8	sand to silty sand	15
0.984	59.90	0.1554	0.259	0.383	8	sand to silty sand	14
1.148	57.59	0.2290	0.398	0.275	8	sand to silty sand	14
1.312	55.36	0.2095	0.378	0.308	8	sand to silty sand	13
1.476	57.74	0.2253	0.390	0.431	8	sand to silty sand	14
1.640	64.49	0.2792	0.433	0.558	8	sand to silty sand	15
1.804	71.55	0.5810	0.812	0.784	8	sand to silty sand	17
1.969	79.79	0.6865	0.860	1.678	8	sand to silty sand	19
2.133	87.53	0.6653	0.760	2.607	8	sand to silty sand	21
2.297	99.52	0.7604	0.764	3.419	8	sand to silty sand	24
2.461	114.31	1.8886	1.652	3.536	7	silty sand to sandy silt	36
2.625	136.96	1.0712	0.782	4.603	9	sand	26
2.789	141.48	1.8762	1.326	6.078	8	sand to silty sand	34
2.953	153.58	2.0663	1.345	5.597	8	sand to silty sand	37
3.117	266.80	1.8982	0.711	2.895	9	sand	51
3.281	-26.19	-0.1627	0.000	19.122	0	<out of range>	0
3.445	436.10	0.1929	0.044	6.229	10	gravelly sand to sand	70

CPT-09

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 12:05:31 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.789 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

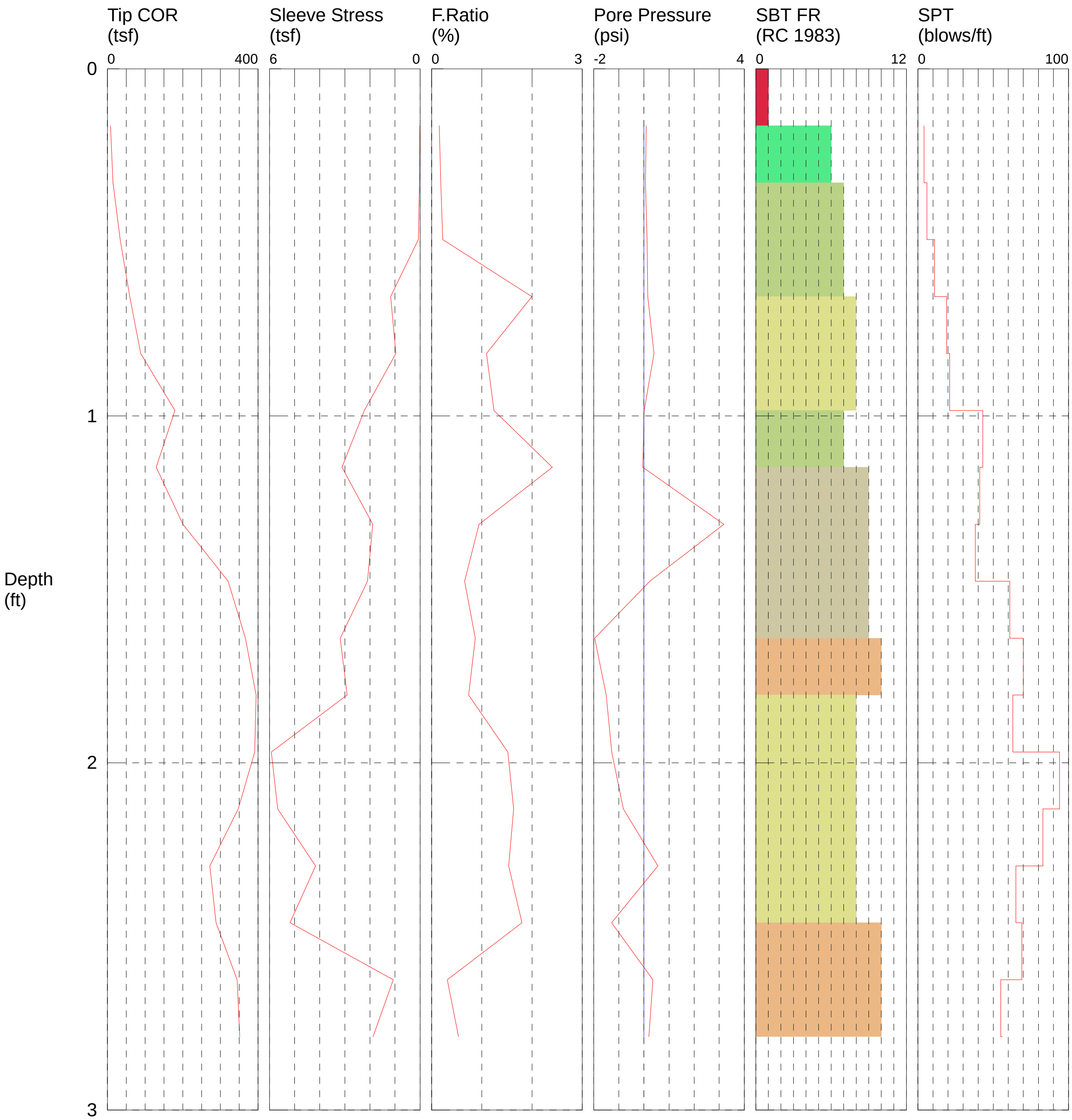
FILE: GNNorthern_AtlasAgro_CPT09.cpt
TEST DATE / TIME: 7/28/2023 12:05:31 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-09
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	4.36	0.0019	0.045	0.003	1	sensitive fine grained	2
0.328	12.17	0.0039	0.032	0.050	6	sandy silt to clayey silt	5
0.492	37.67	0.0294	0.078	0.235	8	sand to silty sand	9
0.656	63.34	0.1959	0.309	0.751	8	sand to silty sand	15
0.820	78.62	1.9723	2.509	0.902	6	sandy silt to clayey silt	30
0.984	106.71	2.1659	2.030	1.345	7	silty sand to sandy silt	34
1.148	173.78	1.1192	0.644	2.116	9	sand	33
1.345	147.10	1.9012	1.292	1.510	8	sand to silty sand	35
1.476	226.96	1.8694	0.824	0.118	9	sand	43
1.640	329.70	1.8039	0.547	-1.440	10	gravelly sand to sand	53
1.804	338.94	1.6226	0.479	-1.222	10	gravelly sand to sand	54
1.969	345.60	0.9115	0.264	-0.774	10	gravelly sand to sand	55
2.133	360.47	2.2741	0.631	-0.569	10	gravelly sand to sand	58
2.297	342.02	3.8798	1.134	0.336	9	sand	66
2.461	278.49	5.3428	1.918	-0.025	8	sand to silty sand	67
2.625	381.38	1.0712	0.281	0.093	10	gravelly sand to sand	61
2.789	392.98	1.8762	0.477	-0.786	10	gravelly sand to sand	63

CPT-09A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 12:14:55 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.789 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

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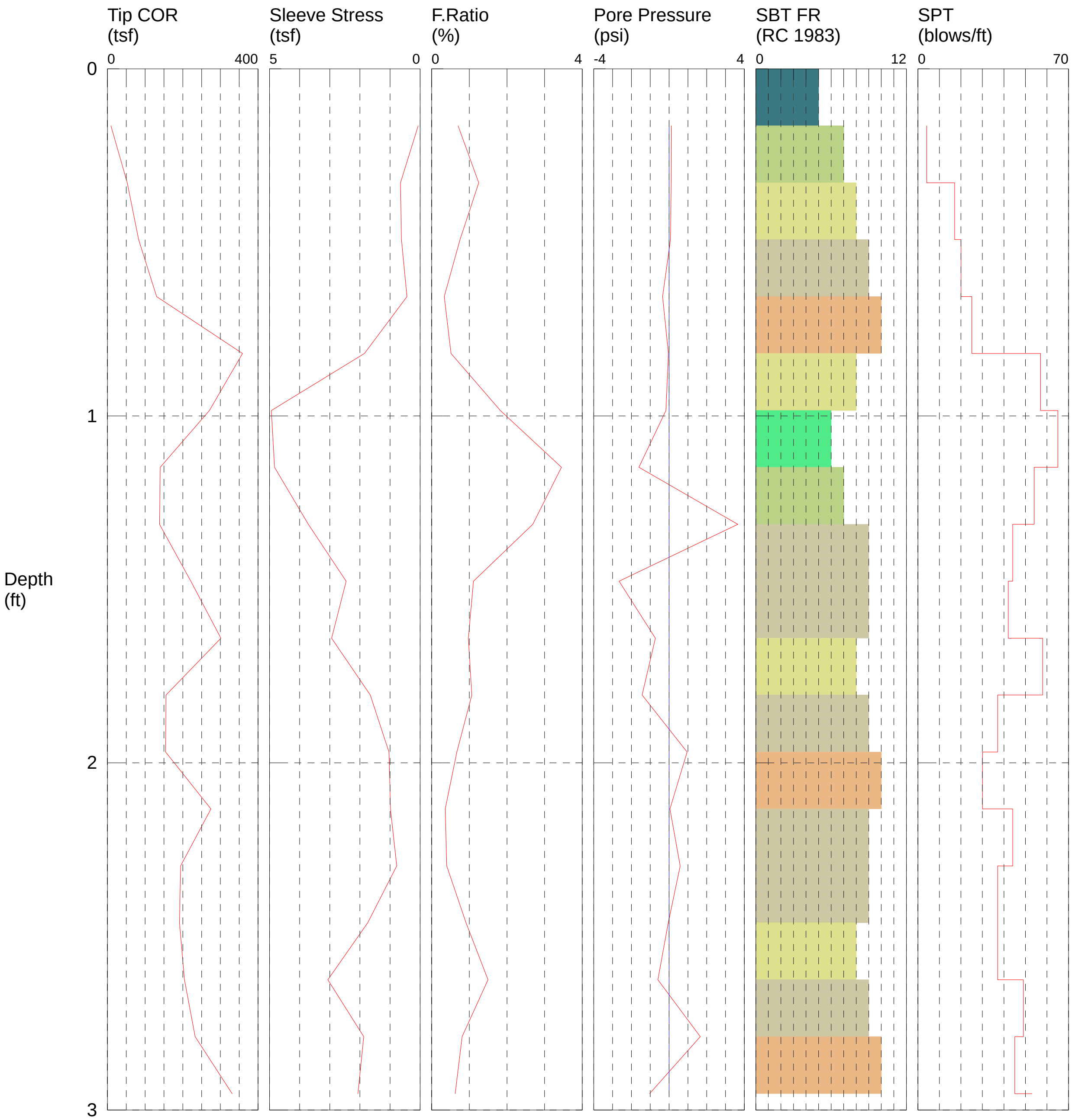
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-09A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	7.98	0.0118	0.148	0.088	1	sensitive fine grained	4
0.328	14.41	0.0263	0.183	0.058	6	sandy silt to clayey silt	6
0.492	33.85	0.0747	0.221	0.120	7	silty sand to sandy silt	11
0.656	59.12	1.1797	1.996	0.153	7	silty sand to sandy silt	19
0.820	88.46	0.9667	1.093	0.403	8	sand to silty sand	21
0.984	179.11	2.2268	1.243	0.005	8	sand to silty sand	43
1.148	129.57	3.1160	2.405	-0.050	7	silty sand to sandy silt	41
1.312	200.52	1.8910	0.943	3.183	9	sand	38
1.476	320.51	2.0980	0.655	0.235	9	sand	61
1.640	366.50	3.1843	0.869	-1.964	9	sand	70
1.804	394.83	2.9061	0.736	-1.505	10	gravelly sand to sand	63
1.969	391.04	5.9290	1.516	-1.287	8	sand to silty sand	94
2.133	347.37	5.6781	1.635	-0.824	8	sand to silty sand	83
2.297	271.71	4.1677	1.534	0.553	8	sand to silty sand	65
2.461	288.41	5.1867	1.798	-1.290	8	sand to silty sand	69
2.625	344.60	1.0712	0.311	0.356	10	gravelly sand to sand	55
2.789	351.58	1.8762	0.534	0.193	10	gravelly sand to sand	56

CPT-10

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 12:30:06 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 2.953 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

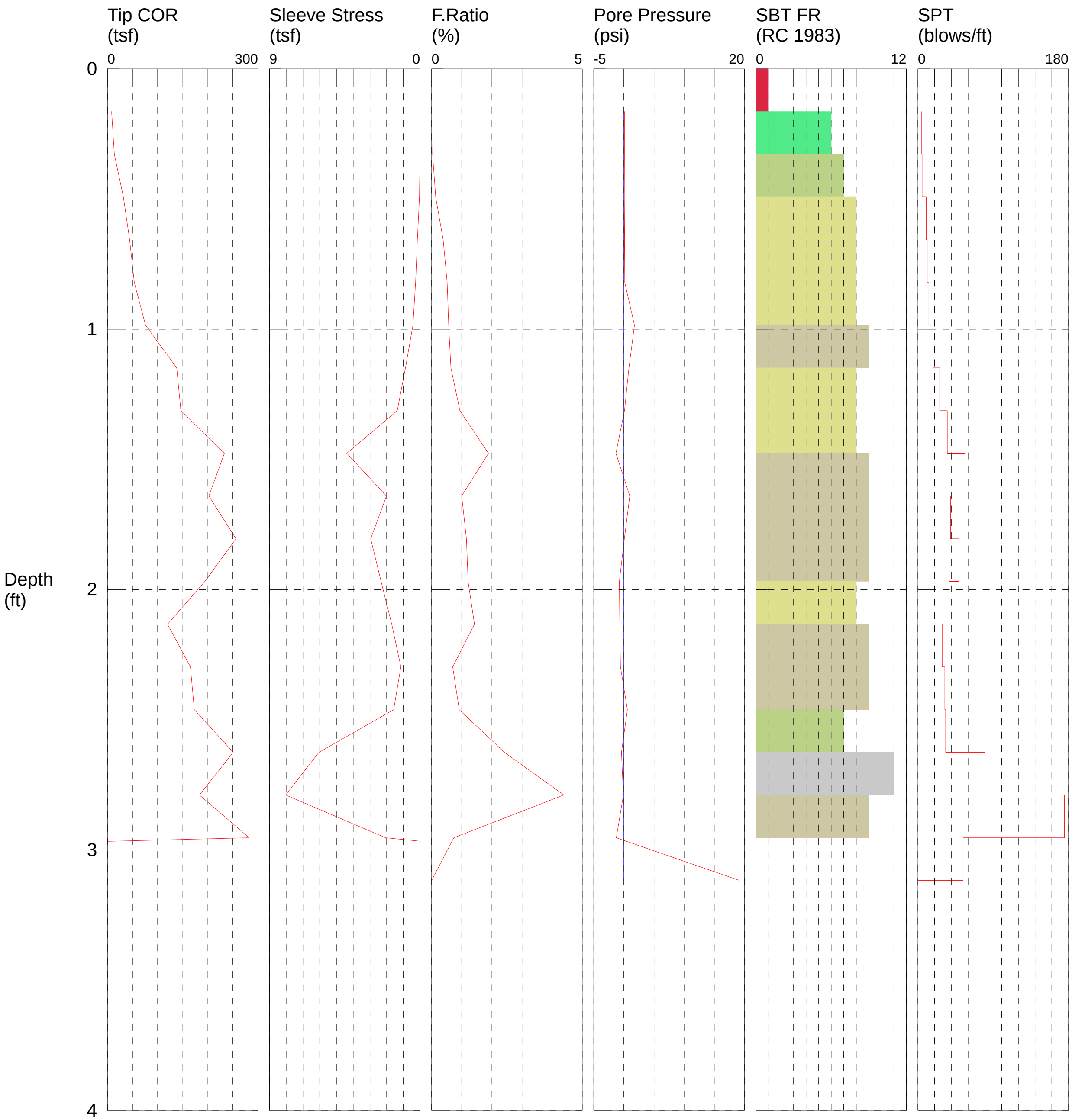
FILE: GNNorthern_AtlasAgro_CPT10.cpt
TEST DATE / TIME: 7/28/2023 12:30:06 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-10
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Soil Behavior Type Zone	UBC-1983	SPT (blows/ft)
0.164	9.24	0.0650	0.703	0.125	5	clayey silt to silty clay	4
0.328	52.39	0.6537	1.248	0.110	7	silty sand to sandy silt	17
0.492	82.70	0.6230	0.753	0.073	8	sand to silty sand	20
0.656	130.31	0.4372	0.336	-0.343	9	sand	25
0.820	358.92	1.8495	0.515	-0.038	10	gravelly sand to sand	57
0.984	270.86	4.9415	1.824	-0.163	8	sand to silty sand	65
1.148	140.32	4.8366	3.447	-1.603	6	sandy silt to clayey silt	54
1.312	138.33	3.7139	2.685	3.649	7	silty sand to sandy silt	44
1.476	221.37	2.4594	1.111	-2.655	9	sand	42
1.640	301.18	2.9402	0.976	-0.724	9	sand	58
1.804	155.62	1.6574	1.065	-1.435	8	sand to silty sand	37
1.969	154.47	1.0343	0.670	0.959	9	sand	30
2.133	274.81	0.9871	0.359	0.045	10	gravelly sand to sand	44
2.297	194.27	0.7771	0.400	0.591	9	sand	37
2.461	191.16	1.7411	0.911	-0.040	9	sand	37
2.625	204.57	3.0648	1.498	-0.594	8	sand to silty sand	49
2.789	232.95	1.8762	0.805	1.655	9	sand	45
2.953	331.19	2.0663	0.624	-1.034	10	gravelly sand to sand	53

CPT-10A

CPT Contractor: In Situ Engineering
CUSTOMER: GN Northern
LOCATION: Richland
JOB NUMBER: 223-1669

OPERATOR: Forinash
CONE ID: DDG1369
TEST DATE: 7/28/2023 12:38:39 PM
Coring: 0ft
Backfill: 20% Bentonite Slurry + Bentonite Chip
Surface Patch: None



TOTAL DEPTH: 3.117 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

FILE: GNNorthern_AtlasAgro_CPT10A.cpt
TEST DATE / TIME: 7/28/2023 12:38:39 PM
LOCATION: Richland
JOB #: 223-1669
HOLE #: CPT-10A
CUSTOMER: GN Northern
CONE ID: DDG1369
OPERATOR: Forinash
WATER TABLE (ft): UNDEFINED
GPS (Lat, Lon, Elev): 0.00,0.00,0.0
Atlas Agro

Depth ft	Tip COR (tsf)	Sleeve Stress (tsf)	F.Ratio (%)	Pore Pressure (psi)	Zone	Soil Behavior Type UBC-1983	SPT (blows/ft)
0.164	8.00	0.0038	0.048	0.125	1	sensitive fine grained	4
0.328	13.83	0.0044	0.032	0.125	6	sandy silt to clayey silt	5
0.492	31.65	0.0416	0.131	0.138	7	silty sand to sandy silt	10
0.656	44.04	0.1671	0.379	0.093	8	sand to silty sand	11
0.820	53.41	0.2739	0.513	0.143	8	sand to silty sand	13
0.984	75.75	0.4267	0.563	1.746	8	sand to silty sand	18
1.148	138.01	0.8790	0.637	0.829	9	sand	26
1.312	145.98	1.3678	0.937	0.103	8	sand to silty sand	35
1.476	232.87	4.3908	1.886	-1.345	8	sand to silty sand	56
1.640	201.94	2.0147	0.998	0.959	9	sand	39
1.804	256.13	2.9516	1.152	0.083	9	sand	49
1.969	193.94	2.3422	1.208	-0.764	9	sand	37
2.133	119.57	1.6952	1.418	-0.694	8	sand to silty sand	29
2.297	165.11	1.1518	0.698	-0.564	9	sand	32
2.461	173.10	1.5800	0.913	0.584	9	sand	33
2.625	250.61	6.0484	2.413	-0.423	7	silty sand to sandy silt	80
2.789	183.21	8.0376	4.387	-0.090	11	very stiff fine grained (*)	175
2.953	282.30	2.0663	0.732	-1.262	9	sand	54
3.117	-26.07	-0.1797	0.000	19.167	0	<out of range>	0

Appendix XI

Down-hole Test Data

Report of P- and S - Wave Velocity Logging:
Atlas Agro Pacific Green Fertilizer Plant
Richland, WA

Submitted to:
GN Northern, Inc.
722 N 16th Ave. #31
Yakima, WA 98902

GN Northern Project #: 223-1672
In Situ Engineering Project #: 2135
Report Date: October 5, 2023

Testing conducted, and report prepared by:

In Situ Engineering

6232 195th Avenue SE

Snohomish, WA 98290   360-568-2807

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Appendix I: Spreadsheet All Data

1.0 INTRODUCTION

The scope of work calls for downhole geophysical testing in 3 boreholes for the Atlas Agro Pacific Green Fertilizer Plant project in north Richland, WA. This report presents the final data interpretation on all boreholes BH - 22, BH - 23 and BH - 25. The geophysical data acquisition was performed over one mobilization between September 28th & 29th of 2023. The testing was performed by In Situ Engineering using a method known as OYO P-S Suspension Logging. Data analysis, review and report preparation was also performed by In Situ Engineering. This report describes the field measurements, data analysis, and results of the work.

2.0 PURPOSE

The purpose of these studies was to acquire shear-wave "S" and compressional-wave "P" velocities as a function of depth, and to determine the Seismic Properties of the boreholes. This report presents the results of in-situ geophysical OYO P-S Suspension Logging seismic measurements collected on 5" sonic drilled boreholes and all were later cased and grouted with 3" PVC pipes.

The acquired data was analyzed, and a profile of the following properties versus depth are produced:

Velocity for both P and horizontally polarized S waves.

Arrival Time

Poison Ratio and

V_p/V_s

3.0 INSTRUMENTATION

The Digital OYO P-S Suspension Logger Probe and Micrologger-2 Recorder of Robertson Geo models were used to acquire in-situ horizontal shear and compressional wave velocity measurements. The P-S Suspension instrument and Micrologger were powered by a 6-cell, 12volts DC battery to reduce any current interference from the power source. A min-winch with depth counter pully was used to lower the probe downhole. Both the winch and pully were secured to an immobile structure such as drill rig, well protection metal bollards and/or bed of work truck in order to minimize any movement (vibration) during acquisition.

4.0 UNDERSTANDING THE BOREHOLE ENVIRONMENT

In general, P waves are less susceptible to borehole factors than S waves. As the P waves are the first arrivals, usually, they can be readily identified. The S waves arrive in conjunction with earlier wave arrivals of the P waves and possibly the direct fluid refracted arrivals. Therefore, as the signal becomes more distorted the characteristics of the S waves can be hidden.

In most cases the following factors cannot be controlled, but a good understanding will help the In-Situ Engineer and the design geotechnical team to understand what is happening to the data.

DIAMETER: Smaller diameter boreholes will produce better data, all else being equal. A step increase in borehole diameter, as is often found at the top of a borehole, will inevitably degrade data quality, again, all else being equal.

RUGOSITY: is defined as a measure of small-scale variations or amplitude in the height of a surface. The re-transmission of waves back into the borehole fluid from the wall is affected by the roughness or rugosity of the surface. A smooth borehole wall will re-transmit a smooth coherent waveform. As the irregularity increases the re-transmitted waves become more and more distorted.

CAVITATION: Cavities and dropouts (washout) in the borehole wall will degrade the signal quality. Sharp edges within the cavity can cause diffraction waves where the edge acts another point source. In extreme cases the S waves can become unrecognizable. The effect is most evident when either the source or a receiver is at exactly the same depth as the cavity and is characterized by a jagged appearance in the S waveforms.

COMPACTION: Competent rocks and fine-grained compacted formations produce the best data. Thus, data quality often improves with depth. Layers of gravel or pebbles or layers with loose mixed material can severely degrade data quality.

FRACTURES: Closed fractures should not markedly affect data quality. Open fractures can give rise to multiples, which occur when a seismic wave reverberates within a layer. The higher velocity contrast from open factures amplifies this effect. Multiples can give a jagged appearance to the S waves caused by the superposition of different ray paths.

CASING: Where plastic casing has been installed it must be grouted so that no voids exist between the casing and the formation. The presence of voids will interrupt the transmission of waves to the formation.

AMBIENT NOISE: When testing adjacent, or near, high vehicle traffic locations, the vibrations and ambient noise created via vehicles can overwhelm the signal from the instrument. This can be compensated to a degree by adding additional stacks to the testing station. However, as the instrument approaches the surface, it may not be possible to stack a signal strong enough to overcome the consistent traffic noise.

5.0 DATA ACQUISITION PROCEDURES

The 19.8ft long PS logger (with 1m filter) is inserted in the borehole and its probe top is zeroed to the ground surface. This positioning will place the receiver point (the midpoint between the geophones) at 2.45m below the surface. This is the shallowest reading of the probe (Figure 1).

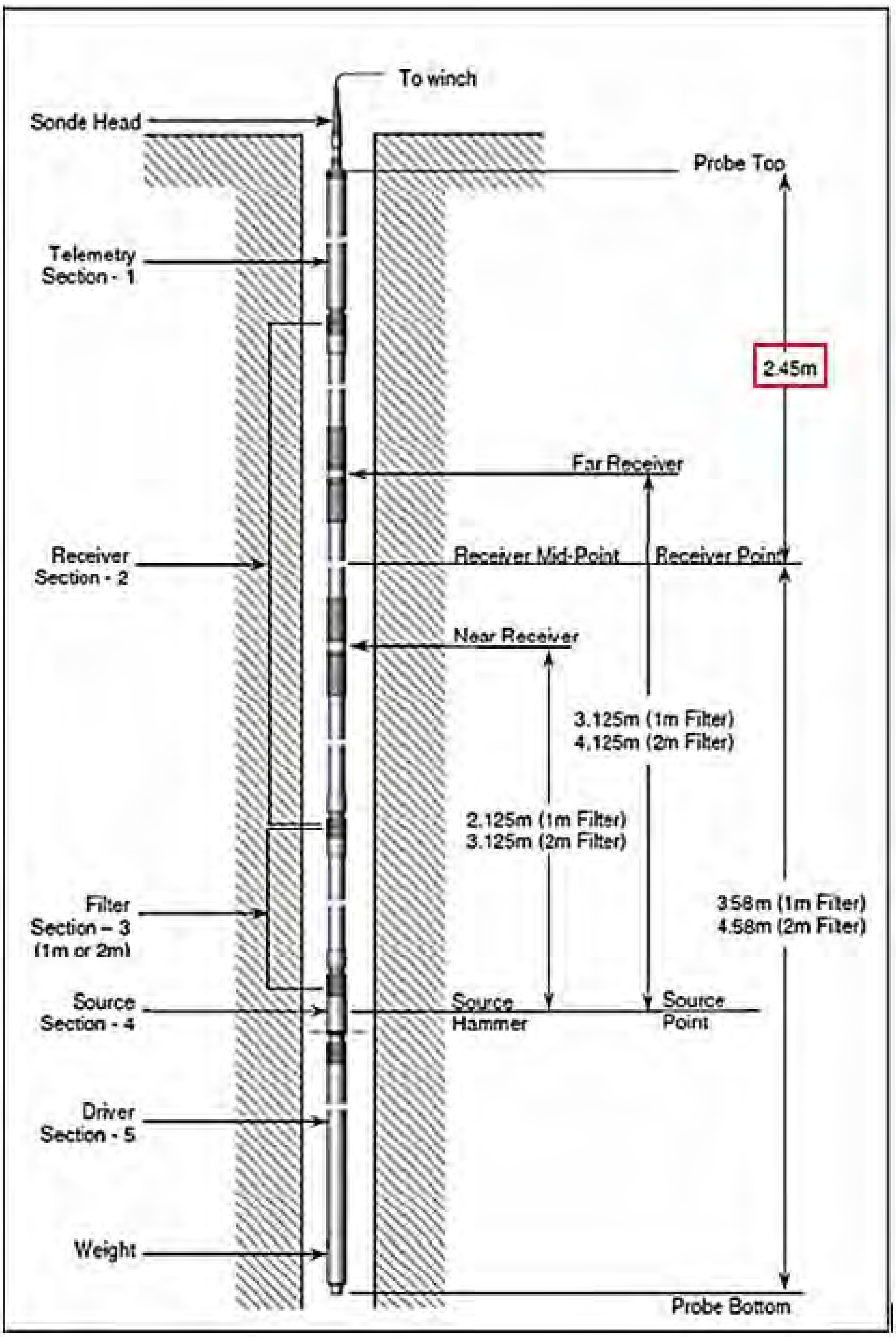


Figure 1: PS Logger Configuration, (source PS Logger Manual, Robertson Geo)

The probe was then lowered to the bottom of the boreholes and logged in a bottom-up scheme. Logging was initiated at the bottom of the borings, minus 12ft of rathole for the driver, hammer source and filter section of the instrument. The probe was then raised to the surface, by stopping for data acquisition every 0.5m interval, called "***the Stations***".

In all boreholes, multiple runs were performed on different sections of the boreholes by adjusting some parameters of probe in order to ensure that the best data quality was acquired. In some sections of the boreholes, the loggers noted distorted signals and multiple shots were "stacked" to acquire a better wave form. Table -1 summarizes the logged intervals.

Table 1 Summary of logged intervals and stations acquired.

Borehole BH-22				
Logging	Run 1	Run 2	Run 3	Poor quality signals
Depth range (ft)			8.2 - 47.5	
Stations			21	0
Data quality			Good	
Borehole BH-23				
Logging	Run 1	Run 2	Run 3	Poor quality signals
Depth range (ft)	8.0 - 47.1	9.8 - 47.1		29.5 – 41.0
Stations	25	24		8
Data quality	Fair	Good		No Use
Borehole BH-25				
Logging	Run 1	Run 2	Run 3	Poor quality signals
Depth range (ft)	8.2 – 64.0	8.2 – 64.3		
Stations	33	36		0
Data quality	Good	Good		

6.0 DATA ANALYSIS

Data was analyzed using PS Logger Application V 1.6. The first step in the process was to filter out and clean the raw waveforms as seen in Figure 2 below. Most of the stations had similar background noises and the waves were filtered around 160-240Hz and 1-2kHz respectively for Shear and Compressional waves. The arrival time of the first signal was then picked to determine the velocities. Figure 3 shows a filtered PS waveform with the arrival time picked for each of the near and the far receivers.

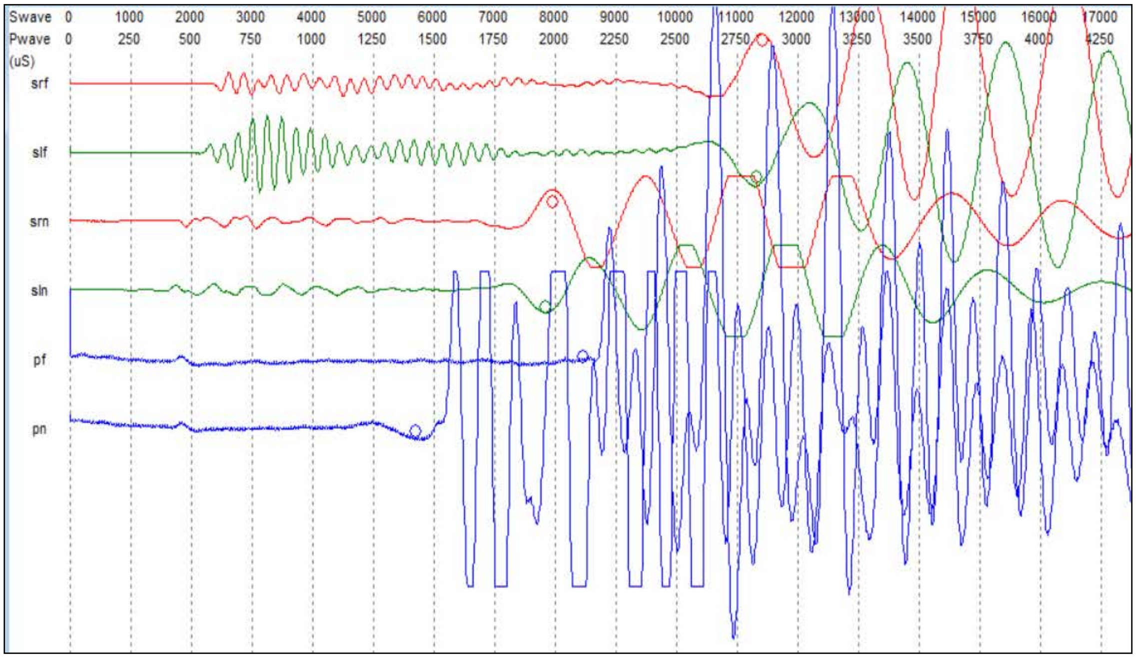


Figure 2: Station Example - raw PS waveforms. Noises in the first thousand of µs.

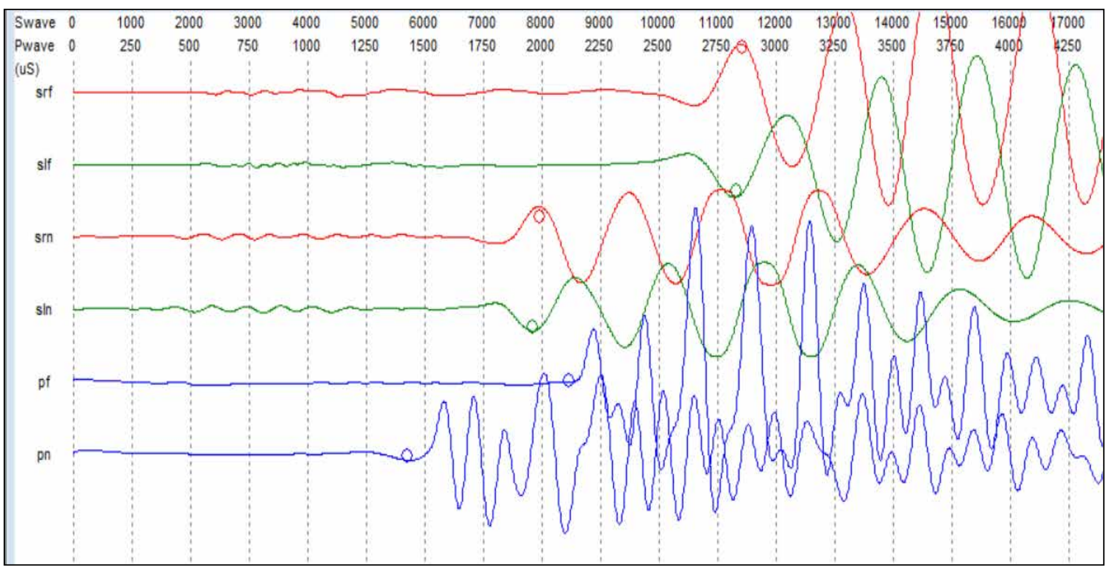


Figure 3: Station Example - filtered PS waveforms. Noises removed, and 1st arrival time picked.

7.0 RESULTS

Reported below are the results of the PS logging of the boreholes. In general, the waveforms were of good quality with few distortions and interpretation was done with confidence. But some stations were difficult to interpret, especially with the S-waves, as they arrive distorted, making it difficult to pick the 1st arrival. Below is an example of S-wave analysis of BH – 23. The upper section 2 – 8m are good & strong signals, but between 8.5-12.5m the waves are distorted and uneasy to interpret. A reasonable explanation of the cause is detailed in Section – 4 above. Considering the nature of the boreholes, the Rugosity and Cavitation effects seem to have a great role in the data quality. An engineering judgment was made in picking a reasonable high strength amplitude of the first arrival.

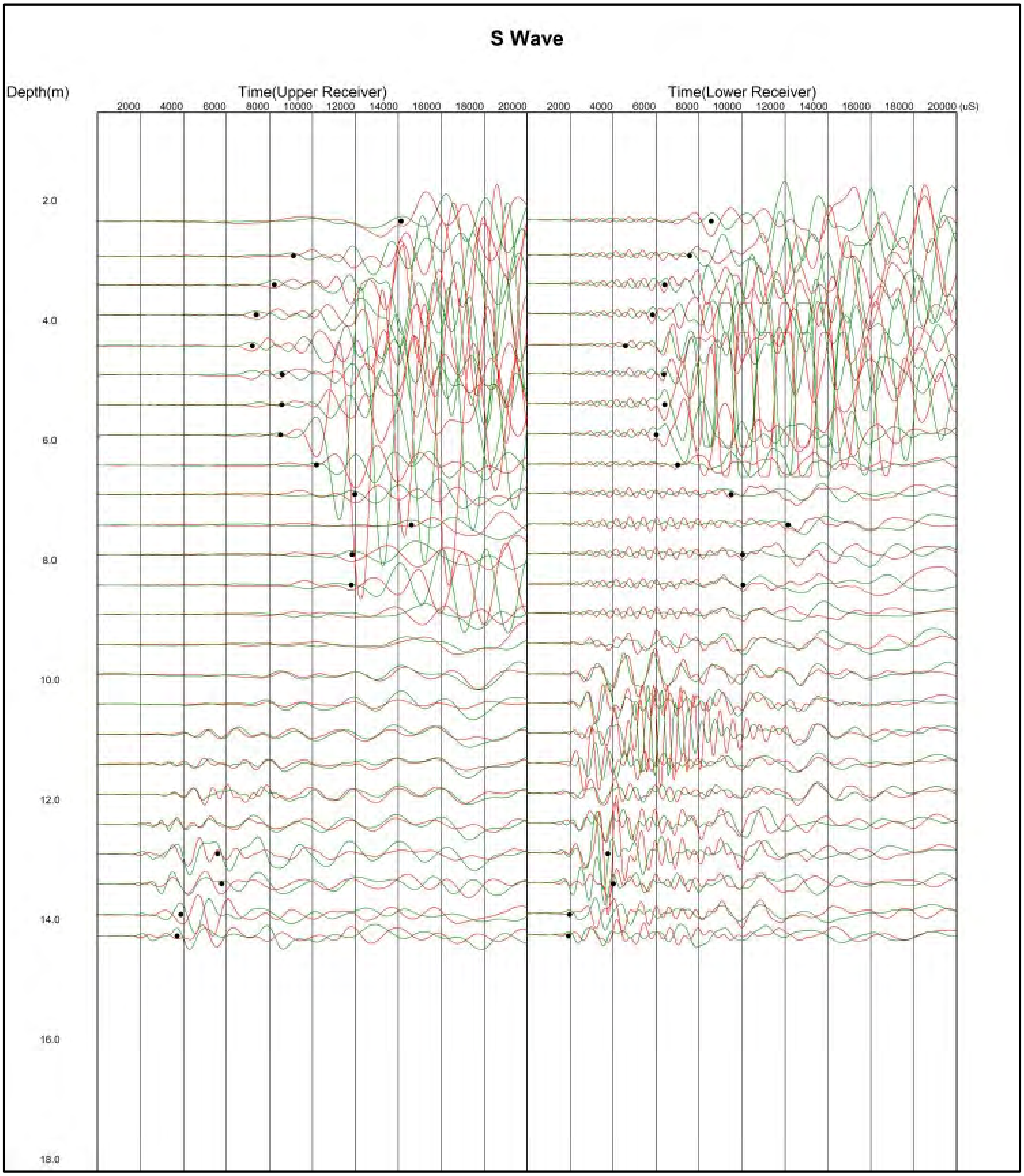


Figure 4: Example of S-waveforms of borehole BH-23.

All the seismic properties of the boreholes were determined from the interpreted logs except a density parameter, which is vital for the moduli analysis. In-Situ engineering did not receive any corresponding density values of the stratigraphy and it was set to default value of 1g/cc. Moduli should be re-calculated accordingly with the appropriate density value of each stratigraphy.

The velocities and Poisson's ratio are plotted in figures 5 through 11. Summary of velocities and Poison's ratio are also given in Tables 2 to 4 for the various runs. A complete list of all the properties is included in an Appendix and separate LAS files are included as part of this report.

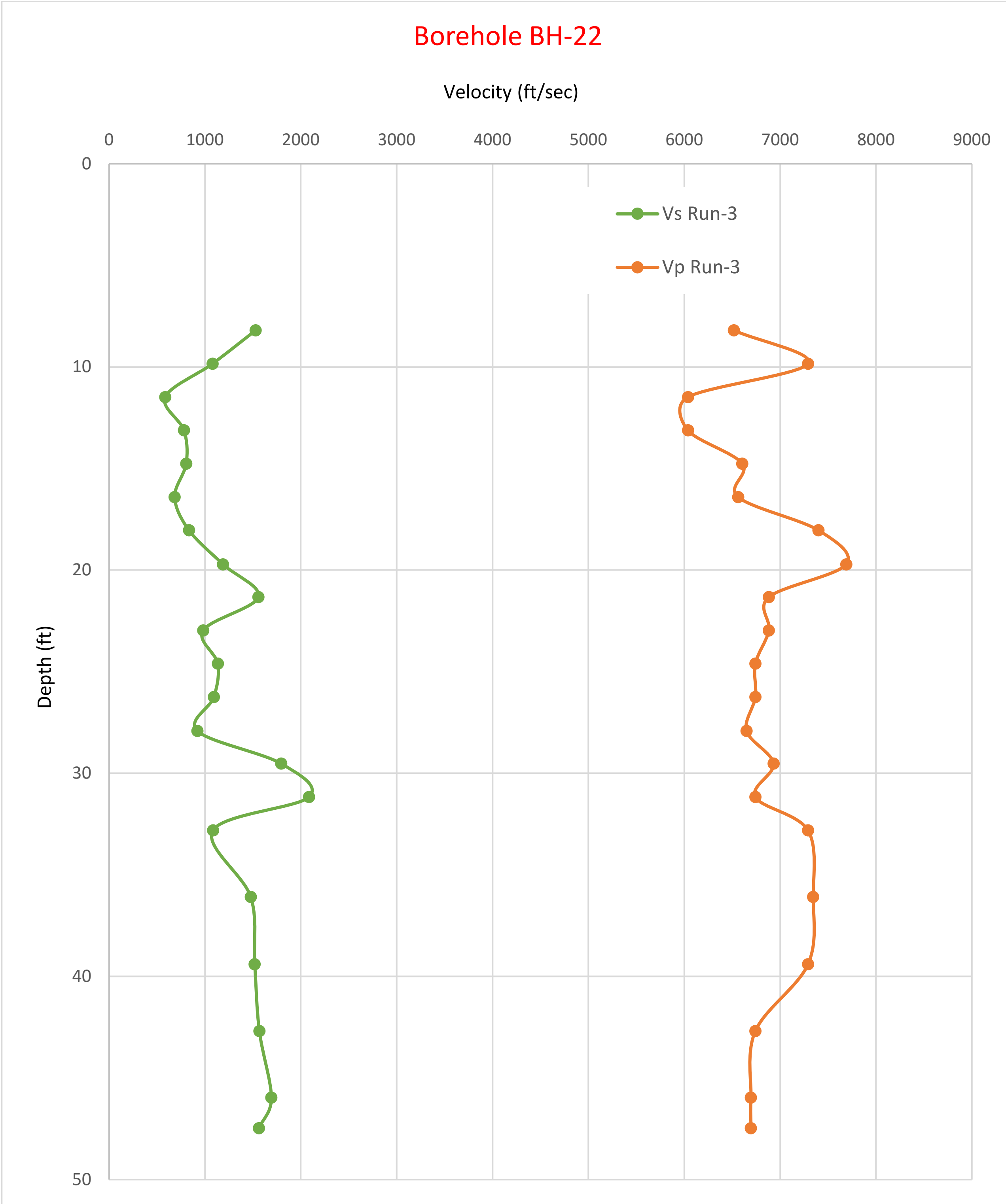


Figure 5: Borehole BH-22: P and S Wave Velocity Profile.

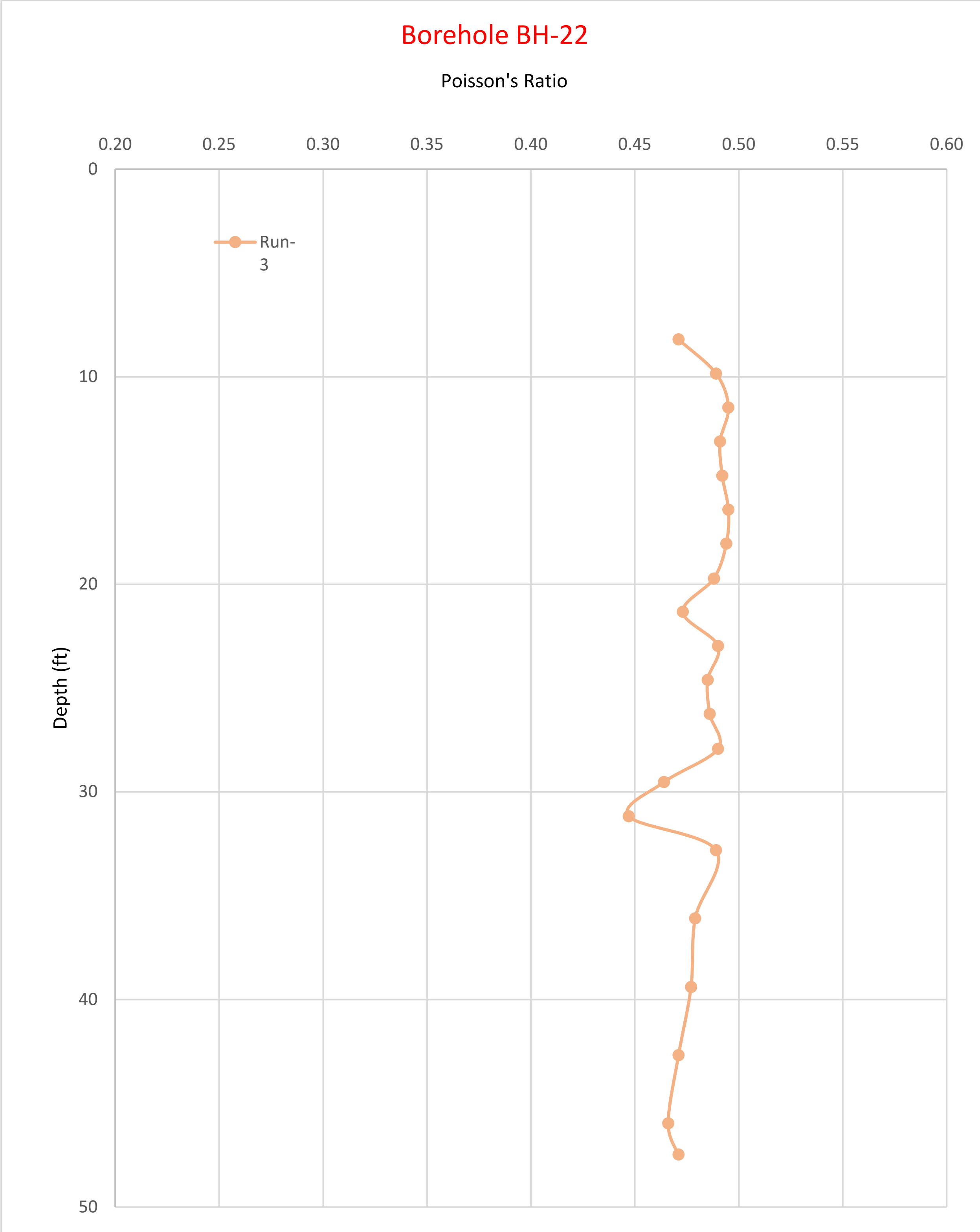


Figure 6: Borehole BH-22: Poisson’s Ratio.

Table 2 Borehole BH-22: Summary of Velocities and Poison's Ratio

Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
Run -3			
8.2	1528.4	6518.2	0.471
9.8	1079.3	7290.8	0.489
11.5	585.9	6038.4	0.495
13.1	781.5	6038.4	0.491
14.8	804.2	6605.7	0.492
16.4	683.9	6561.7	0.495
18.0	834.4	7400.4	0.494
19.7	1189.0	7689.5	0.488
21.3	1558.4	6882.9	0.473
23.0	981.6	6882.9	0.490
24.6	1134.0	6741.5	0.485
26.2	1093.6	6741.5	0.486
27.9	921.6	6650.4	0.490
29.5	1796.2	6931.4	0.464
31.2	2085.3	6741.5	0.447
32.8	1084.2	7290.8	0.489
36.1	1478.0	7345.2	0.479
39.4	1519.4	7290.8	0.477
42.7	1567.3	6741.5	0.471
46.0	1692.8	6695.6	0.466
47.5	1562.4	6695.6	0.471

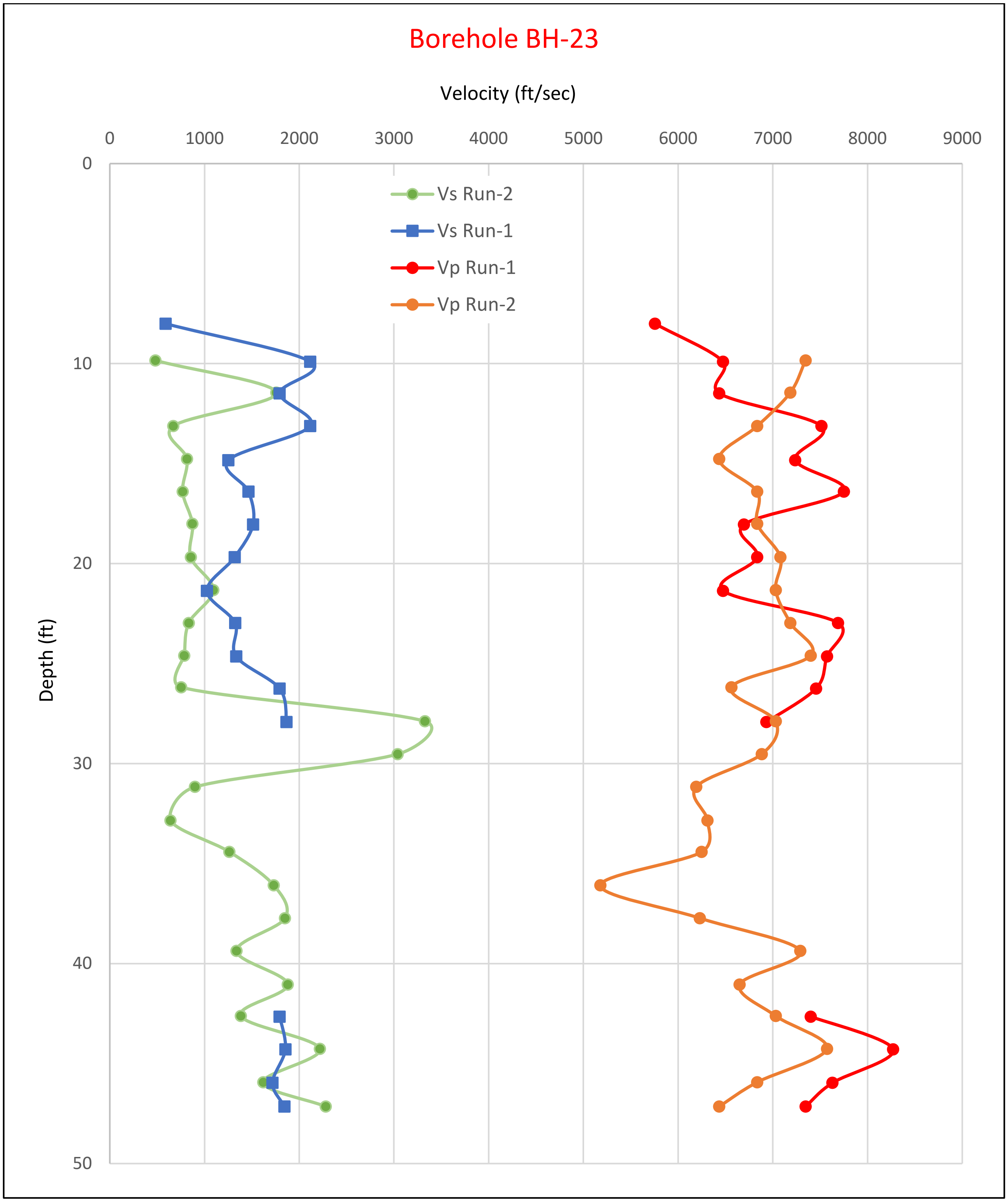


Figure 7: Borehole BH-23: P and S Wave Velocity Profile of all runs.

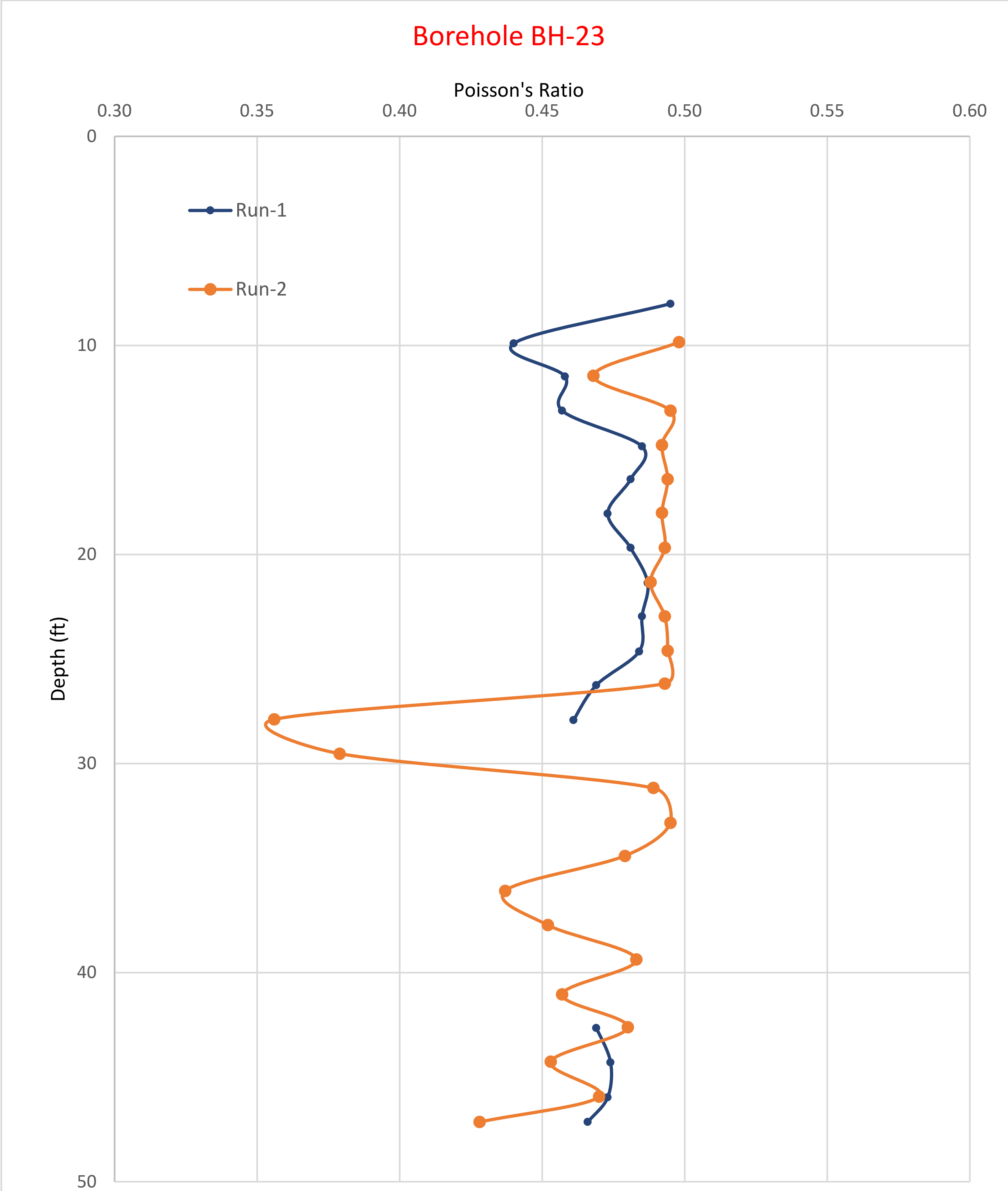


Figure 8: Borehole BH-23: Poisson's Ratio of all runs.

Table 3 Borehole BH-23: Summary of Velocities and Poisson's Ratio

Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
Run -1			
8.0	590.1	5755.9	0.495
9.9	2116.8	6475.3	0.440
11.5	1793.3	6433.0	0.458
13.1	2116.8	7513.4	0.457
14.8	1252.5	7237.1	0.485
16.4	1464.8	7750.0	0.481
18.0	1512.2	6695.6	0.473
19.7	1317.6	6835.1	0.481
21.4	1025.3	6475.3	0.487
23.0	1323.0	7689.5	0.485
24.6	1333.8	7571.2	0.484
26.2	1792.9	7456.5	0.469
27.9	1865.1	6931.4	0.461
29.5			
31.2			
32.8			
34.4			
36.1			
37.7			
39.4			
41.0			
42.7	1792.9	7400.4	0.469
44.3	1853.6	8271.0	0.474
46.0	1717.8	7629.9	0.473
47.1	1843.4	7345.2	0.466

Run -2			
9.8	481.6	7345.2	0.498
11.5	1758.0	7184.3	0.468
13.1	670.7	6835.1	0.495
14.8	814.9	6433.0	0.492
16.4	769.0	6835.1	0.494
18.0	872.7	6835.1	0.492
19.7	854.5	7080.9	0.493
21.3	1093.6	7030.4	0.488
23.0	834.2	7184.3	0.493
24.6	786.2	7400.4	0.494
26.2	752.5	6561.7	0.493
27.9	3327.6	7030.4	0.356
29.5	3039.7	6882.9	0.379
31.2	899.9	6190.3	0.489
32.8	640.8	6309.3	0.495
34.4	1263.1	6249.2	0.479
36.1	1731.6	5180.3	0.437
37.7	1850.2	6229.4	0.452
39.4	1337.3	7290.8	0.483
41.0	1878.5	6650.4	0.457
42.6	1382.6	7030.4	0.480
44.3	2217.0	7571.2	0.453
45.9	1619.1	6835.1	0.470
47.1	2279.1	6433.0	0.428

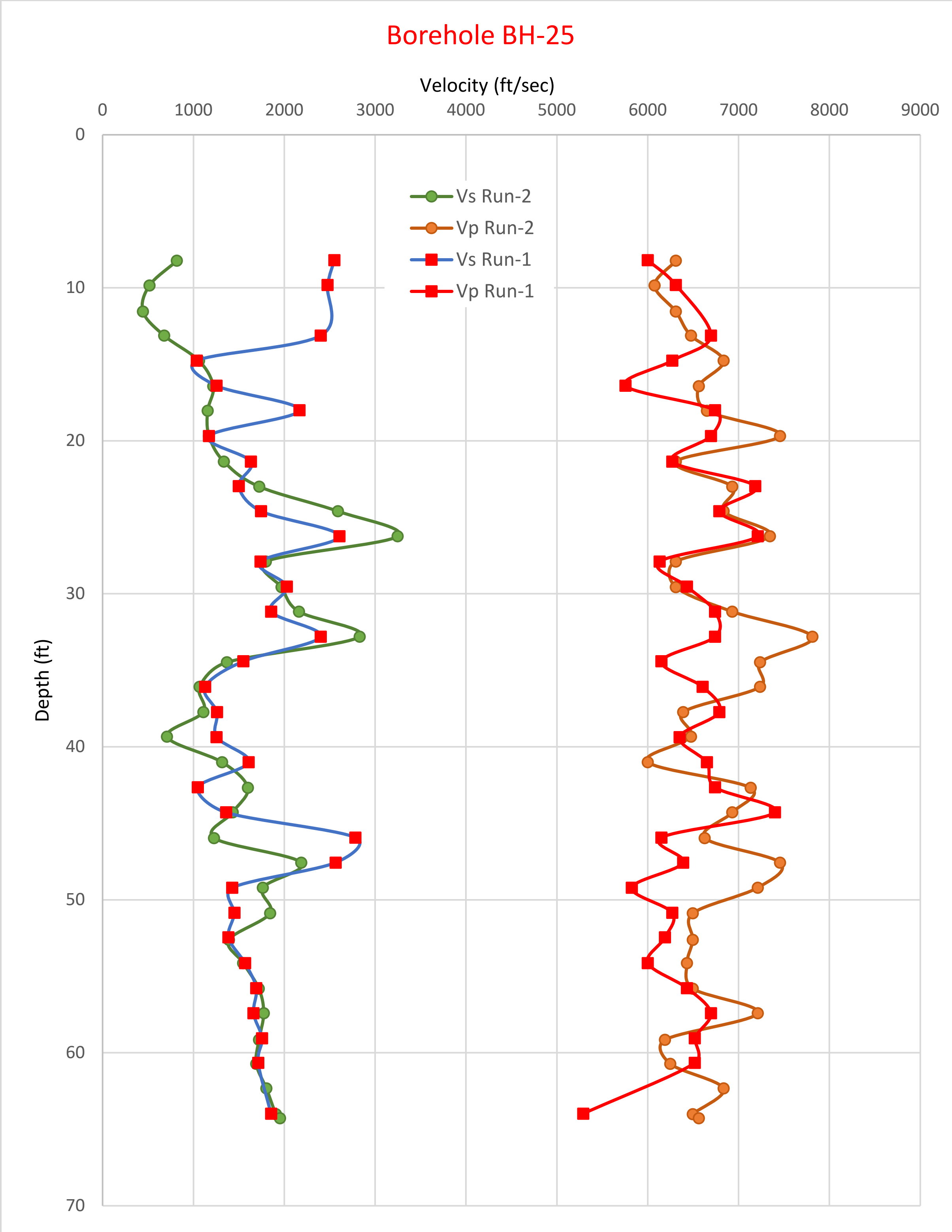


Figure 9: Borehole BH-25: P and S Wave Velocity Profile of all runs.

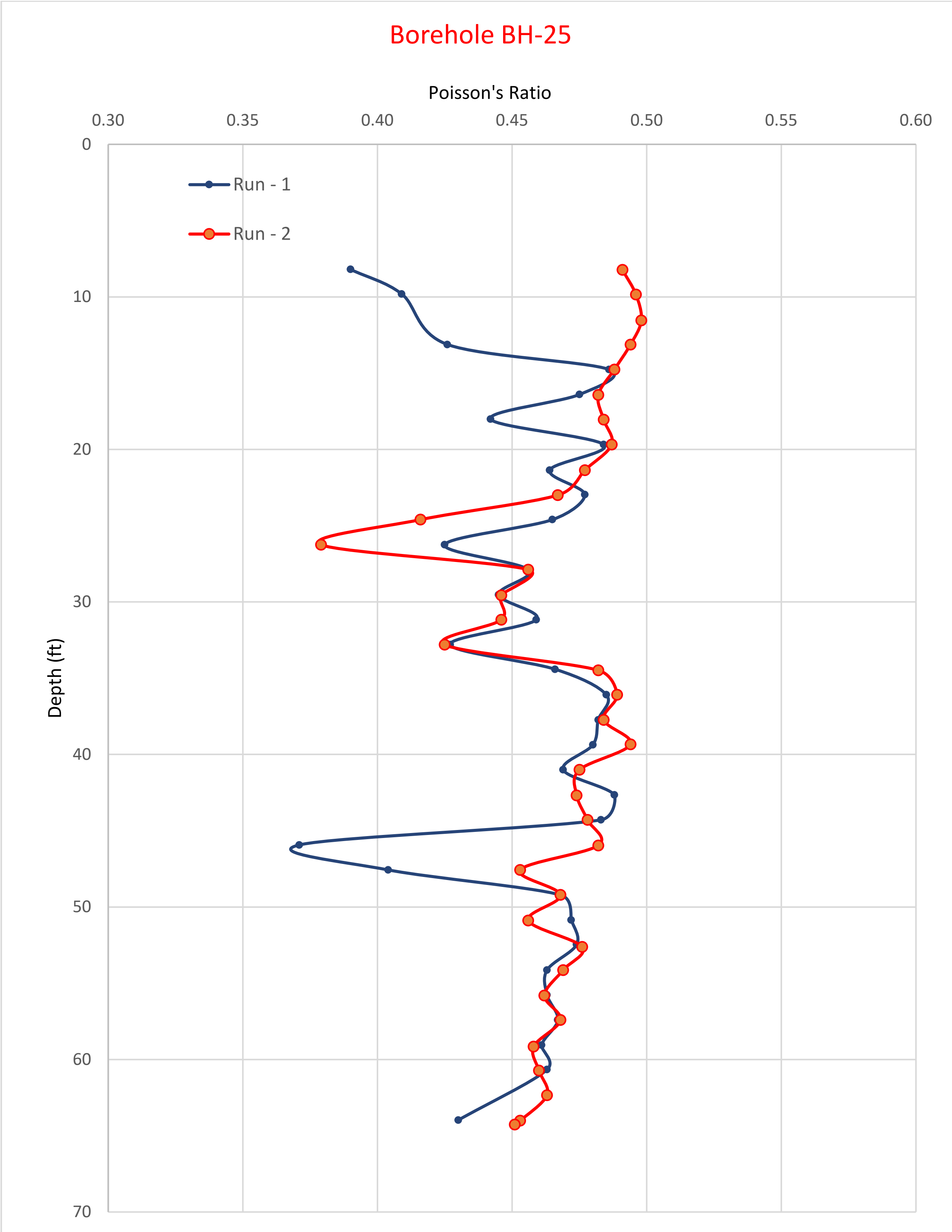


Figure 10: Borehole BH-25: Poisson's Ratio of all runs.

Table 4 Borehole BH-25: Summary of Velocities and Poisson's Ratio

Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
Run -1			
8.2	2549.9	6001.5	0.390
9.8	2476.1	6309.3	0.409
13.1	2400.7	6695.6	0.426
14.8	1036.8	6269.1	0.486
16.4	1254.2	5755.9	0.475
18.0	2168.3	6741.5	0.442
19.7	1170.6	6695.6	0.484
21.4	1632.1	6269.1	0.464
23.0	1498.2	7184.3	0.477
24.6	1745.1	6787.9	0.465
26.2	2606.5	7210.6	0.425
27.9	1737.1	6132.4	0.456
29.5	2028.0	6433.0	0.445
31.2	1854.1	6741.5	0.459
32.8	2400.7	6741.5	0.427
34.4	1548.1	6151.6	0.466
36.1	1127.9	6605.7	0.485
37.7	1258.7	6787.9	0.482
39.4	1255.4	6350.0	0.480
41.0	1608.3	6650.4	0.469
42.7	1047.2	6741.5	0.488
44.3	1359.5	7400.4	0.483
45.9	2782.6	6151.6	0.371
47.6	2564.3	6391.2	0.404
49.2	1427.4	5824.0	0.468
50.9	1451.7	6269.1	0.472
52.5	1386.3	6190.3	0.474
54.1	1567.3	6001.5	0.463
55.8	1691.3	6433.0	0.463
57.4	1661.3	6695.6	0.467
59.1	1754.9	6518.2	0.461
60.7	1713.2	6518.2	0.463
64.0	1854.1	5291.7	0.430
Run -2			
8.2	818.2	6309.3	0.491
9.8	516.9	6075.6	0.496
11.5	444.2	6309.3	0.498
13.1	676.5	6475.3	0.494
14.8	1060.7	6835.1	0.488
16.4	1218.1	6561.7	0.482
18.0	1155.9	6650.4	0.484
19.7	1171.7	7456.5	0.487
21.4	1335.5	6309.3	0.477
23.0	1724.9	6931.4	0.467
24.6	2590.4	6835.1	0.416
26.2	3246.7	7345.2	0.379
27.9	1796.9	6309.3	0.456
29.6	1968.6	6309.3	0.446
31.2	2161.1	6931.4	0.446
32.8	2828.7	7811.5	0.425
34.5	1367.0	7237.1	0.482
36.1	1067.6	7237.1	0.489
37.7	1108.5	6391.2	0.484
39.3	709.1	6475.3	0.494
41.0	1316.2	6001.5	0.475
42.7	1598.1	7132.3	0.474
44.3	1431.4	6931.4	0.478
46.0	1227.4	6628.0	0.482
47.6	2187.6	7456.5	0.453
49.2	1763.9	7210.6	0.468
50.9	1843.2	6496.7	0.456
52.6	1390.2	6496.7	0.476
54.1	1547.7	6433.0	0.469
55.8	1720.0	6496.7	0.462
57.4	1773.5	7210.6	0.468
59.2	1721.2	6190.3	0.458
60.7	1691.3	6249.2	0.460
62.3	1802.9	6835.1	0.463
64.0	1907.7	6496.7	0.453
64.3	1954.0	6561.7	0.451

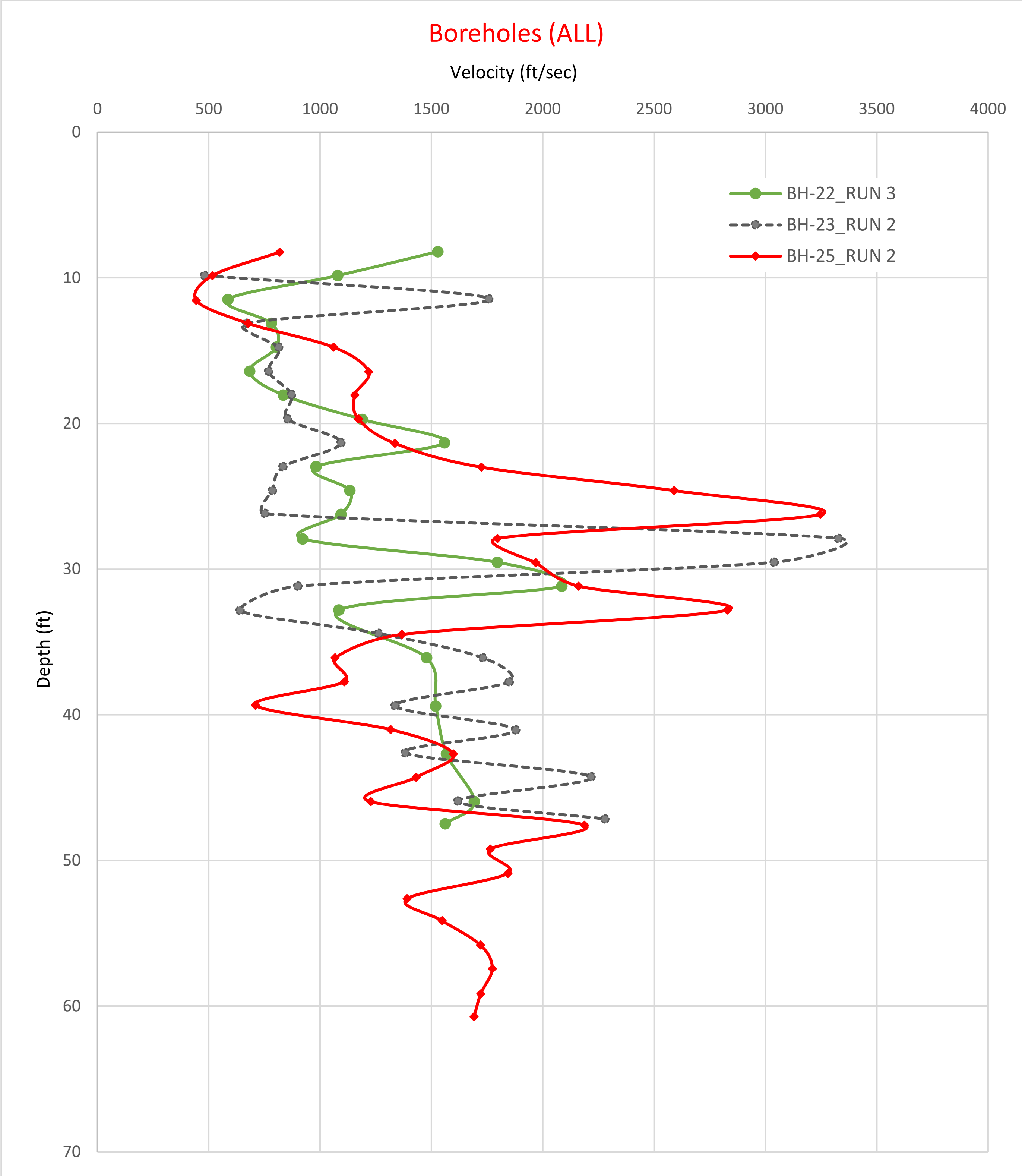


Figure 11: P and S Wave Velocity Profile of all Boreholes.

Appendix I: Spreadsheet All Data

Appendix I: Spreadsheet All Data

Depth	meters
VsLeft.m/s	Shot S Velocity
VsRight.m/s	Shot S Velocity
VsAvg.m/s	Velocity in average
Vp.m/s	Velocity in average
NearTLS.us	Near S Left arrival time
NearTRS.us	Near S Right arrival time
NearTP.us	Near P arrival time
FarTLS.us	Far S Left arrival time
FarTRS.us	Far S Right arrival time
FarTP.us	Far P arrival time
Bulk.MPa	Bulk modulus
Shear.MPa	Shear modulus
Young.MPa	Young's modulus
Vp/Vs	Vp/Vs Ratio
Poisson.n/a	Poisson Ratio

Boring	BH-22
Date	9/29/2023
Company	In Situ Engineering
Client	GN Northern
City	Richland
County	
State	WA
County	USA
Project	Atlas Agro
Run 3	2.5 - 14.47
Run 2	

Run -3	Depth	VsLeft	VsRight	VsAvg	Vp	NearTLS	NearTRS	NearTP	FarTLS	FarTRS	FarTP	Vp/Vs	Poisson
	2.5	462.963	468.75	465.857	1986.755	3866.667	3920	1260	6026.667	6053.333	1763.333	4.265	0.471
	3	326.087	331.858	328.973	2222.222	4373.333	4400	1250	7440	7413.333	1700	6.755	0.489
	3.5	177.725	179.426	178.576	1840.491	12026.67	12106.67	1246.667	17653.33	17680	1790	10.307	0.495
	4	243.507	232.919	238.213	1840.491	8320	8346.667	1243.333	12426.67	12640	1786.667	7.726	0.491
	4.5	247.525	242.718	245.122	2013.422	8040	8080	1236.667	12080	12200	1733.333	8.214	0.492
	5	196.335	220.588	208.462	2000	12586.67	13146.67	1243.333	17680	17680	1743.333	9.594	0.495
	5.5	238.854	269.784	254.319	2255.639	14880	15253.33	1246.667	19066.67	18960	1690	8.869	0.494
	6.01	367.647	357.143	362.395	2343.75	11360	11333.33	1260	14080	14133.33	1686.667	6.467	0.488
	6.5	462.963	487.013	474.988	2097.902	12346.67	12426.67	1276.667	14506.67	14480	1753.333	4.417	0.473
	7	288.462	309.917	299.189	2097.902	9013.333	9013.333	1263.333	12480	12240	1740	7.012	0.49
	7.5	344.037	347.222	345.63	2054.795	11173.33	11253.33	1293.333	14080	14133.33	1780	5.945	0.485
	8	331.858	334.821	333.34	2054.795	11120	11200	1290	14133.33	14186.67	1776.667	6.164	0.486
	8.51	279.851	281.955	280.903	2027.027	11386.67	11386.67	1283.333	14960	14933.33	1776.667	7.216	0.49
	9	543.478	551.471	547.475	2112.677	11226.67	11226.67	1293.333	13066.67	13040	1766.667	3.859	0.464
	9.5	635.593	635.593	635.593	2054.794	10026.67	10000	1316.667	11600	11573.33	1803.333	3.233	0.447
	10	334.821	326.087	330.454	2222.222	8720	8666.667	1286.667	11706.67	11733.33	1736.667	6.725	0.489
	11	446.429	454.545	450.487	2238.806	3920	4080	1290	6160	6280	1736.667	4.97	0.479
	12.01	454.545	471.698	463.122	2222.222	3920	4000	1263.333	6120	6120	1713.333	4.798	0.477
	13.01	480.769	474.684	477.726	2054.795	3626.667	3653.333	1310	5706.667	5760	1796.667	4.301	0.471
	14.01	500	531.915	515.958	2040.816	3960	4040	1293.333	5960	5920	1783.333	3.955	0.466
	14.47	480.769	471.698	476.234	2040.816	3600	3600	1260	5680	5720	1750	4.285	0.471

Appendix I: Spreadsheet All Data

Depth	meters
VsLeft.m/s	Shot S Velocity
sRight.m/s	Shot S Velocity
VsAvg.m/s	Velocity in average
Vp.m/s	Velocity in average
NearTLS.us	Near S Left arrival time
NearTRS.us	Near S Right arrival time
NearTP.us	Near P arrival time
FarTLS.us	Far S Left arrival time
FarTRS.us	Far S Right arrival time
FarTP.us	Far P arrival time
Bulk.MPa	Bulk modulus
Shear.MPa	Shear modulus
oung.MPa	Young's modulus
Vp/Vs	Vp/Vs Ratio
oisson.n/a	Poisson Ratio

Boring	BH-23
Date	9/29/2023
Company	In Situ Engineering
Client	GN Northern
City	Richland
County	
State	WA
County	USA
Project	Atlas Agro
Run 1	2.44 - 14.37
Run 2	3.0 - 14.37
Run 3	N/A

Run - 1	Depth	VsLeft	VsRight	VsAvg	Vp	NearTLS	NearTRS	NearTP	FarTLS	FarTRS	FarTP	Vp/Vs	Poisson
	2.44	180.505	179.212	179.858	1754.386	8580	8560	1233.333	14120	14140	1803.333	9.754	0.495
	3.02	649.351	641.026	645.188	1973.684	7560	7580	1240	9100	9140	1746.667	3.059	0.44
	3.5	555.556	537.634	546.595	1960.784	6420	6380	1233.333	8220	8240	1743.333	3.587	0.458
	4	649.351	641.026	645.188	2290.077	5840	5840	1220	7380	7400	1656.667	3.549	0.457
	4.52	387.597	375.94	381.768	2205.882	4620	4560	1240	7200	7220	1693.333	5.778	0.485
	5	442.478	450.45	446.464	2362.205	6420	6300	1240	8680	8520	1663.333	5.291	0.481
	5.5	454.545	467.29	460.918	2040.816	6400	6420	1240	8600	8560	1730	4.428	0.473
	6	403.226	400	401.613	2083.333	6020	6020	1233.333	8500	8520	1713.333	5.187	0.481
	6.51	310.559	314.465	312.512	1973.684	7000	7000	1250	10220	10180	1756.667	6.316	0.487
	7	406.504	400	403.252	2343.75	9500	9500	1260	11960	12000	1686.667	5.812	0.485
	7.51	403.226	409.836	406.531	2307.693	12140	12160	1243.333	14620	14600	1676.667	5.677	0.484
	8	543.478	549.451	546.464	2272.727	10040	10040	1250	11880	11860	1690	4.159	0.469
	8.51	555.556	581.395	568.476	2112.677	10020	10100	1253.333	11820	11820	1726.667	3.716	0.461
	9	0	0	0	0	0	0	0	0	0	0	0	0
	9.5	0	0	0	0	0	0	0	0	0	0	0	0
	10.01	0	0	0	0	0	0	0	0	0	0	0	0
	10.5	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0
	11.5	0	0	0	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0	0	0	0
	12.5	0	0	0	0	0	0	0	0	0	0	0	0
	13	549.451	543.478	546.464	2255.639	3760	3780	1173.333	5580	5620	1616.667	4.128	0.469
	13.5	568.182	561.798	564.99	2521.008	4040	4000	1176.667	5800	5780	1573.333	4.462	0.474
	14.01	526.316	520.833	523.575	2325.581	1980	1960	1186.667	3880	3880	1616.667	4.442	0.473
	14.37	555.556	568.182	561.869	2238.806	1920	1940	1183.333	3720	3700	1630	3.985	0.466

Run - 2	Depth	VsLeft	VsRight	VsAvg	Vp	NearTLS	NearTRS	NearTP	FarTLS	FarTRS	FarTP	Vp/Vs	Poisson
	3	148.221	145.349	146.785	2238.806	8320	8400	1253.333	15066.67	15280	1700	15.252	0.498
	3.49	543.478	528.169	535.824	2189.781	6480	6480	1240	8320	8373.333	1696.667	4.087	0.468
	4	200.535	208.333	204.434	2083.333	7066.667	7226.667	1236.667	12053.33	12026.67	1716.667	10.191	0.495
	4.5	245.098	251.678	248.388	1960.784	9680	9813.333	1236.667	13760	13786.67	1746.667	7.894	0.492
	5	235.849	232.919	234.384	2083.333	7573.333	7413.333	1240	11813.33	11706.67	1720	8.889	0.494
	5.49	268.817	263.158	265.988	2083.333	6320	6320	1240	10040	10120	1720	7.832	0.492
	6	263.158	257.732	260.445	2158.273	6320	6240	1251.667	10120	10120	1715	8.287	0.493
	6.5	334.821	331.858	333.34	2142.857	7293.333	7000	1245	10280	10013.33	1711.667	6.428	0.488
	7	256.849	251.678	254.264	2189.781	7960	8013.333	1251.667	11853.33	11986.67	1708.333	8.612	0.493
	7.5	241.935	237.342	239.639	2255.639	8933.333	8906.667	1245	13066.67	13120	1688.333	9.413	0.494
	7.98	228.659	230.061	229.36	2000	7573.333	7600	1246.667	11946.67	11946.67	1746.667	8.72	0.493
	8.5	986.842	1041.667	1014.255	2142.857	10746.67	10773.33	1266.667	11760	11733.33	1733.333	2.113	0.356
	9	903.615	949.367	926.491	2097.902	14173.33	14066.67	1268.333	15280	15120	1745	2.264	0.379
	9.5	278.81	269.784	274.297	1886.792	14453.33	14453.33	1246.667	18040	18160	1776.667	6.879	0.489
	10.01	195.313	195.313	195.313	1923.077	14400	14320	1233.333	19520	19440	1753.333	9.846	0.495
	10.49	396.825	373.134	384.98	1904.762	17680	17560	1233.333	20200	20240	1758.333	4.948	0.479
	11	500	555.556	527.778	1578.947	6120	6240	1300	8120	8040	1933.333	2.992	0.437
	11.5	568.182	559.702	563.942	1898.734	1786.667	1840	1213.333	3546.667	3626.667	1740	3.367	0.452
	12	407.609	407.609	407.609	2222.222	2560	2506.667	1213.333	5013.333	4960	1663.333	5.452	0.483
	12.51	576.923	568.182	572.552	2027.027	2053.333	2400	1236.667	3786.667	4160	1730	3.54	0.457
	12.99	426.136	416.667	421.402	2142.857	2906.667	2933.333	1136.667	5253.333	5333.333	1603.333	5.085	0.48
	13.49	669.643	681.818	675.731	2307.692	2506.667	2586.667	1156.667	4000	4053.333	1590	3.415	0.453
	14	500	487.013	493.507	2083.333	1920	1973.333	1143.333	3920	4026.667	1623.333	4.221	0.47
	14.37	707.547	681.818	694.683	1960.784	2560	2533.333	1150	3973.333	4000	1660	2.823	0.428

Appendix I: Spreadsheet All Data

Depth	meters
VsLeft.m/s	Shot S Velocity
VsRight.m/s	Shot S Velocity
VsAvg.m/s	Velocity in average
Vp.m/s	Velocity in average
NearTLS.us	Near S Left arrival time
NearTRS.us	Near S Right arrival time
NearTP.us	Near P arrival time
FarTLS.us	Far S Left arrival time
FarTRS.us	Far S Right arrival time
FarTP.us	Far P arrival time
Bulk.MPa	Bulk modulus
Shear.MPa	Shear modulus
Young.MPa	Young's modulus
Vp/Vs	Vp/Vs Ratio
Poisson.n/a	Poisson Ratio

Boring	BH-25
Date	9/28/2023
Company	In Situ Engineering
Client	GN Northern
City	Richland
County	
State	WA
County	USA
Project	Atlas Agro
Run 1	2.5 - 19.5
Run 2	2.51 - 19.59
Run 3	N/A

Run - 1	Depth	VsLeft	VsRight	VsAvg	Vp	NearTLS	NearTRS	NearTP	FarTLS	FarTRS	FarTP	Vp/Vs	Poisson
	2.5	773.196	781.25	777.223	1829.268	5540	5500	1238.333	6833.333	6780	1785	2.354	0.39
	2.99	781.25	728.155	754.703	1923.077	6313.333	6220	1231.667	7593.333	7593.333	1751.667	2.548	0.409
	4	728.155	735.294	731.725	2040.816	5646.667	5686.667	1225	7020	7046.667	1715	2.789	0.426
	4.5	324.675	307.377	316.026	1910.828	6113.333	5900	1228.333	9193.333	9153.333	1751.667	6.046	0.486
	5	375.94	388.601	382.27	1754.386	5040	5060	1228.333	7700	7633.333	1798.333	4.589	0.475
	5.49	652.174	669.643	660.908	2054.794	4673.333	4740	1231.667	6206.667	6233.333	1718.333	3.109	0.442
	6	362.319	351.288	356.804	2040.816	4340	4273.333	1225	7100	7120	1715	5.72	0.484
	6.51	517.241	477.707	497.474	1910.828	4580	4353.333	1218.333	6513.333	6446.667	1741.667	3.841	0.464
	7	474.684	438.597	456.64	2189.781	3740	3726.667	1231.667	5846.667	6006.667	1688.333	4.795	0.477
	7.5	531.915	531.915	531.915	2068.965	4806.667	4846.667	1235	6686.667	6726.667	1718.333	3.89	0.465
	8	819.672	769.231	794.451	2197.802	4940	4900	1240	6160	6200	1695	2.766	0.425
	8.5	543.478	515.464	529.471	1869.159	5580	5560	1220	7420	7500	1755	3.53	0.456
	9	595.238	641.026	618.132	1960.784	6360	6460	1240	8040	8020	1750	3.172	0.445
	9.5	555.556	574.713	565.134	2054.795	6170	6320	1222.5	7970	8060	1709.167	3.636	0.459
	10	726.392	737.101	731.747	2054.794	6623.333	6623.333	1209.167	8000	7980	1695.833	2.808	0.427
	10.49	480.769	462.963	471.866	1875	6020	6040	1222.5	8100	8200	1755.833	3.974	0.466
	11	350.877	336.7	343.789	2013.423	5560	5520	1215.833	8410	8490	1712.5	5.857	0.485
	11.5	386.598	380.711	383.654	2068.966	5410	5370	1195.833	7996.667	7996.667	1679.167	5.393	0.482
	12	382.653	382.653	382.653	1935.484	5370	5383.333	1209.167	7983.333	7996.667	1725.833	5.058	0.48
	12.5	493.421	487.013	490.217	2027.027	5596.667	5570	1189.167	7623.333	7623.333	1682.5	4.135	0.469
	13	321.888	316.456	319.172	2054.795	5010	4970	1192.5	8116.667	8130	1679.167	6.438	0.488
	13.5	416.667	412.088	414.377	2255.639	4850	4796.667	1212.5	7250	7223.333	1655.833	5.443	0.483
	14	872.093	824.176	848.134	1875	5543.333	5516.667	1195.833	6690	6730	1729.167	2.211	0.371
	14.5	765.306	797.872	781.589	1948.052	5010	5076.667	1202.5	6316.667	6330	1715.833	2.492	0.404
	15	446.429	423.729	435.079	1775.148	4996.667	4970	1192.5	7236.667	7330	1755.833	4.08	0.468
	15.5	443.787	441.176	442.482	1910.828	4463.333	4476.667	1195.833	6716.667	6743.333	1719.167	4.318	0.472
	15.99	423.729	421.348	422.539	1886.792	4210	4223.333	1189.167	6570	6596.667	1719.167	4.465	0.474
	16.5	480.769	474.684	477.726	1829.268	4170	4170	1195.833	6250	6276.667	1742.5	3.829	0.463
	17	520.833	510.204	515.519	1960.784	3850	3823.333	1192.5	5770	5783.333	1702.5	3.804	0.463
	17.5	502.513	510.204	506.358	2040.816	3790	3780	1189.167	5780	5740	1679.167	4.03	0.467
	18	543.478	526.316	534.897	1986.755	3790	3750	1195.833	5630	5650	1699.167	3.714	0.461
	18.49	523.56	520.833	522.197	1986.755	3470	3450	1189.167	5380	5370	1692.5	3.805	0.463
	19.5	574.713	555.556	565.134	1612.903	2810	2780	1232.5	4550	4580	1852.5	2.854	0.43

Run - 2	Depth	VsLeft	VsRight	VsAvg	Vp	NearTLS	NearTRS	NearTP	FarTLS	FarTRS	FarTP	Vp/Vs	Poisson
	2.51	256.849	241.936	249.392	1923.077	11040	10826.67	1220	14933.33	14960	1740	7.711	0.491
	3	157.563	157.563	157.563	1851.852	6533.333	6373.333	1200	12880	12720	1740	11.753	0.496
	3.52	135.87	134.892	135.381	1923.077	7386.667	7413.333	1190	14746.67	14826.67	1710	14.205	0.498
	4	200.535	211.864	206.2	1973.684	5946.667	6000	1213.333	10933.33	10720	1720	9.572	0.494
	4.5	320.513	326.087	323.3	2083.333	6106.667	6133.333	1213.333	9226.667	9200	1693.333	6.444	0.488
	5.01	371.287	371.287	371.287	2000	5066.667	5066.667	1213.333	7760	7760	1713.333	5.387	0.482
	5.5	344.037	360.577	352.307	2027.027	4373.333	4586.667	1193.333	7280	7360	1686.667	5.754	0.484
	6	357.143	357.143	357.143	2272.727	4320	4346.667	1220	7120	7146.667	1660	6.364	0.487
	6.51	406.504	407.609	407.056	1923.077	4260	4320	1206.667	6720	6773.333	1726.667	4.724	0.477
	7.01	500	551.471	525.735	2112.676	4106.667	4240	1220	6106.667	6053.333	1693.333	4.019	0.467
	7.5	781.25	797.872	789.561	2083.333	4853.333	4800	1213.333	6133.333	6053.333	1693.333	2.639	0.416
	8	1041.667	937.5	989.583	2238.806	5013.333	5013.333	1220	5973.333	6080	1666.667	2.262	0.379
	8.5	535.714	559.702	547.708	1923.077	5653.333	5653.333	1206.667	7520	7440	1726.667	3.511	0.456
	9.01	595.238	604.839	600.038	1923.077	6240	6320	1200	7920	7973.333	1720	3.205	0.446
	9.5	635.593	681.818	658.706	2112.677	6213.333	6293.333	1213.333	7786.667	7760	1686.667	3.207	0.446
	10	852.273	872.093	862.183	2380.952	6533.333	6560	1220	7706.667	7706.667	1640	2.762	0.425
	10.51	416.667	416.667	416.667	2205.882	6186.667	6240	1200	8586.667	8640	1653.333	5.294	0.482
	11	323.276	327.511	325.393	2205.882	5600	5640	1220	8693.333	8693.333	1673.333	6.779	0.489
	11.5	340.909	334.821	337.865	1948.052	4960	4986.667	1213.333	7893.333	7973.333	1726.667	5.766	0.484
	11.99	216.763	215.517	216.14	1973.684	5200	5253.333	1213.333	9813.333	9893.333	1720	9.132	0.494
	12.5	407.609	394.737	401.173	1829.268	4960	4853.333	1206.667	7413.333	7386.667	1753.333	4.56	0.475
	13.01	493.421	480.769	487.095	2173.913	5173.333	5093.333	1220	7200	7173.333	1680	4.463	0.474
	13.5	426.136	446.429	436.283	2112.677	4880	4880	1213.333	7226.667	7120	1686.667	4.842	0.478
	14.01	377.834	370.37	374.102	2020.202	5653.333	5600	1200	8300	8300	1695	5.4	0.482
	14.5	657.895	675.676	666.785	2272.727	4720	4800	1230	6240	6280	1670	3.408	0.453
	15	537.634	537.634	537.634	2197.802	4740	4720	1220	6600	6580	1675	4.088	0.468
	15.51	561.798	561.798	561.798	1980.198	4340	4320	1215	6120	6100	1720	3.525	0.456
	16.04	423.729	423.729	423.729	1980.198	4080	4120	1215	6440	6480	1720	4.673	0.476
	16.5	476.191	467.29	471.74	1960.784	4180	4160	1205	6280	6300	1715	4.156	0.469
	17.01	543.478	505.051	524.264	1980.198	3860	3740	1220	5700	5720	1725	3.777	0.462
	17.5	537.634	543.478	540.556	2197.802	3740	3780	1220	5600	5620	1675	4.066	0.468
	18.03	515.464	533.808	524.636	1886.792	3700	3740	1215	5640	5613.333	1745	3.596	0.458
	18.51	510.204	520.833	515.519	1904.762	3300	3360	1220	5260	5280	1745	3.695	0.46
	19	555.556	543.478	549.517	2083.333	3020	3020	1235	4820	4860	1715	3.791	0.463
	19.51	574.713	588.235	581.474	1980.198	2720	2720	1210	4460	4420	1715	3.405	0.453
	19.59	609.756	581.395	595.576	2000	2720	2660	1245	4360	4380	1745	3.358	0.451

Appendix XII

Seismic Refraction Test Data

Global Geophysics

P. O. Box 2229
Redmond, WA, 98073-2229
Tel: 425-890-4321
Fax: 206-582-0838

August 10, 2023 Our Ref.: 113-0718-001

GN Northern Inc.
722 North 16th Avenue, Suite 31
Yakima, WA 98902

Attention: Mr. Imran Magsi

RE: REPORT ON THE SEISMIC REFRACTION SURVEY AT THE PROPOSED PACIFIC GREEN FERTILIZERS PLANT (GNN JOB NO. 223-1672), RICHLAND, WA

Dear Mr. Magsi:

This letter report presents the results of the seismic refraction survey performed by Global Geophysics. The seismic refraction survey was carried out along 10 transects in the last week of July 2023 at the proposed Pacific Green Fertilizers Plant in Richland, WA. The objective of the geophysical survey is to study subsurface conditions to 100 ft below ground surface under the seismic transects.

GEOPHYSICAL METHODS AND FIELD PROCEDURES

The following paragraphs describe the method and field procedures.

Seismic Refraction

Seismic refraction is the traditional method for determining the rock velocity for rock rippability using a controlled energy source (hammer, blank shotgun shells, or chemical explosives) to generate a seismic signal. The seismic signals are received by a series of geophones (24, for example) that are connected to a seismic cable laid on the surface in a linear manner. The geophones, evenly spaced along the geophone cable, are placed on the ground surface. The seismic energy source (explosive) is discharged at several places along the array and off both ends.

The seismic wavelets travel through the earth to the geophones that convert the acoustic energy in the ground to an electric signal in the geophone cable. The seismograph detects the arriving electric signals with respect to time and stores the records for future data processing. The seismic data is processed to determine the seismic velocity of the earth material through which the energy has traveled and to model the subsurface geology. This geophysical model depicts the earth in cross-section showing the velocity and thickness of the subsurface layers below the seismic line.

The seismic refraction survey was conducted using a Geometrics Geode 24-channel digital seismograph. The sensors used were Mark Products 4.5-Hz vertical geophones and the seismic energy source was a PEG-40kg Propelled Energy Generator. The typical field procedure consisted of laying out the cables and planting the geophones at 10 ft intervals. The shots were set off at seven locations along the geophone array. Data was collected and saved in digital format and a field record was produced on the computer screen to check the data quality in real time.

ANALYSIS AND RESULTS

The seismic transects and resistivity sounding locations are shown in Figure 1. The seismic refraction was conducted along 10 transects.

The inverted depth vs p-wave velocity profiles are presented in Figures 2 to 5.

Three geological units are interpreted.

- The surface layer: 900-2000 ft/s; Unconsolidated top soil;
- 2nd layer: 2000-5300 ft/s; gravel stratum.
- Basal layer: 5300 ft/s, very dense gravel stratum.

The interpreted interfaces are based on the borehole logs.

CLOSURE

Global Geophysics services will be conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. However, seismic refraction is a remote sensing geophysical methods that may not detect all subsurface conditions. Furthermore, velocity inversion and hidden layers are the limitations of seismic refraction. In general, the errors in the interpreted depths and velocities, dependent on the resolution of the technique, are estimated to be approximately ±15 % of the true depths and velocities.

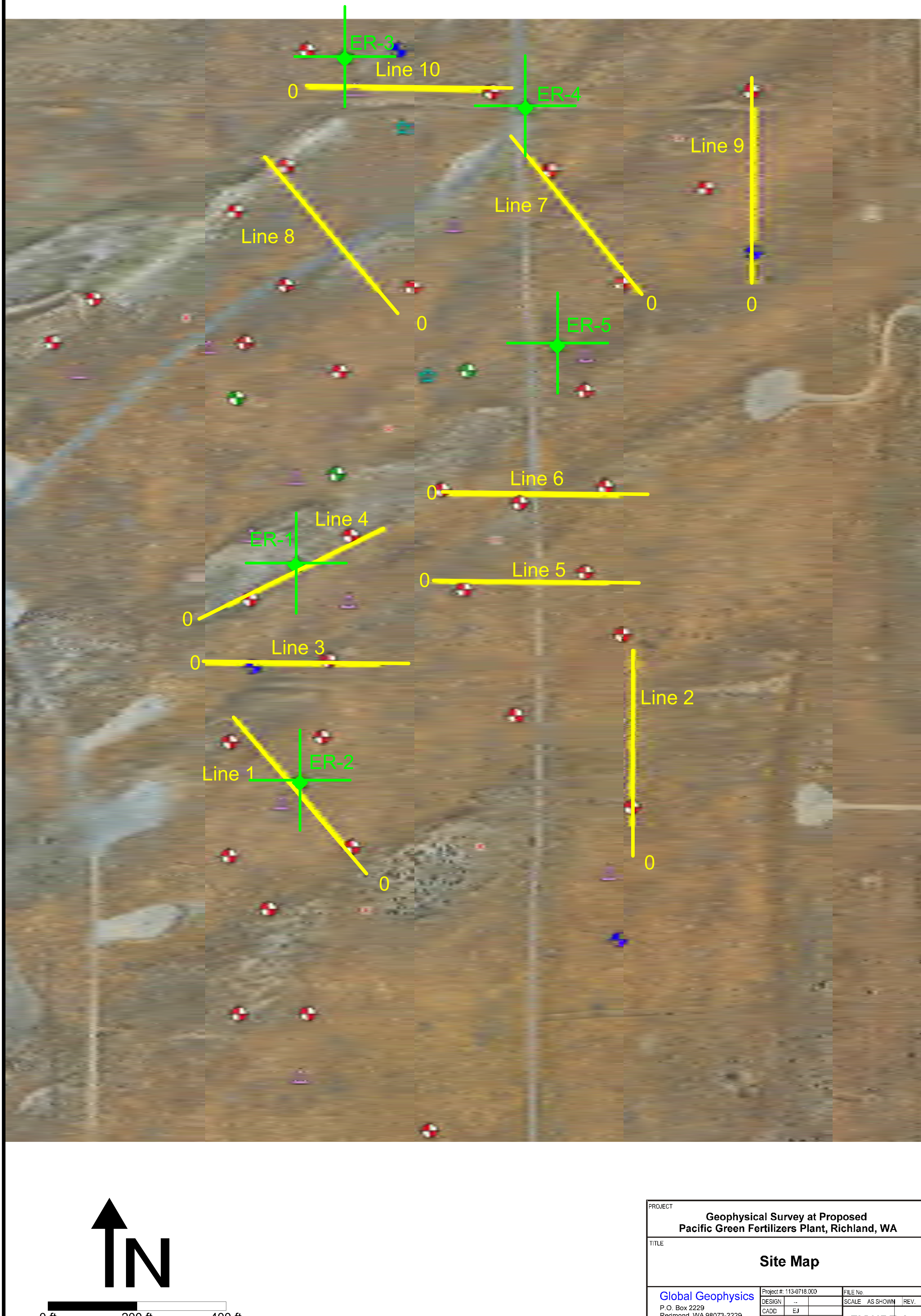
We appreciate the opportunity to work with you on this project, and we hope that you find the results of the geophysical survey useful to your investigation. If you have any questions regarding this report, please call the undersigned at 425-890-4321. We look forward to providing you with additional geophysical services in the future.

Sincerely,

Global Geophysics.

John

John Liu, Ph.D., R.G.
Principal Geophysicist



PROJECT **Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA**			
TITLE **Site Map**			
Global Geophysics P.O. Box 2229 Redmond, WA 98073-2229 Tel: 425-890-4321	Project #: 113-0718.000	FILE No.	
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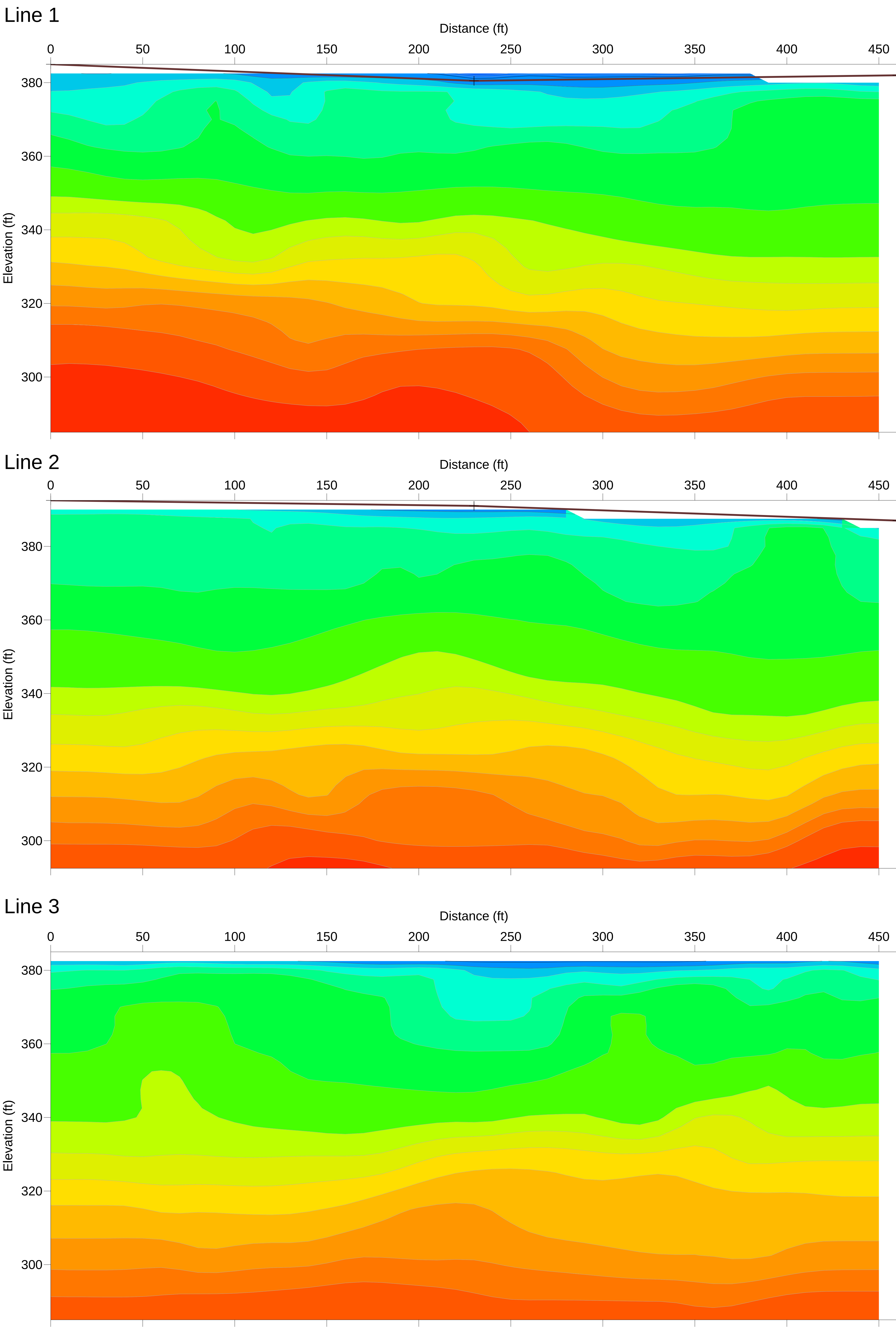
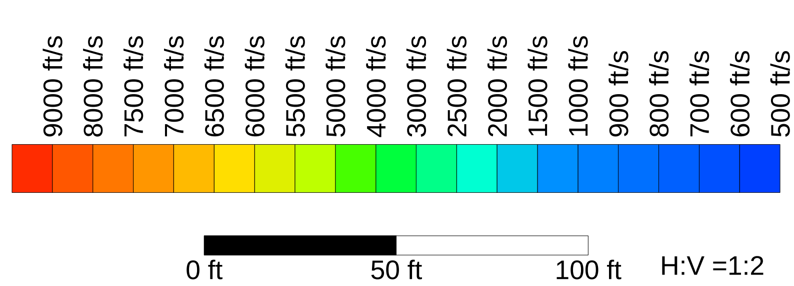
	CADD EJ	**FIGURE 1**	
	CHECK JL		
	REVIEW --		





PROJECT			
Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA			
TITLE **Seismic Profiles 1-3**			
Global Geophysics P.O. Box 2229 Redmond, WA 98073-2229 Tel: 425-890-4321	Project #: 113-0718.000		FILE No.
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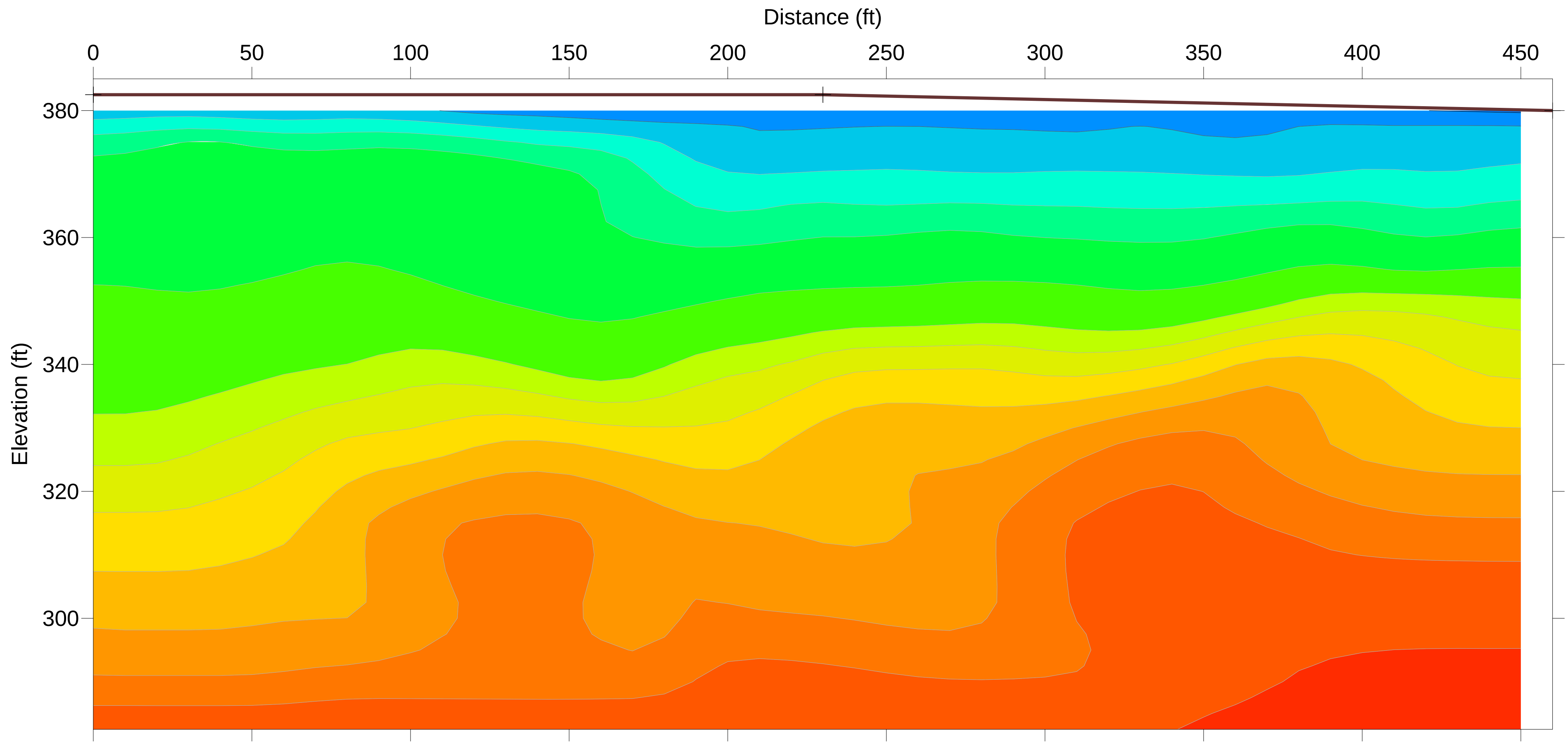

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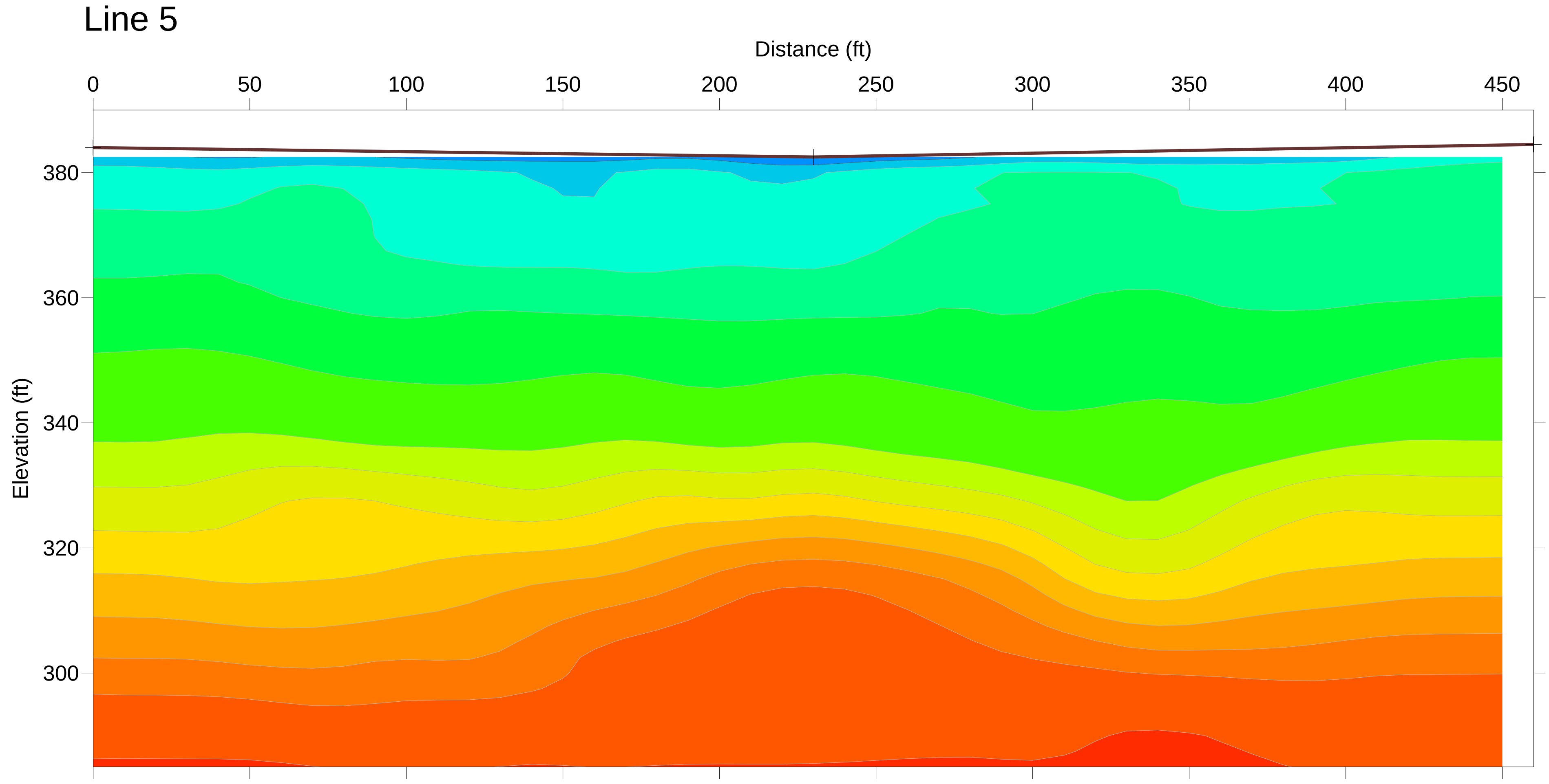
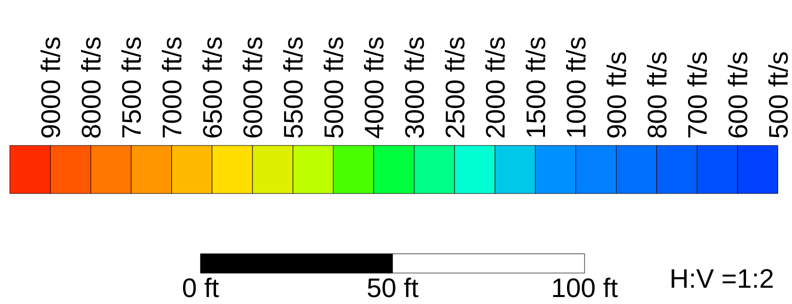




PROJECT

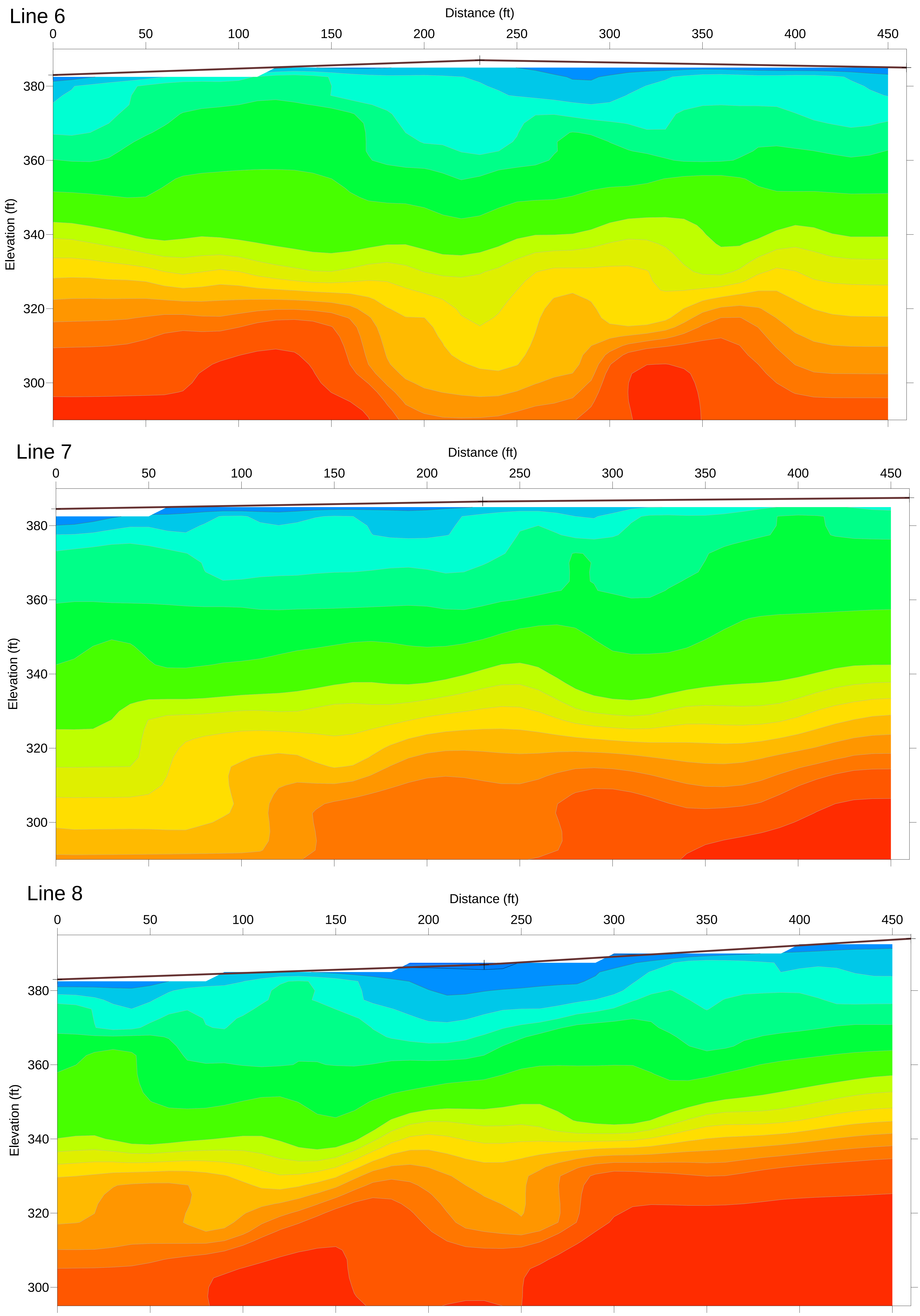
Geophysical Survey at Proposed
Pacific Green Fertilizers Plant, Richland, WA

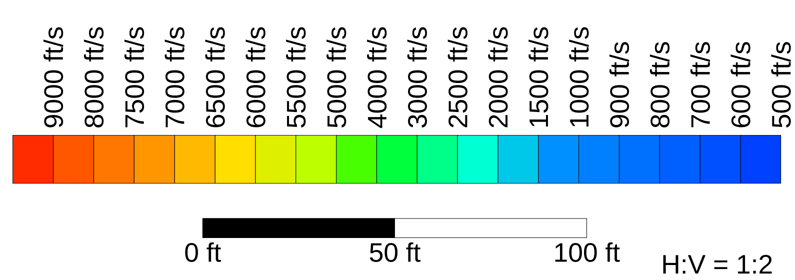
TITLE

Seismic Profiles 4-5

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 113-0718.000		FILE No.
DESIGN	--	SCALE AS SHOWN / REV.
CADD	EJ	
CHECK	JL	**FIGURE 3**
REVIEW	--	





PROJECT

Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA

TITLE

Seismic Profiles 6-8

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 113-0718.000		FILE No.	
DESIGN	--	SCALE AS SHOWN	REV.
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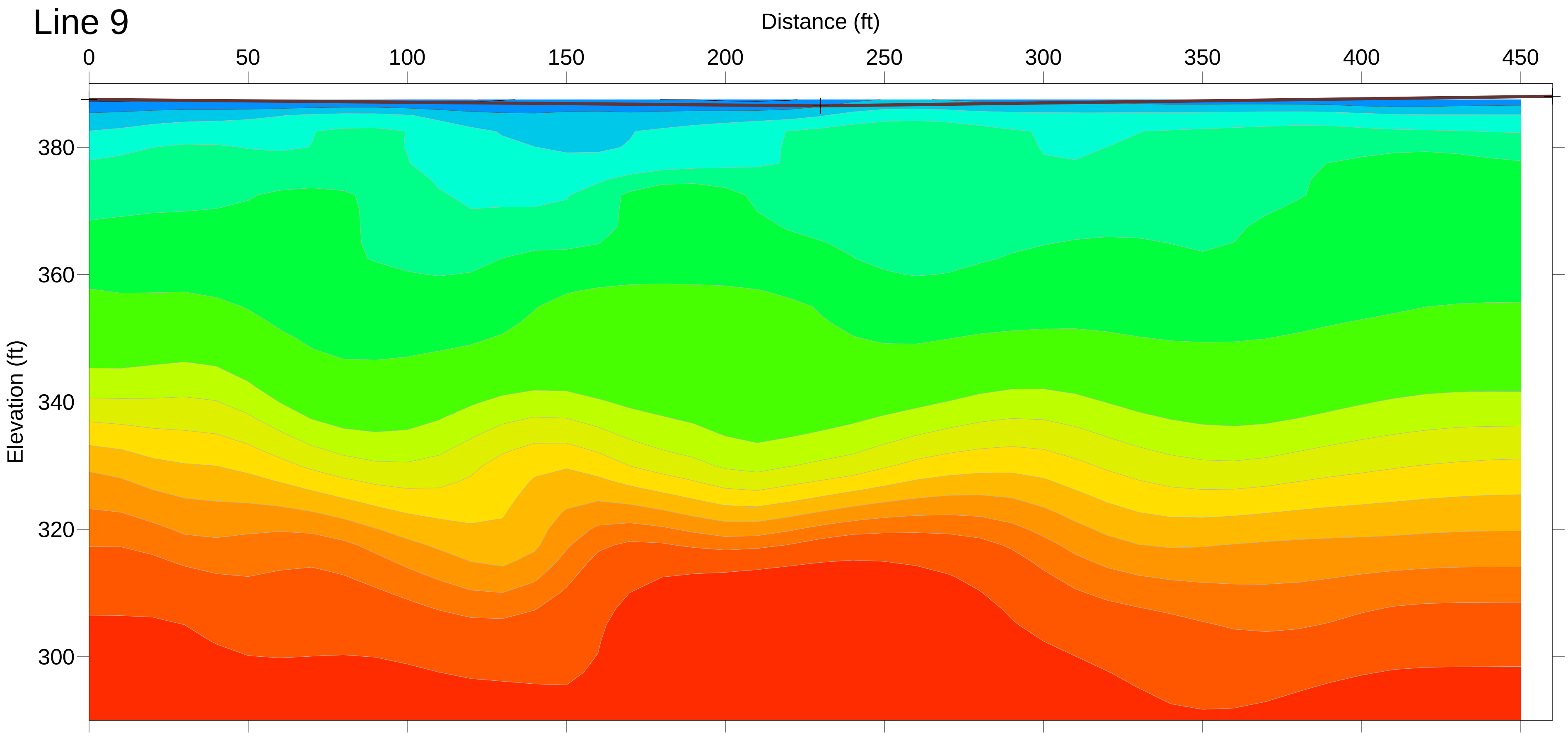
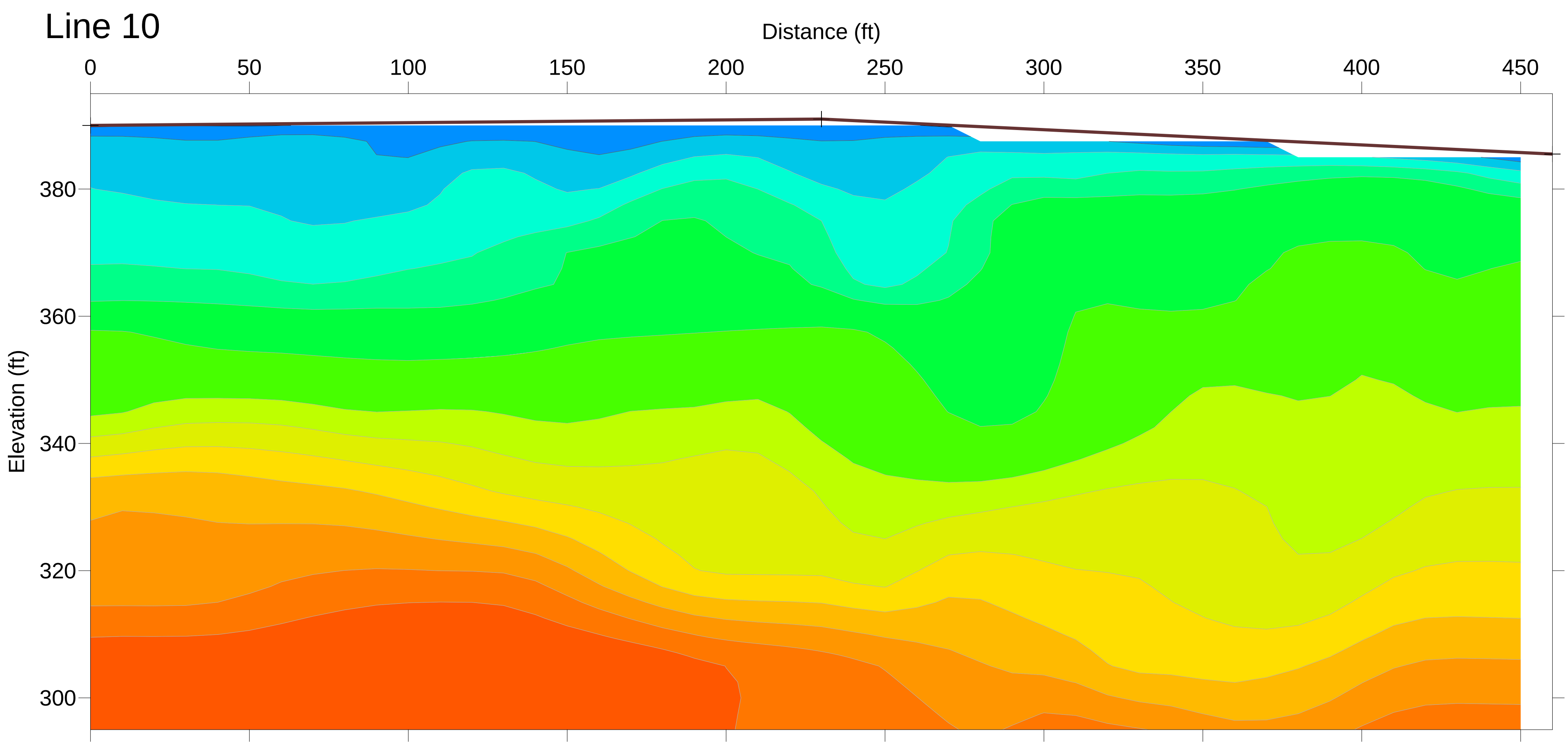
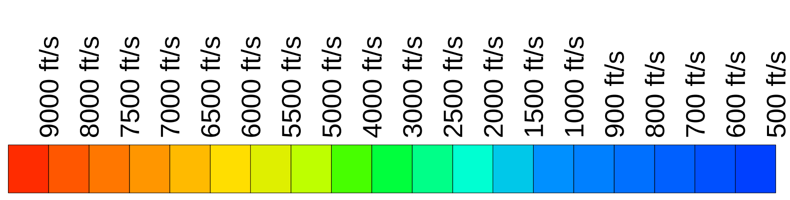
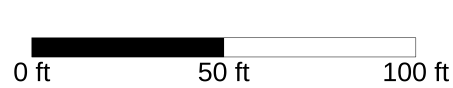
REVIEW	--		

FIGURE 4









PROJECT
Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA

TITLE
Seismic Profiles 9-10

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 113-0718.000		FILE No.	
DESIGN	--	SCALE AS SHOWN	REV.
CADD	EJ	FIGURE 5	
CHECK	JL		
REVIEW	--		

Appendix XIII

Refraction Micro**tremor** (ReMi) Survey Data

Global Geophysics

P. O. Box 2229
Redmond, WA, 98073-2229
Tel: 425-890-4321
Fax: 206-582-0838

August 10, 2023 Our Ref.: 113-0718-003

GN Northern Inc.
722 North 16th Avenue, Suite 31
Yakima, WA 98902

Attention: Mr. Imran Magsi

RE: REPORT ON THE REFRACTION MICROTREMOR AT THE PROPOSED PACIFIC GREEN FERTILIZERS PLANT(GNN JOB NO. 223-1672), RICHLAND, WA

Dear Mr. Magsi:

This letter report presents the results of the geophysical surveys performed by Global Geophysics. The seismic refraction microtremor survey was carried out at 5 locations. The objective of the surveys is to provide s-wave velocity profile to 100 ft below ground surface.

GEOPHYSICAL METHODS AND FIELD PROCEDURES

The following paragraphs describe the method and field procedures.

Refraction Microtremor (ReMi)

The ReMi method determines variations in surface wave velocities with increasing distances and wavelengths. The data from these measurements are used to model the shear wave velocities of the subsurface. This information can then be used to infer rock/soil types, stratigraphy and soil conditions.

The ReMi survey requires a seismic source, to generate surface-waves, and at least 24 geophones, to measure the ground response at increasing distances from the source. Surface waves are a special type of seismic wave whose propagation is confined to the near surface medium. The depth of subsurface penetration of a surface-wave is directly proportional to its wavelength. In a non-homogeneous medium, surface-waves are dispersive, i.e. each wavelength has a characteristic velocity stemming from subsurface heterogeneities. The relationship between surface-wave velocity and wavelength is used to calculate the shear-wave velocity of the medium with increasing depth.

The seismic source can be either active or passive, depending on the application and location of the survey. Examples of active sources include explosives, weight-drops, and vibrating pads. Examples of passive sources are drill rigs, road traffic, micro-tremors, and water-wave action (in near-shore environments). Geophone measures the arrival time of the various components of the surface wave-train traveling from the seismic source.

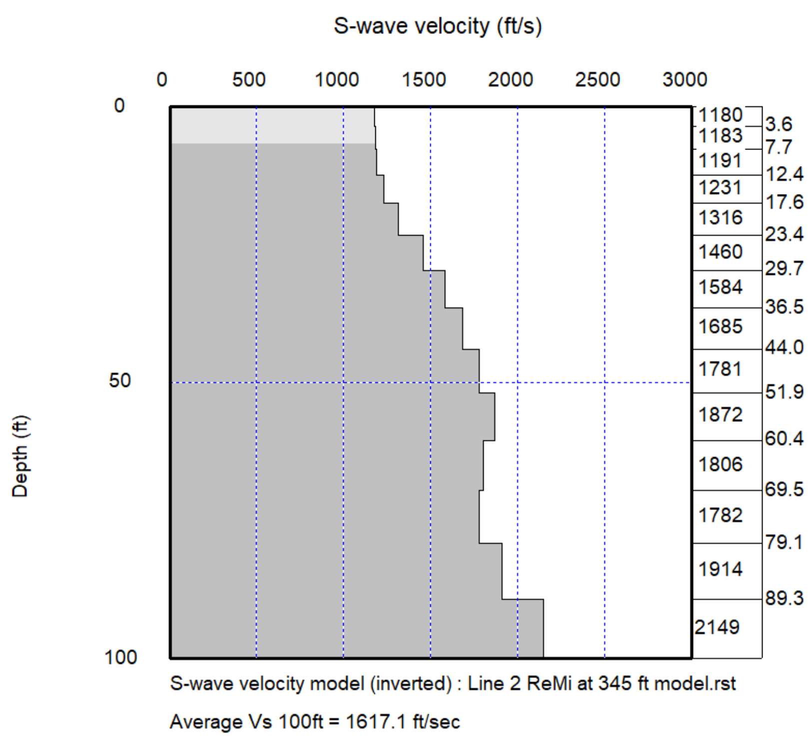
The surface-wave velocity with respect to frequency (called the 'dispersion curve') is determined by measuring the delay time in wave propagation between the geophones. The dispersion curve is then matched to a theoretical dispersion curve using an iterative forward-modeling procedure. The result is a profile of shear-wave velocity versus depth. This shear wave profile can be with used other parameters such as density, to estimate the dynamic shear modulus of the medium as a function of depth.

The ReMi survey was conducted using a Geometrics Geode 24-channel digital seismograph with acquisition software. The sensors were Mark Products 4.5-Hz vertical geophones placed at 10 ft spacing and the seismic energy source was ambient noise.

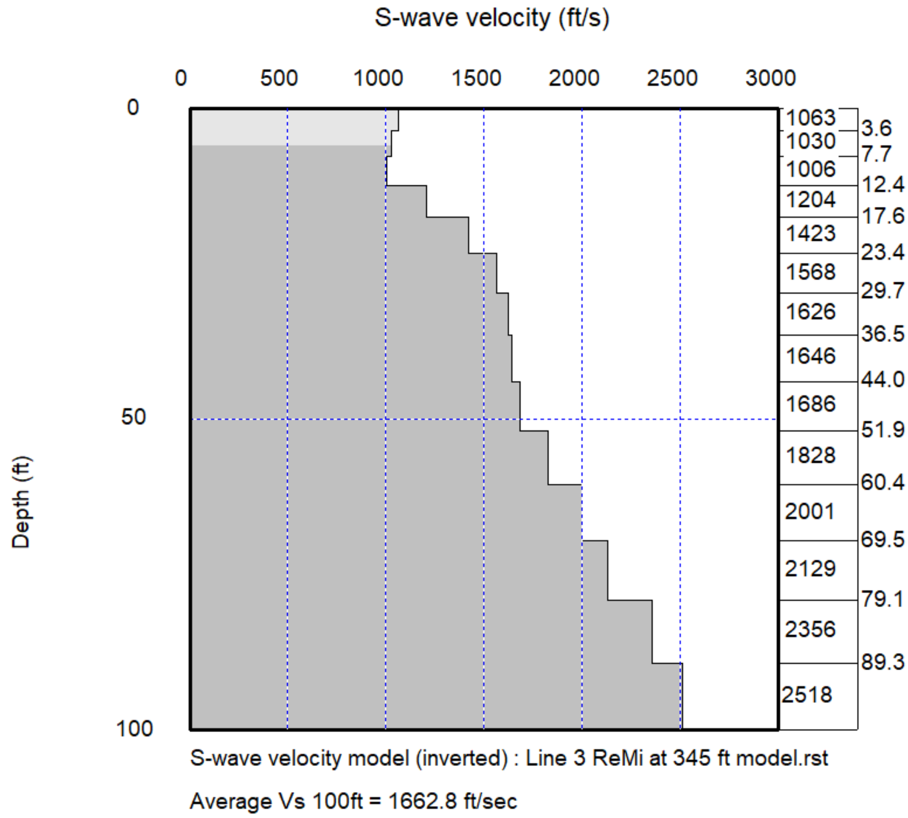
ANALYSIS AND RESULTS

The seismic transects and resistivity sounding locations are shown in Figure 1.

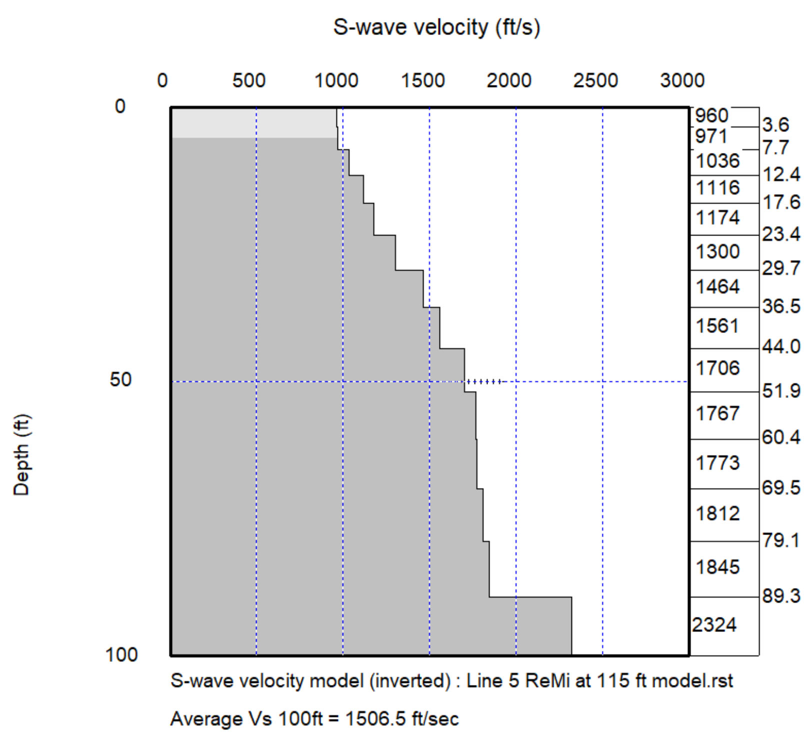
The S-wave model at ST 115 on Line 2 is show below:



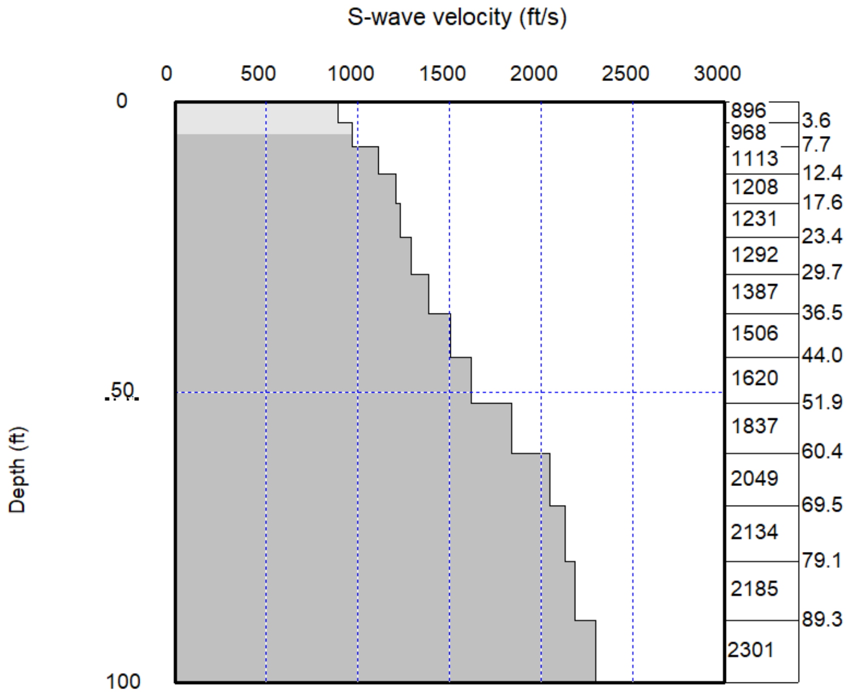
The S-wave model at ST 345 on Line 3 is show below:



The S-wave model at ST 115 on Line 5 is show below:



The S-wave model at ST 345 on Line 6 is show below:



S-wave velocity model (inverted) : Line 6 ReMi at 345 ft model.rst

Average Vs 100ft = 1562.9 ft/sec

CLOSURE

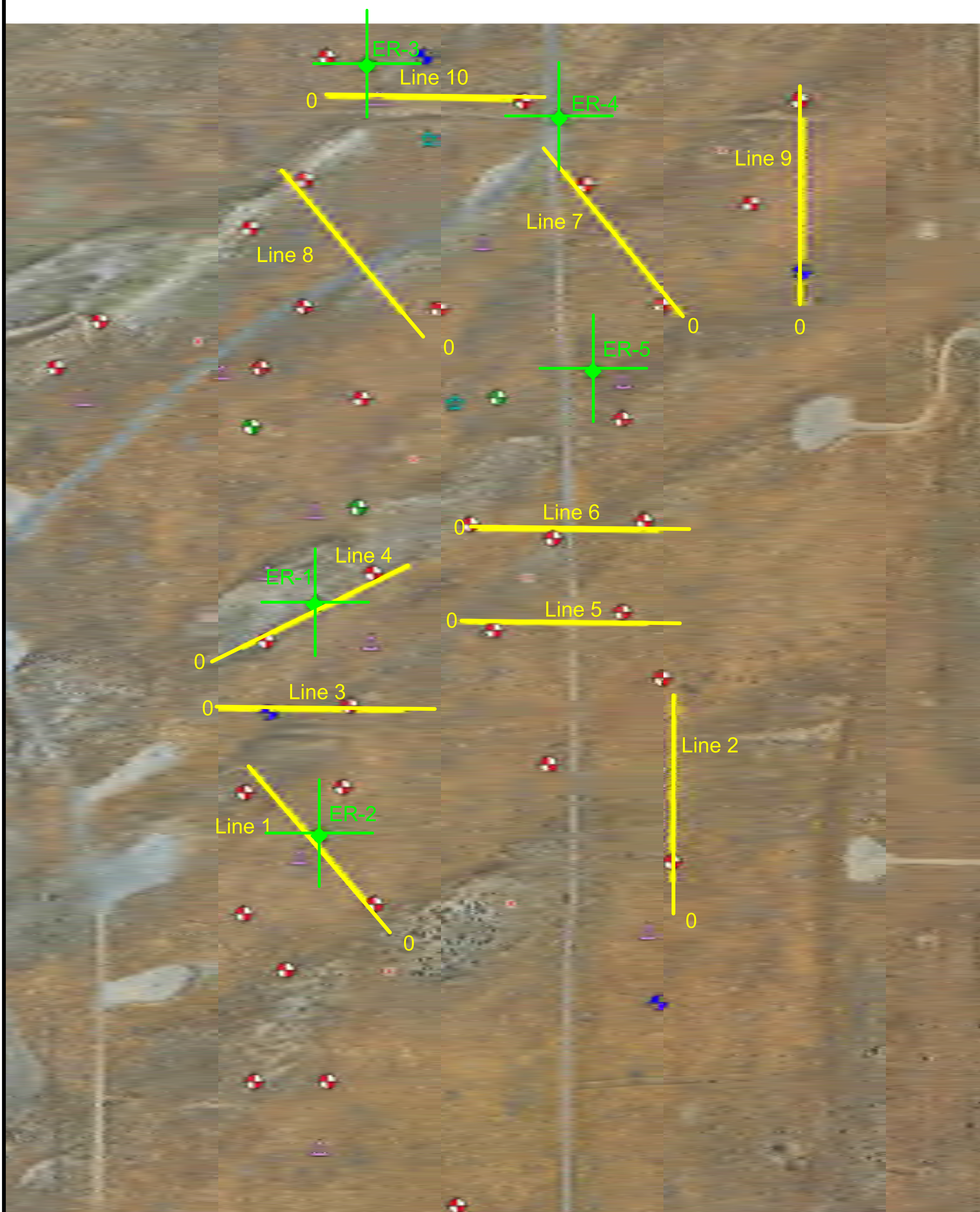
Global Geophysics services will be conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. However, ReMi is a remote sensing geophysical method that may not detect all subsurface conditions.

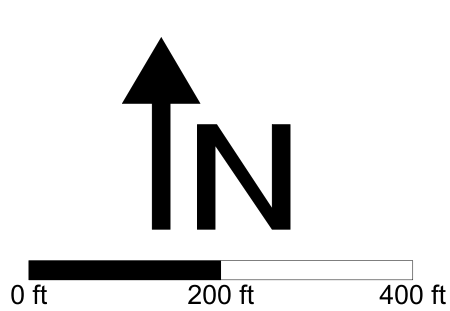
We appreciate the opportunity to work with you on this project, and we hope that you find the results of the geophysical survey useful to your investigation. If you have any questions regarding this report, please call the undersigned at 425-890-4321. We look forward to providing you with additional geophysical services in the future.

Sincerely,

Global Geophysics.

John Liu, Ph.D., R.G.
Principal Geophysicist





PROJECT
Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA

TITLE
Site Map

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 113-0718.000		FILE No.	
DESIGN	--	SCALE AS SHOWN	REV.
CADD	EJ	**FIGURE 1**	
CHECK	JL		
REVIEW	--		

Appendix XIV

Electrical Resistivity Test Data

Global Geophysics

P. O. Box 2229
Redmond, WA, 98073-2229
Tel: 425-890-4321
Fax: 206-582-0838

August 10, 2023 Our Ref.: 113-0718-002

GN Northern Inc.
722 North 16th Avenue, Suite 31
Yakima, WA 98902

Attention: Mr. Imran Magsi

RE: REPORT ON THE RESISTIVITY SURVEY AT THE PROPOSED PACIFIC GREEN FERTILIZERS PLANT (GNN JOB NO. 223-1672), RICHLAND, WA

Dear Mr. Magsi:

This letter report presents the results of the resistivity survey performed by Global Geophysics. The resistivity soundings were conducted at 5 locations in the last week of July 2023 at the proposed Pacific Green Fertilizers Plant in Richland, WA. The objective of the geophysical survey is to study subsurface conditions to 150 ft below ground surface at 5 resistivity sounding locations.

GEOPHYSICAL METHODS AND FIELD PROCEDURES

The following paragraphs describe the method and field procedures.

Electrical Resistivity

The electrical resistivity sounding technique measures the differences in the electrical properties of geologic materials. These differences can result from variations in lithology, water content, and pore-water chemistry. The method involves transmitting an electric current into the ground between two electrodes and measuring the voltage between two other electrodes. The direct measurement is the apparent resistivity of the area beneath the electrodes. The measurements include deeper layers as the electrode spacing is increased.

The data were acquired with an L&R MiniRes resistivity meter, along 10 traverses at 5 locations.

ANALYSIS AND RESULTS

The resistivity sounding locations are shown in Figure 1. The resistivity sounding data are presented in the Tables below.

Location: Richland, WA

Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/28/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

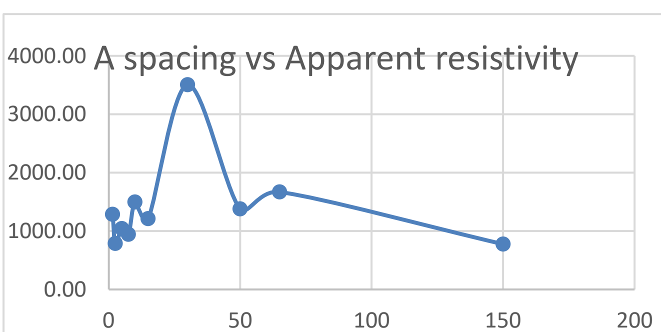
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-1-NS

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	447.4	1285.52
2.5	164.2	786.33
5	108.7	1041.10
7.5	65.6	942.45
10	78.1	1496.04
15	42.2	1212.54
30	61	3505.45
50	14.4	1379.20
65	13.4	1668.44
150	2.7	775.80



Location: Richland, WA

Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/28/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

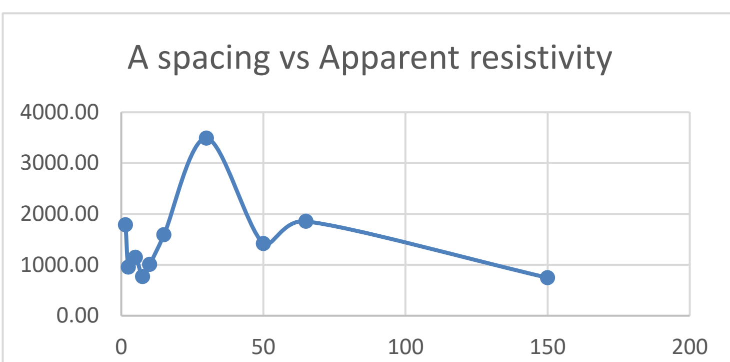
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-1-EW

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	622.1	1787.49
2.5	199.4	954.90
5	119.8	1147.41
7.5	53.6	770.05
10	52.7	1009.49
15	55.4	1591.82
30	60.7	3488.21
50	14.8	1417.51
65	14.9	1855.21
150	2.6	747.06



Location: Richland, WA

Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

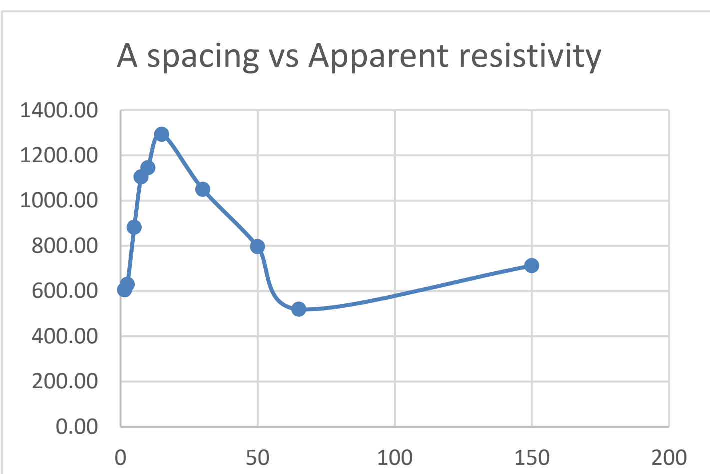
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-2-NS

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	210.6	605.12
2.5	131.5	629.74
5	92.1	882.11
7.5	76.9	1104.79
10	59.8	1145.50
15	45	1293.00
30	18.263	1049.51
50	8.315	796.39
65	4.177	520.08
150	2.48	712.58



Location: Richland, WA

Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

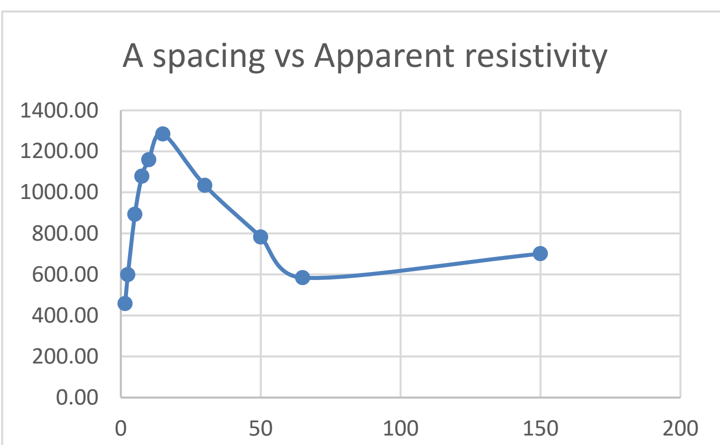
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-2-EW

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	159.4	458.01
2.5	125.1	599.09
5	93.2	892.65
7.5	75.1	1078.93
10	60.5	1158.91
15	44.7	1284.38
30	17.988	1033.71
50	8.163	781.83
65	4.694	584.45
150	2.44	701.09



Location: Richland, WA

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Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

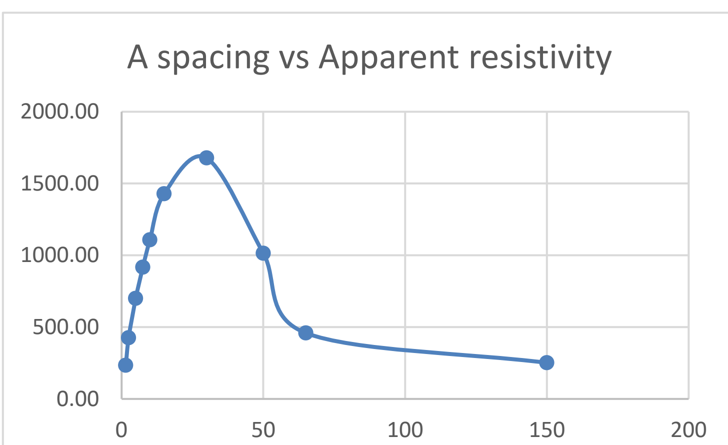
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-3-NS

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	81.5	234.18
2.5	88.9	425.73
5	73	699.18
7.5	63.8	916.59
10	57.8	1107.19
15	49.7	1428.04
30	29.2	1678.02
50	10.582	1013.52
65	3.682	458.45
150	0.877	251.99



Location: Richland, WA

Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

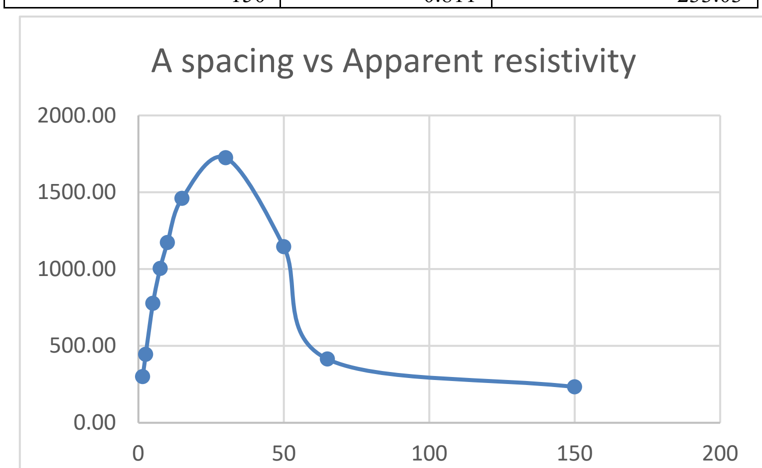
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-3-EW

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	104.2	299.40
2.5	92.8	444.41
5	81.1	776.76
7.5	69.9	1004.23
10	61.2	1172.32
15	50.8	1459.65
30	30	1723.99
50	11.954	1144.92
65	3.33	414.62
150	0.811	233.03



Location: Richland, WA

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Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

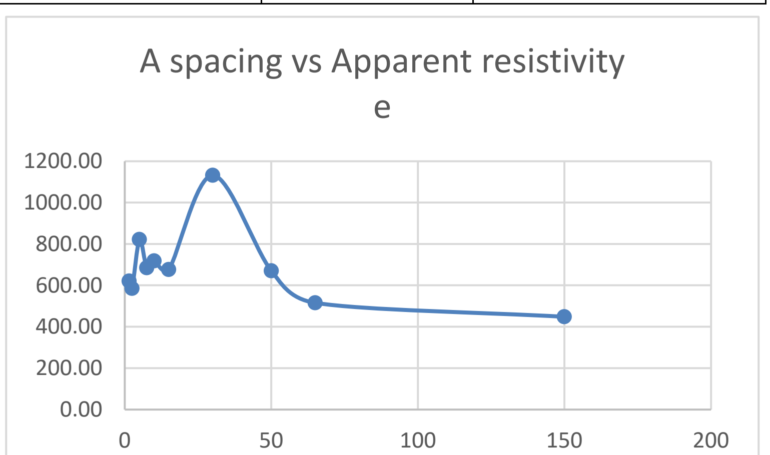
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-4-NS

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	216.1	620.93
2.5	122.3	585.68
5	85.8	821.77
7.5	47.7	685.29
10	37.5	718.33
15	23.545	676.52
30	19.7	1132.09
50	6.998	670.25
65	4.14	515.47
150	1.56	448.24



Location: Richland, WA

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Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

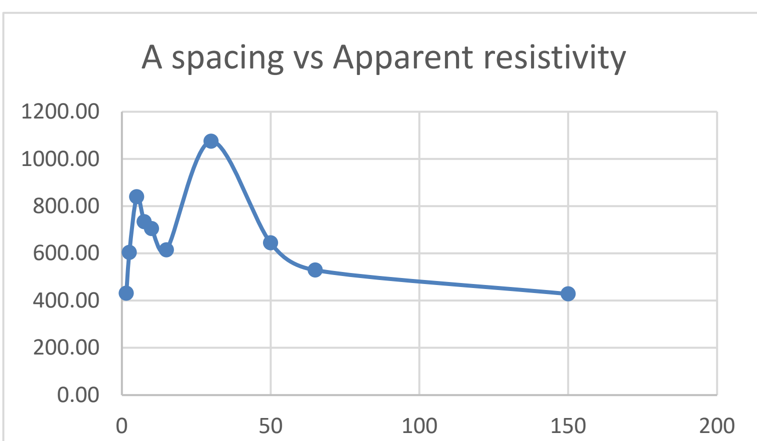
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-4-EW

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	150	431.00
2.5	126.1	603.88
5	87.7	839.97
7.5	51.1	734.13
10	36.8	704.92
15	21.4	614.89
30	18.7	1074.62
50	6.726	644.20
65	4.248	528.92
150	1.49	428.13



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Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

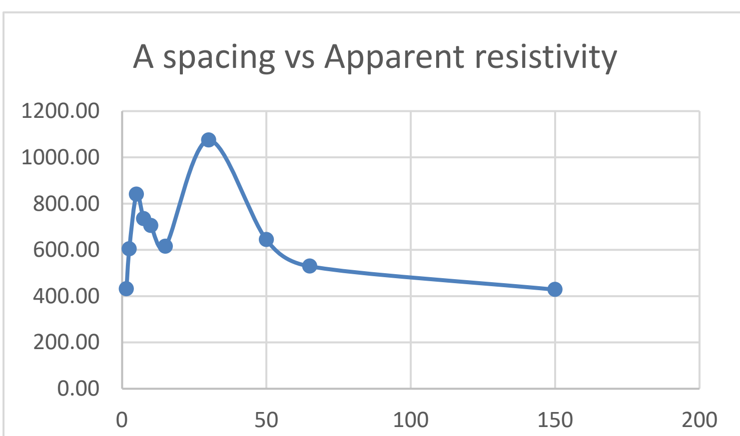
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-5-NS

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	150	431.00
2.5	126.1	603.88
5	87.7	839.97
7.5	51.1	734.13
10	36.8	704.92
15	21.4	614.89
30	18.7	1074.62
50	6.726	644.20
65	4.248	528.92
150	1.49	428.13



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Supplier: Conducted by Global Geophysics, P.O. Box 2229, Redmond, WA, 98073.
Tel. 425-890-4321; email: Jliu@GlobalGeophysics.com;

Date of Test: 7/29/2023

Test Type: In situ

Manufacturer and model: LRI MINI-RES Resistivity Meter

Date of last meter calibration: April, 2023

Ambient temperature: 90 F

Weather condition: Clear

Recent precipitation: None

Soil composition: Silty **Sand**

Difficulty of inserting the electrodes: Easy to Moderately Easy

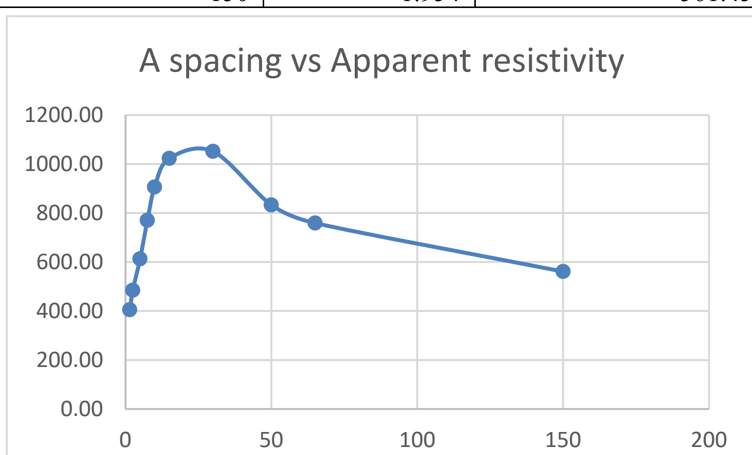
Terrain condition: Sparse Short Grass

Lead cable size: 16 gauge copper wires

Electrode: 3/4 inch in diameter, 12 inch long stainless steel

Sounding Name: ER-5-EW

Electrode Spacing "a" (ft)	Apparent Resistance (ohm)	Apparent Resistivity (ohm-m)
1.5	140.9	404.85
2.5	101.2	484.63
5	64	612.98
7.5	53.6	770.05
10	47.3	906.05
15	35.6	1022.90
30	18.3	1051.64
50	8.7	833.26
65	6.1	759.52
150	1.954	561.45



CLOSURE

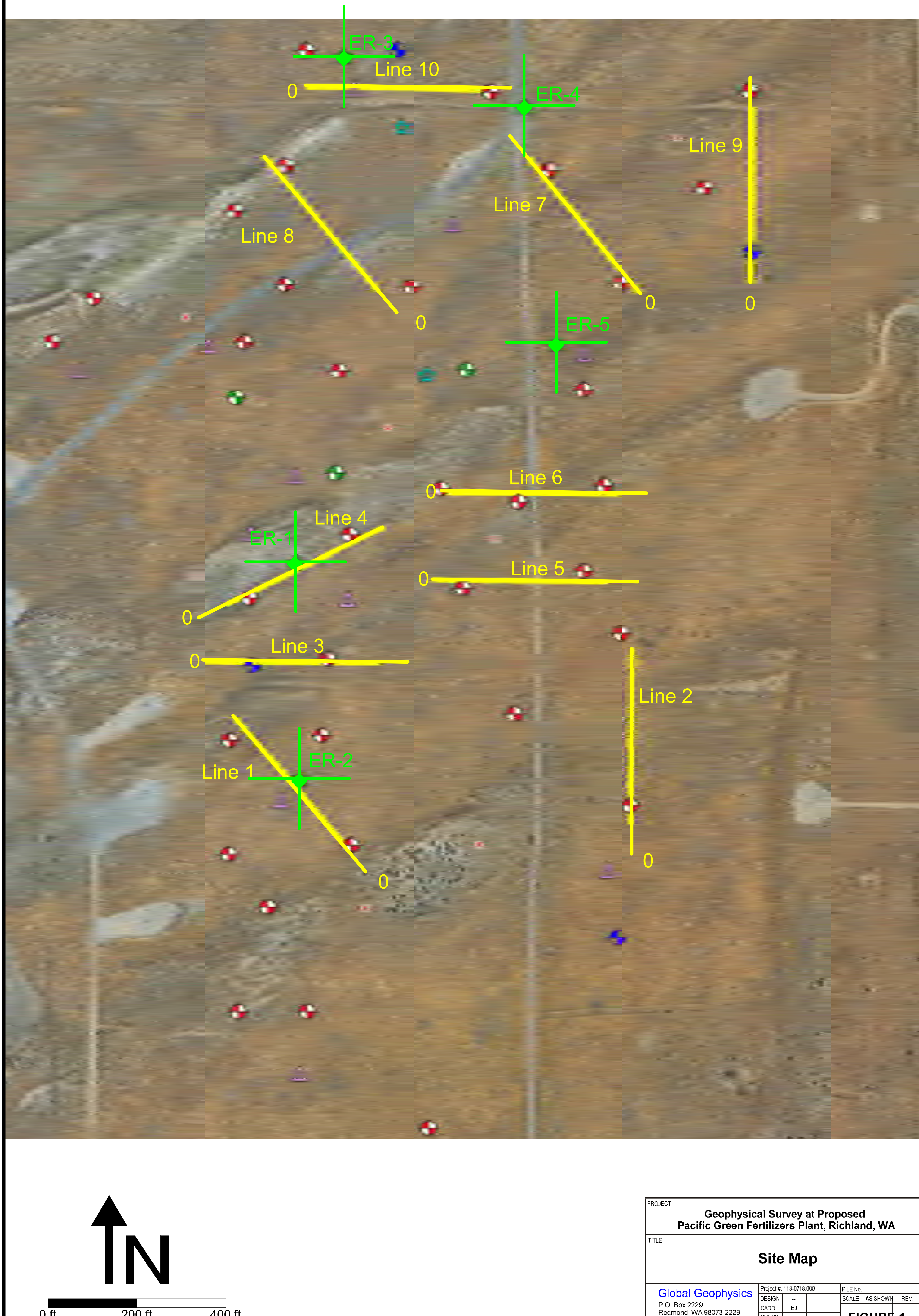
Global Geophysics services will be conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. However, resistivity is aremote sensing geophysical method that may not detect all subsurface conditions.

We appreciate the opportunity to work with you on this project, and we hope that you find the results of the geophysical survey useful to your investigation. If you have any questions regarding this report, please call the undersigned at 425-890-4321. We look forward to providing you with additional geophysical services in the future.

Sincerely,

Global Geophysics.

John Liu, Ph.D., R.G.
Principal Geophysicist



PROJECT

Geophysical Survey at Proposed Pacific Green Fertilizers Plant, Richland, WA

TITLE

Site Map

Global Geophysics
P.O. Box 2229
Redmond, WA 98073-2229
Tel: 425-890-4321

Project #: 113-0718.000		
DESIGN	--	
CADD	EJ	
CHECK	JL	
REVIEW	--	

FILE No.

SCALE AS SHOWN

REV.

FIGURE 1

Appendix XV

Thermal Resistivity Test Data

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

August 31, 2023

GN Northern, Inc.
722 North 16th Ave, Ste 31
Yakima, WA 98902
Attn: Rebecca Larsen

Re: Thermal Analysis of Native Soil Samples
Atlas Agro Pacific Green Fertilizer – Richland, WA (Project No. 223-1672)

The following is the report of thermal dryout characterization tests conducted on two (2) samples of native soil from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The samples were tested at the 'optimum' moisture content and 95% of the modified Proctor dry density ***provided by GN Northern.*** The tests were conducted in accordance with the IEEE standard 442-2017. The results are tabulated below and the thermal dryout curves are presented in **Figures 1 and 2.**

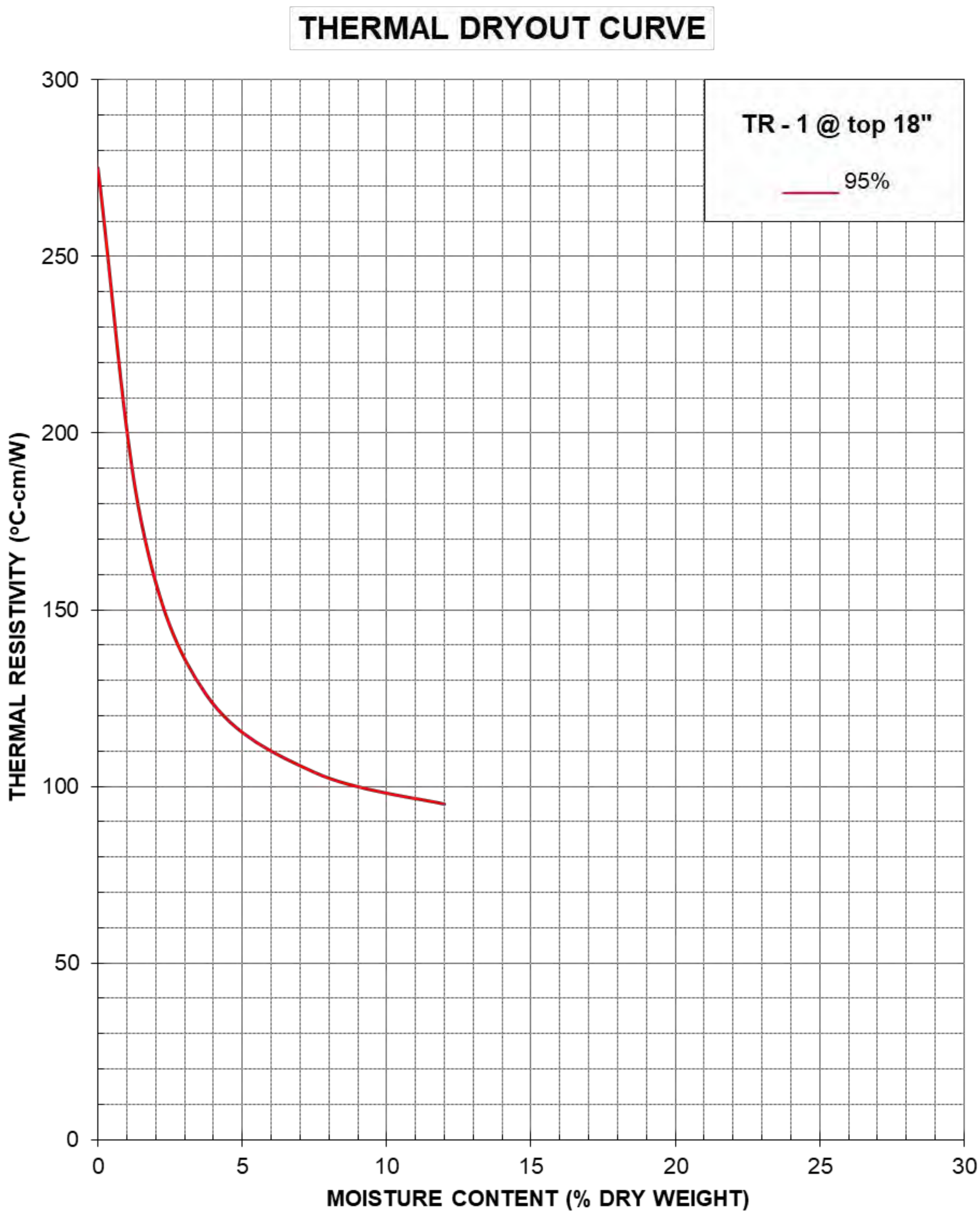
Sample ID, Description, Thermal Resistivity, Moisture Content and Density

Sample ID	Depth (ft)	Effort (%)	Description (GN Northern)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
				Wet	Dry		
TR - 1	Top 18"	95	Sand	95	275	12	103
TR - 2	Top 18"	95	Sand	90	227	12	107

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA

Nimesh Patel

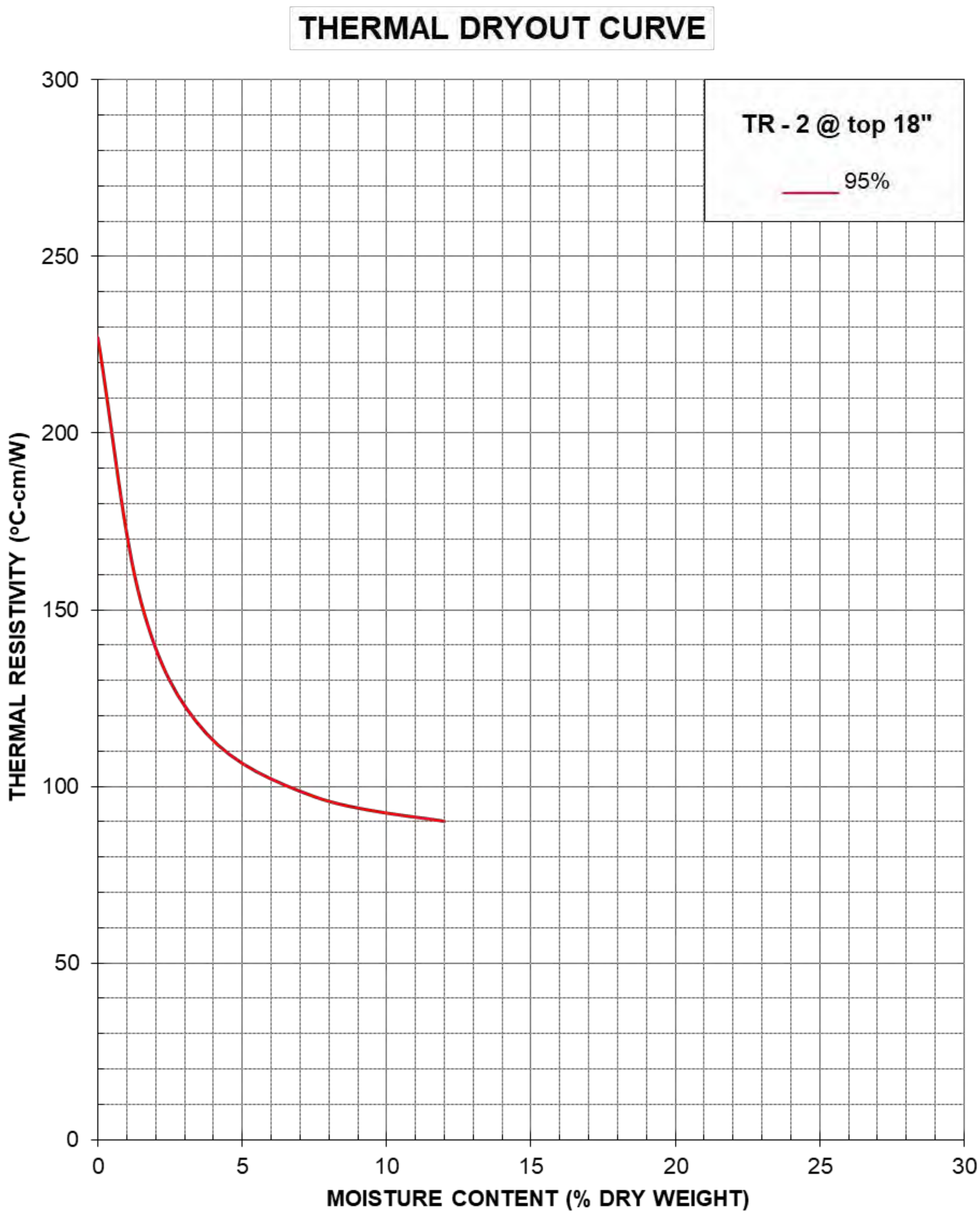


GN Northern (Project No. 223-1672)

Atlas Agro Pacific Green Fertilizer – Richland, WA

Thermal Analysis of Native Soil Samples

August 2023 **Figure 1**



GN Northern (Project No. 223-1672)

Atlas Agro Pacific Green Fertilizer – Richland, WA

Thermal Analysis of Native Soil Samples

August 2023 **Figure 2**

GN Northern, Inc.
Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

CLIENT:	Tecnicas Reunidas	JOB NO:	223-1672
PROJECT:	Pacific Green Fertilizer Plant	LABORATORY NO:	172041
SAMPLE SOURCE:	TR-1	WORK ORDER NO:	164582
DATE SAMPLED:	8/18/2023	DATE TESTED:	8/22/2023
MATERIAL TYPE:	Native	TESTED BY:	GV

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
4"		#4	100%
3"		#8	
2 1/2"		#10	89%
2"		#16	
1 1/2"		#20	65%
1 1/4"		#30	
1"		#40	39%
3/4"		#50	
5/8"		#60	
1/2"		#80	19%
3/8"		#100	19%
1/4"		#200	13.8%

SAND EQUIVALENT - ASTM D 2419

MOISTURE DENSITY RELATIONSHIP ASTM D 1557

% Moisture	Dry Density	Note
6.6%	102.1	Moist Preparation Method
8.9%	105.5	Manual Rammer
11.2%	**108.7**	Procedure: A
13.1%	105.5	S.G. (est): **2.3**
15.4%	102.1	

OVERSIZE CORRECTION - ASTM D 4718

Dry Density: **108.7 pcf** **% Moisture:** **11.2%**

LL, PL & PI - ASTM D 4318

Liquid Limit	Plastic Limit	Plast. Index
		NP

MOISTURE - ASTM D 2216

Moisture Content:

SOIL S.G. - ASTM D 854

Specific Gravity @ 20°C:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		

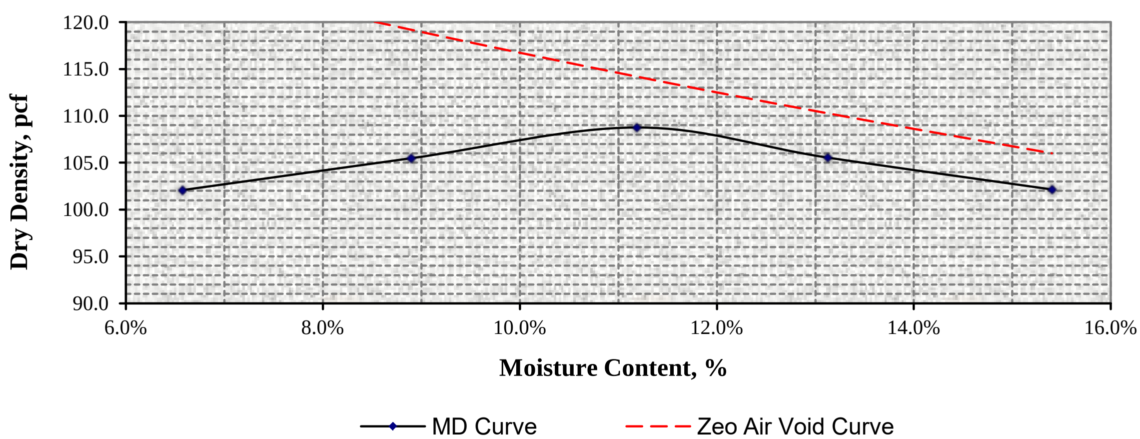
FINENESS MODULUS - ASTM C 136

Fineness Modulus: **0.81**

ORGANIC IMPURITIES - ASTM C 40

Organic Plate Number:

MOISTURE-DENSITY RELATIONSHIP



Reviewed By: ________________________________

Guy Vincent, Materials Testing Manager

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Pacific Green Fertilizer Plant	**Date Received:**	8/22/23
Client:	Tecnicas Reunidas	**Job #:**	223-1672
Material:	Native	**W.O. #:**	164582
Source:	TR1	**Lab #:**	172041

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"			
#4	100%		
#8			
#10	89%		
#16			
#20	65%		
#30			
#40	39%		
#50			
#60			
#80	19%		
#100	19%		
#200	14%		

Sieve Analysis Data: ASTM D422, D1140

Fineness Modulus:	
% Gravel:	
% Sand:	86.2
% Silt & Clay:	13.8
Moisture Content:	

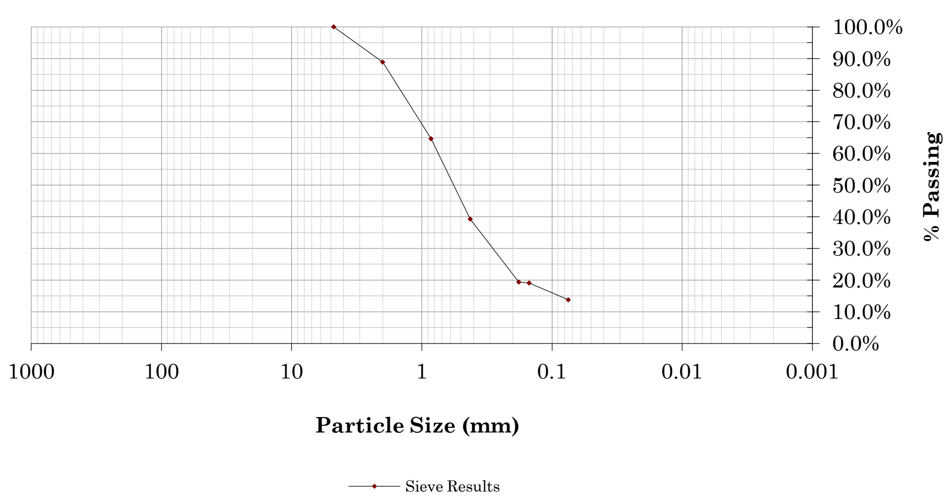
Atterburg Limits: ASTM D 4318

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	NP

Gradation Coeffecient of Uniformity Cu

%passing	sieve (mm)
D10 :	
D30 :	
D60 :	
C_u:	
C_c:	

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

GN Northern, Inc.
Consulting Engineers Environmental Scientists Geologists
Construction Materials Testing Geophysical Services

CLIENT:	Tecnicas Reunidas	JOB NO:	223-1972
PROJECT:	Pacific Green Fertilizer Plant	LABORATORY:	172042
SAMPLE SOURCE:	TR-2, upper 18 inches	WORK ORDER:	164582
DATE SAMPLED:	8/18/2023	DATE TESTED:	8/22/2023
MATERIAL TYPE:	Native	TESTED BY:	GV

SIEVE ANALYSIS

Sieve Size	% Passing	Sieve Size	% Passing
4"		#4	97%
3"		#8	
2 1/2"		#10	82%
2"		#16	
1 1/2"		#20	67%
1 1/4"		#30	
1"		#40	51%
3/4"		#50	
5/8"		#60	
1/2"		#80	36%
3/8"	100%	#100	34%
1/4"		#200	11.6%

USCS CLASSIFICATION - ASTM D 2487

silty sand (SM)

SAND EQUIVALENT - ASTM D 2419

MOISTURE DENSITY RELATIONSHIP ASTM D 1557

% Moisture	Dry Density	Note
7.0%	107.7	Moist Preparation Method
9.6%	110.5	Manual Rammer
12.3%	112.3	Procedure: A
13.4%	110.3	S.G. (est): **2.4**
15.4%	106.4	

OVERSIZE CORRECTION - ASTM D 4718

Dry Density: **112.3 pcf** **% Moisture:** **12.3%**

LL, PL & PI - ASTM D 4318

Liquid Limit	Plastic Limit	Plast. Index
		NP

MOISTURE - ASTM D 2216

Moisture Content:

SOIL S.G. - ASTM D 854

Specific Gravity @ 20°C:

AGGREGATE - ASTM C 127/ C 128

Spec. Grav.	Coarse	Fine
S.G.:		
SSD S.G.:		
App. S.G.:		
Absorption:		

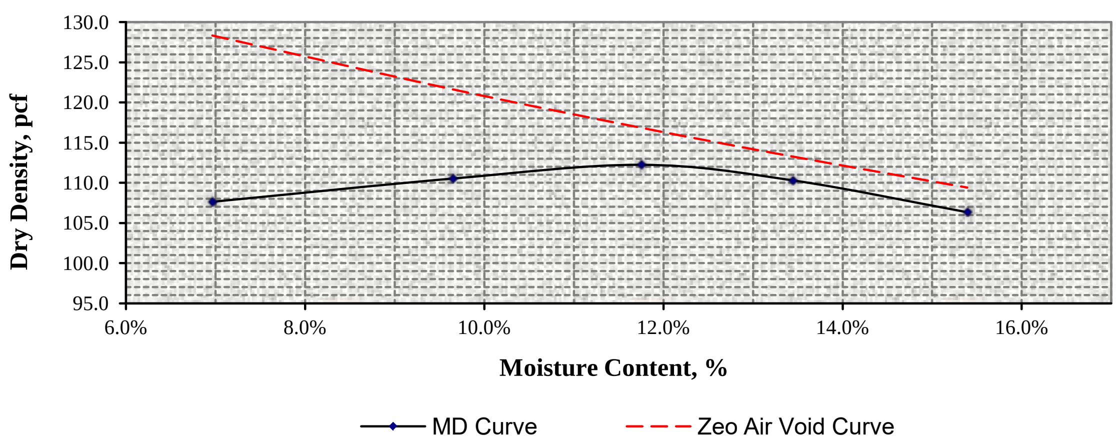
FINENESS MODULUS - ASTM C 136

Fineness Modulus: **0.70**

ORGANIC IMPURITIES - ASTM C 40

Organic Plate Number:

MOISTURE-DENSITY RELATIONSHIP



Reviewed By: ________________________________

Guy Vincent, Materials Testing Manager

LABORATORY SIEVE ANALYSIS

Northern, Inc.

Project:	Pacific Green Fertilizer Plant	**Date Received:**	8/18/23
Client:	Tecnicas Reunidas	**Job #:**	223-1972
Material:	Native	**W.O. #:**	164582
Source:	TR-2, upper 18 inches	**Lab #:**	172042

Sieve Size	Percent Passing	Specifications Minimum	Specifications Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"	100%		
1/4"			
#4	97%		
#8			
#10	82%		
#16			
#20	67%		
#30			
#40	51%		
#50			
#60			
#80	36%		
#100	34%		
#200	12%		

Sieve Analysis Data: ASTM D422, D1140

Fineness Modulus:
% Gravel: 3.0
% Sand: 85.4
% Silt & Clay: 11.6
Moisture Content:

Soil Classification (USCS): ASTM D 2487

silty sand (SM)

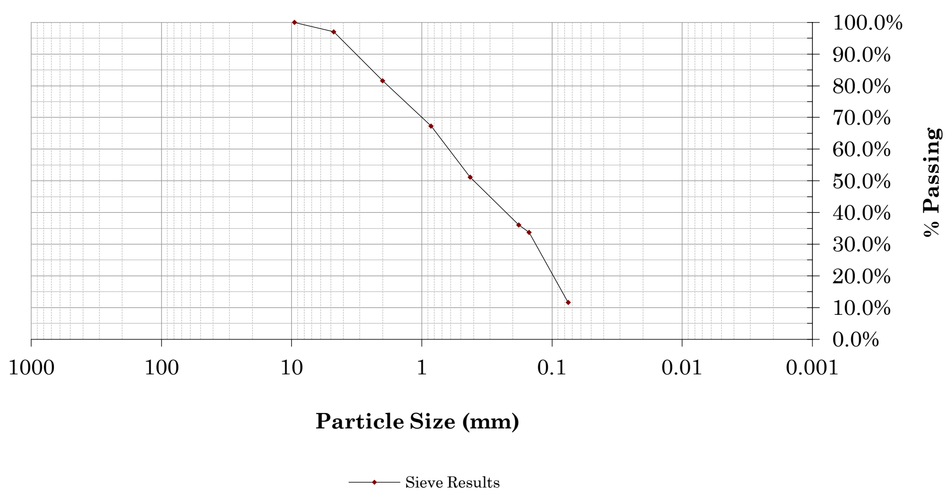
Atterburg Limits: ASTM D 4318

Liquid Limit:
Plastic Limit:
Plasticity Index:

Gradation Coeffecient of Uniformity Cu

%passing sieve (mm)
D10 :
D30 :
D60 :
C_u:
C_c:

Grain Size Distribution



Reviewed by: ____________________ **Date:** ______________

Appendix XVI

Well Location Map (Figure 9)

Washington Department of Ecology Well Logs

FIGURE 9: WELL LOCATION MAP

PROJECT NO.: 223-1672

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

2885 Start Card No. 011472

Water Right Permit No. Monitor WEll

(1) **OWNER:** Name Dept. of Energy Address 825 Jadwin Richland, WA

(2) **LOCATION OF WELL:** County Benton ¼ NW ¼ Sec. 15 T. 10 N., R. 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) Richland, WA

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) MW-9
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 4" inches.
Drilled 81 feet. Depth of completed well 79.6 ft.

(6) **CONSTRUCTION DETAILS:**
Casing Installed: 4" Diam. from 69.3 ft. to surface ft.
Welded ☐ Liner installed ☐ Threaded ☒ " Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type S/S Channel Pack Model No.
Diam. 4" Slot size .010 from 69.3 ft. to 79.3 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 20-40
Gravel placed from 66.7 ft. to 80.7 ft.

Surface seal: Yes ☒ No ☐ To what depth? 66.7 ft.
Material used in seal Cement, Bentonite, grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) **PUMP:** Manufacturer's Name
Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.
Static level 13 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand	0	3.5
Silty sandy gravel	3.5	13.9
Sand	13.9	18.1
Sandy Gravel	18.1	35.2'
Clayey Silt	35.2	42.0'
Silt	42.0	62.4'
Sandy Silt	62.4	63.6'
Silt	63.6	68.4'
Silty sandy gravel	68.4	?
Possible sand lenses		

ENTERED

Work started 11/6/89, 19. Completed 2/3/90, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Onwego Drilling Co., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address Kennewick, WA 99337
(Signed) Russell A. Vance (WELL DRILLER) License No. 1574
Contractor's Registration No. ONWEGDC120B8 Date 3/13/, 1990

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

Please print, sign and return to the Department of Ecology

342103

Water Well Report

Original – Ecology, 1st copy – owner, 2nd copy – driller

Construction/Decommission

[X] Construction
[ ] Decommission ORIGINAL INSTALLATION Notice of Intent Number D-14979

Current Notice of Intent No. D-14979
Unique Ecology Well ID Tag No. ____
Water Right Permit No. ____
Property Owner Name Arcuz NP INC
Well Street Address 2101 Horn Rapid's
City Richland County Benton
Location NW 1/4-1/4 SW 1/4 Sec 15 Twn 10 N R 28 E [X] EWM or WWM circle one
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec M
Tax Parcel No. 115893000004000

PROPOSED USE: [ ] Domestic [ ] Industrial [ ] Municipal [X] DeWater [ ] Irrigation [ ] Test Well [ ] Other ____

TYPE OF WORK: Owner's number of well (if more than one) ____
[ ] New well [ ] Reconditioned Method: [ ] Dug [ ] Bored [ ] Driven
[ ] Deepened [X] Cable [ ] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 10 inches, drilled 27 ft.
Depth of completed well 27 ft.

CONSTRUCTION DETAILS
Casing Installed: [X] Welded 10" Diam. from +6 ft. to 27 ft.
[ ] Liner installed ____" Diam. from ____ ft. to ____ ft.
[ ] Threaded ____" Diam. from ____ ft. to ____ ft.

Perforations: [ ] Yes [ ] No
Type of perforator used ____
SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: [X] Yes [ ] No [ ] K-Pac Location ____
Manufacturer's Name Royal Pipe System's
Type 150 mm Sch 40 Model No. ____
Diam. 6" Slot size 10 th from 12 ft. to 27 ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: [X] Yes [ ] No [X] Size of gravel/sand 10-20
Materials placed from 12 ft. to 27 ft.

Surface Seal: [ ] Yes [X] No To what depth? ____ ft.
Material used in seal ____
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 13 ft. below top of well Date ____
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [ ] No If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest ____ gal./min. with stem set at ____ ft. for ____ hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? [ ] Yes [ ] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Sand + Gravel	0'	12'
Gravel + Compact Clay	12'	13'
13' Water bearing Sand + Gravel large Gravel	13'	27'

RECEIVED
AUG 02 2007
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT OF ECOLOGY FISCAL OFFICE BUDGET
07 JUL 31 A8:48

RECEIVED
JUN 01 2009
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

DEPT OF ECOLOGY Received AUG 08 2007 CENTRAL REGION OFFICE

Start Date 6-11-7 Completed Date 6-12-7

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller/Engineer/Trainee Name (Print) Gary Howell
Driller/Engineer/Trainee Signature Gary Howell
Driller or trainee License No. 1930

If TRAINEE,
Driller's Licensed No. ____
Driller's Signature ____

Drilling Company Blue Star Enterprises
Address 3019 Butler Loop
City, State, Zip Richland WA. 99354
Contractor's Registration No. BLUESEN942RM Date 8/24/07

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE 16167

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)
☐ Construction
☒ Decommission 440981

ORIGINAL INSTALLATION Notice of Intent Number: SE 44495

Consulting Firm Shannon & Wilson

Unique Ecology Well IDTag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee
Name (Print Last, First Name) Timothy S. Smith
Driller/Engineer /Trainee Signature [signature]
Driller or Trainee License No. 2837

If trainee, licensed driller's Signature and License Number:

Type of Well ("x in box)
☐ Resource Protection
☐ Geotech Soil Boring

Property Owner Siemens Nuclear Power Corp
Site Address 2455 Horn Rapids Rd.
City Richland County Benton
Location SW 1/4-1/4 NE 1/4 Sec 15 Twn ~~23E~~ 10N R 28E
EWM ☐ or WWM ☐
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Min ____ Sec ____
Long Deg ____ Min ____ Sec ____
Tax Parcel No. 115083000001000
Cased or Uncased Diameter 8" Static Level 14'
Work/Decommission Start Date 1-16-2012
Work/Decommission Completed Date 1-16-2012

Construction Design	Well Data	Formation Description
0 Bentonite 25	Drill method - Auger Backfilled with Bentonite chips	0-9 Fine sand 9-25 sand & gravel

DEPT OF ECOLOGY Received JAN 19 2012 CENTRAL REGION OFFICE

SCALE: 1"= ____ PAGE 1 OF 2

ECY 050-12 (Rev. 7/06)

Ecology is an Equal Opportunity Employer

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

2652
Start Card No 011460

Water Right Permit No 825

(1) OWNER: Name DOE - RL Address 825 JADWIN RICHLAND WA

(2) LOCATION OF WELL: County BENTON ¼ NW ¼ Sec 15 T 10N N., R. 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) C/D/E/F

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) MW-8
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 4 inches.
Drilled 35 feet. Depth of completed well 35 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10 " Diam. from +1 ft. to 10 ft.
Welded ☐ 8 " Diam. from +1 ft. to 35 ft.
Liner installed ☐
Threaded ☒ 4 " Diam. from +1 ft. to 35 ft.
STAINLESS STEEL
Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON S-S
Type Model No.
Diam. 4 Slot size 20 from 15 ft. to 35 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel SAND 10-20
SAND PACK
Gravel placed from 13 ft. to 35 ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal CEMENT GROUT
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name N/A
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 18 ft. below top of well Date 10-26-89
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
COBBLES SOME SAND NO WATER	0	18
COBBLES BOULDERS SOME SAND WATER	18	35

ENTERED

ALL 10" + 8" CARBON STEEL CASING REMOVED

RECEIVED JAN 8 1990 DEPT. OF ECOLOGY

Work started 10-23, 19 . Completed 12-29, 1989

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME KAISER ENGINEERS HANFORD (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 888 RICHLAND WA 99352
(Signed) R. Dene Thomas (WELL DRILLER) License No. 867
Contractor's LIAISON REPRESENTATIVE
Registration No. 1224 Date 1-3, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) 1229

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 2634 011458

Water Right Permit No. ______

(1) OWNER: Name DOE - RL Address 825 JADWIN RICHLAND WA

(2) LOCATION OF WELL: County BENTON ¼ NW ¼ Sec 15 T. 10N N., R 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) C/D/E/F

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) MW-15
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 4 inches.
Drilled 53 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from +1 ft. to 52 ft.
Welded ☒ Liner installed ☐ Threaded ☒
" Diam. from ______ ft. to ______ ft.
4 " Diam. from +1 ft. to 40 ft.
STAINLESS STEEL
Perforations: Yes ☐ No ☒
Type of perforator used ______
SIZE of perforations ______ in. by ______ in.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON
Type ______ Model No. ______
Diam. 4 Slot size 10 from 20 ft. to 40 ft.
Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel SAND 20-40
SAND PACK
Gravel placed from 20 ft. to 40 ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal CEMENT GROUT
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

(7) PUMP: Manufacturer's Name N/A
Type: ______ H.P. ______

(8) WATER LEVELS: Land-surface elevation above mean sea level ______ ft.
Static level 28 ft. below top of well Date 11-27-89
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.
Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
COBBLES GRAVEL + SAND	0	28
NO WATER		
COBBLES GRAVEL + SAND	28	52
WATER		
LIGHT GRAY SILT	52	55
NO WATER		
ALL 8" CARBON STEEL		
CASING REMOVED		

ENTERED

RECEIVED JAN 8 [illegible] DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 11-20-89, 19. Completed 12-29, 1989

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME KAISER ENGINEERS HANFORD
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address P.O. Box 888 RICHLAND WA 99352

(Signed) R. Dene Thomas License No. 867
(WELL DRILLER)

Contractor's LIAISON REPRESENTATIVE
Registration No. 1224 Date 1-3, 1990

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

The Dep. The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

2882

Start Card No 011482

Water Right Permit No Monitor WEll

(1) OWNER: Name Dept. of Energy Address 825 Jadwin Richland, WA

(2) LOCATION OF WELL: County Benton ¼ NW ¼ Sec 15 T 10 N., R 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Richland, WA

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) MW-13
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐ Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 4" inches.
Drilled 44 feet. Depth of completed well 41.5 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 4" Diam. from 41.5 ft. to surface
Welded ☐ Liner installed ☐ Threaded ☒ ___ Diam. from ___ ft. to ___ ft.
___ Diam. from ___ ft. to ___ ft.

Perforations: Yes ☐ No ☒
Type of perforator used ___
SIZE of perforations ___ in. by ___ in.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type S/S Channel Pack Model No. ___
Diam. 4" Slot size .010 from 26.5 ft. to 41.5 ft.
Diam. ___ Slot size ___ from ___ ft. to ___ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 20-40
Gravel placed from 22.82 ft. to 44.50 ft.

Surface seal: Yes ☒ No ☐ To what depth? 22.82 ft.
Material used in seal Cement and Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ___ Depth of strata ___
Method of sealing strata off ___

(7) PUMP: Manufacturer's Name ___
Type: ___ H.P. ___

(8) WATER LEVELS: Land-surface elevation above mean sea level ___ ft.
Static level 30 ft. below top of well Date ___
Artesian pressure ___ lbs. per square inch Date ___
Artesian water is controlled by ___ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ___
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ___
Bailer test ___ gal./min. with ___ ft. drawdown after ___ hrs.
Airtest ___ gal./min. with stem set at ___ ft. for ___ hrs.
Artesian flow ___ g.p.m. Date ___
Temperature of water ___ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Gravelly Sand	0	6'
Sand	6'	9'
Gravelly Sand	9'	14'
Silty Sandy Gravel	14'	25'
Sandy Gravel	25'	44'

ENTERED

APR 12 1990

Work started 11/6/89, 19. Completed 1/12/90, 19.

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Onwego Drilling co., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address Kennewick, WA 99337
(Signed) [signature] (WELL DRILLER) License No. 066
Contractor's Registration No. ONWEGDC120B8 Date 3/13/, 19 90

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

2881

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No 011481

Water Right Permit No. Monitor Well

(1) OWNER: Name Dept. of Energy Address 825 Jadwin, Richland, WA 99352

(2) LOCATION OF WELL: County Benton ¼ NW ¼ Sec. 15 T 10 N., R. 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Richland, WA

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) MW 14
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 4" inches.
Drilled 60.5 feet. Depth of completed well 53.98 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 4" Diam. from 53.53 ft. to surface
Welded ☐
Liner installed ☐
Threaded ☒
_____ Diam. from _____ ft. to _____ ft.
_____ Diam. from _____ ft. to _____ ft.

Perforations: Yes ☐ No ☒
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Channel pack Model No. _____
Diam. 4" Slot size 0.010 from 43 ft. to 53 ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 20-40
Gravel placed from 38.25 ft. to 53.98 ft.

Surface seal: Yes ☒ No ☐ To what depth? 38.25 ft.
Material used in seal Cement and bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 30 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand, Gravelly sand	0.0	8'
Silty sandy gravel	8	35'
Sandy Gravel	35	55'
Ash-vitric tuff	55	60.5'

ENTERED

APR 12 1990

Work started 11/6/89, 19. Completed 1/7/90, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Onwego Drilling Co., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address Route 14 Box 3010 Kennewick, WA

(Signed) [signature] (WELL DRILLER) License No. 066

Contractor's Registration No. ONWEGDC120B8 Date 3/13/, 1990

(USE ADDITIONAL SHEETS IF NECESSARY)

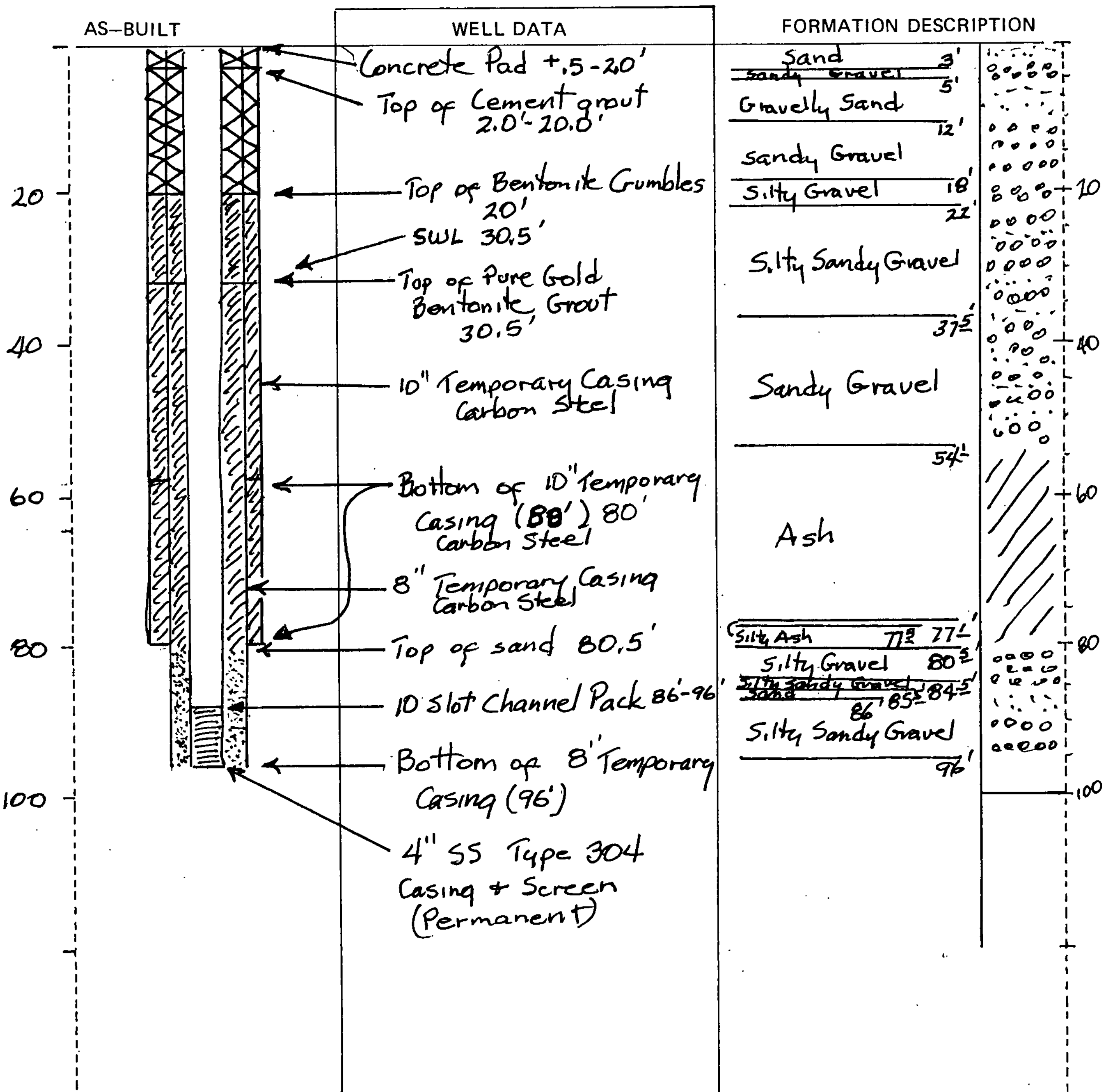
ECY 050-1-20 (10-87) 1329

RESOURCE PROTECTION WELL REPORT

START CARD NO. [redacted]

PROJECT NAME: CERCLA / 1100-EM-1
WELL INDENTIFICATION NO. MW-21
DRILLING METHOD: CABLE TOOL
DRILLER: DAVID ROSSMAN
FIRM: KAISER ENGINEERS HANFORD
SIGNATURE: David J. Rossman LIC# 1860
CONSULTING FIRM: N/A
REPRESENTATIVE: N/A

LOCATION: T 10N, R 28E, SEC. 15
DISTANCE: N/A FT. FROM N/S SECTION LINE
N/A FT. FROM E/W SECTION LINE
DATUM: GROUND LEVEL
WATER LEVEL ELEVATION: 30.5'
INSTALLED: 7-1-91
DEVELOPED: ON GOING



SCALE: 1"= 20'

PAGE 1 OF 1

ECY 050-12

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

2883

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No 011483

Water Right Permit No Monitor Well

(1) OWNER: Name Dept. of Energy Address 825 Jadwin Richland, WA

(2) LOCATION OF WELL: County Benton ¼ NW ¼ Sec. 15 T. 10 N., R. 28E W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Richland, WA

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) MW-12
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 4" inches.
Drilled 59.17 feet. Depth of completed well 46.85 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 4" Diam. from 46.85 ft. to surface ft.
Welded ☐ Liner installed ☐ Threaded ☒
___ " Diam. from ___ ft. to ___ ft.
___ " Diam. from ___ ft. to ___ ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations ___ in. by ___ in.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type S/S Channel Pack Model No.
Diam. 4" Slot size .010 from 26.52 ft. to 46.52 ft.
Diam. ___ Slot size ___ from ___ ft. to ___ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 20-40
Gravel placed from 22.5 ft. to 48.0 ft.

Surface seal: Yes ☒ No ☐ To what depth? 22.5 ft.
Material used in seal Cement and Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ___ Depth of strata ___
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: ___ H.P. ___

(8) WATER LEVELS: Land-surface elevation above mean sea level ___ ft.
Static level 32 ft. below top of well Date
Artesian pressure ___ lbs. per square inch Date
Artesian water is controlled by ___ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test ___ gal./min. with ___ ft. drawdown after ___ hrs.
Airtest ___ gal./min. with stem set at ___ ft. for ___ hrs.
Artesian flow ___ g.p.m. Date
Temperature of water ___ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand	0	1.5'
Silty sand	1.5	4.0'
Sand	4.0	6.4'
Gravelly Sand	6.4	9.0'
Sandy Gravel	9.0	15.2'
Silty Sandy Gravel	15.2	30.1'
Sandy gravel	30.1	56.4
Ash-Vitric tuff	56.4	59.17

ENTERED

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APR 12 1990

Work started 11/6/89, 19 Completed 1/18/90, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Onwego Drilling Co., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address Kennewick, WA

(Signed) [signature] (WELL DRILLER) License No 066

Contractor's Registration No. ONWEGDC120B8 Date 3/13/, 1990

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. G 4283 112
Permit No.

(1) OWNER: Name Larry Goodwin Address Rt 1 Box 5685 Harrington Rd

(2) LOCATION OF WELL: County Benton W Richland E½ SW¼ Sec. 14 T. 10N., R. 28 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 8" inches.
Drilled 61 ft. Depth of completed well 59 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8" Diam. from +1 ft. to 54 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Steel Model No.
Diam. 8" Slot size 50 from 54 ft. to 59 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☐ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 34 ft. below top of well Date 6-9-83
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" Blowing Air 60 gpm " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: LP

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Sand Tan + Black	0	21
Gravel 1" minus sand Blk	21	23
Sand Blk	23	36
Gravel 1" minus sand Blk water Bearing	36	59
Gravel 1" minus sand Blk Silty	59	61

RECEIVED SEP 8 1983 DEPARTMENT OF ECOLOGY

2 1983

Work started 6-8 1983 Completed 6-9 1983

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Nelson Well Drilling Inc (Person, firm, or corporation) (Type or print)

Address 1004 W Argent Pasco

[Signed] James Nelson (Well Driller)

License No. 361 Date 6-9-83, 19

(USE ADDITIONAL SHEETS IF NECESSARY) EP 9/30/83

RESOURCE PROTECTION WELL REPORT

START CARD NO. [redacted]

PROJECT NAME: CERCLA/1100-EM-1

WELL INDENTIFICATION NO. MW-19

DRILLING METHOD: CABLE TOOL

DRILLER: [redacted] TIM GIFFORD

FIRM: KAISER ENGINEERS HANFORD

SIGNATURE: TAGifford LIC.# [redacted] 1781

CONSULTING FIRM:

REPRESENTATIVE: N/A

LOCATION: T 10N, R 28E, SEC. 15

DISTANCE: N/A FT. FROM N/S SECTION LINE

N/A FT. FROM E/W SECTION LINE

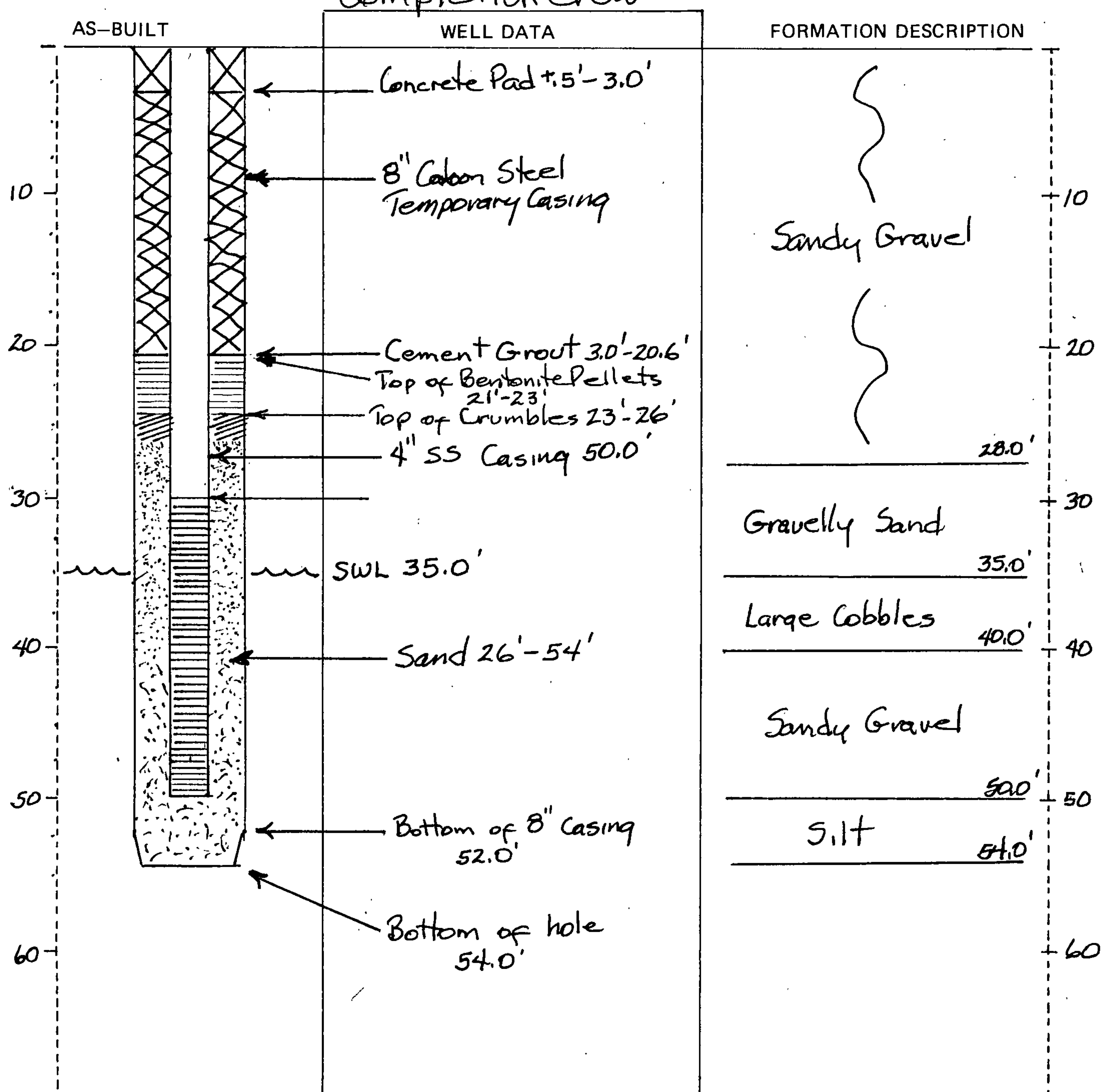
DATUM: GROUND LEVEL

WATER LEVEL ELEVATION: 35.0'

INSTALLED: 6-21-91

DEVELOPED: ON GOING

Completion Crew



SCALE: 1"= 10'

PAGE 1 OF 1

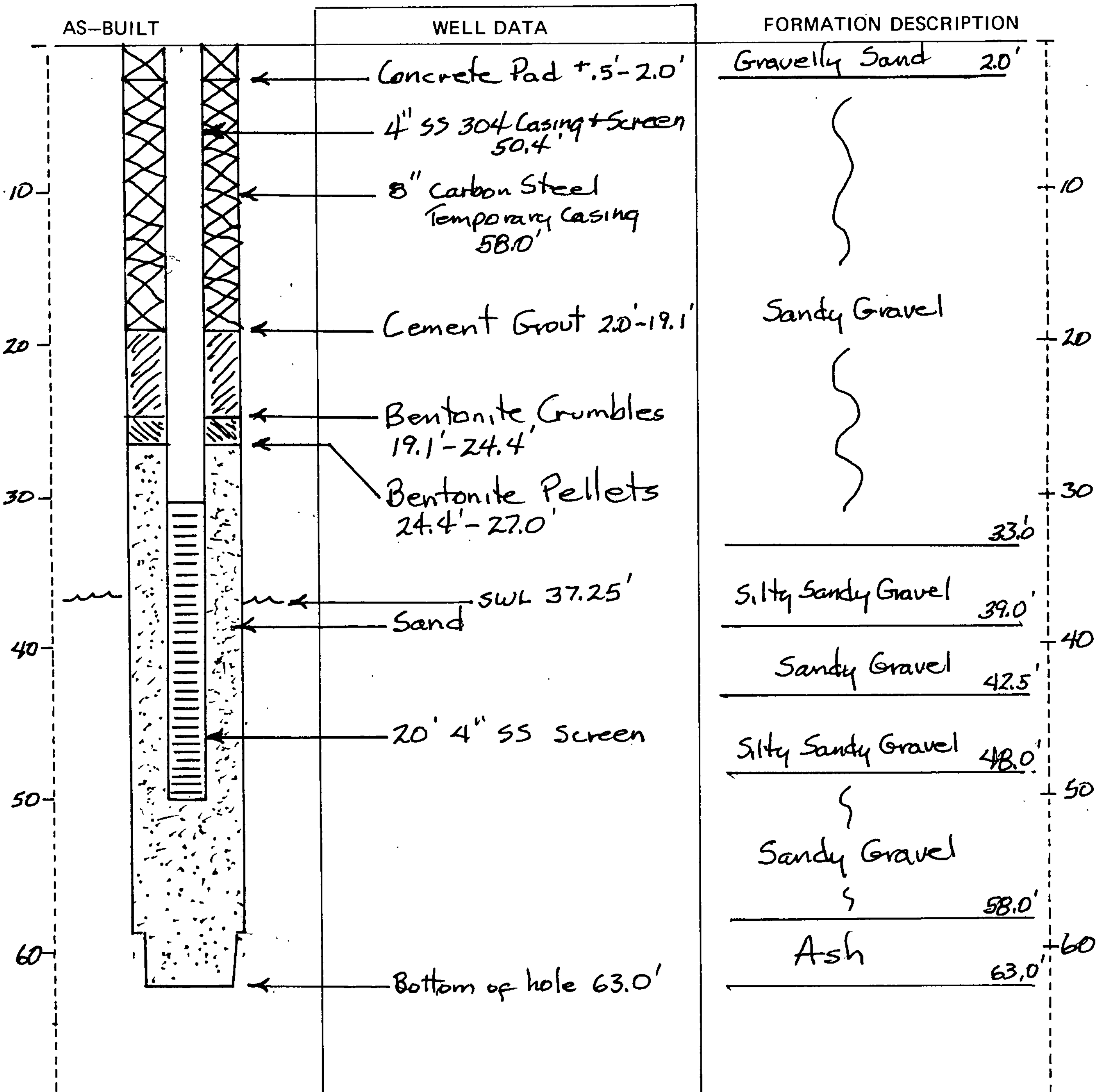
ECY 050-12

RESOURCE PROTECTION WELL REPORT

START CARD NO. [redacted]

PROJECT NAME: CERCLA / 1100-EM-1
WELL INDENTIFICATION NO. MW-22
DRILLING METHOD: CABLE TOOL
DRILLER: GARY LYDIN
FIRM: KAISER ENGINEERS HANFORD
SIGNATURE: Gary Lydin LIC # 1023
CONSULTING FIRM:
REPRESENTATIVE: N/A

LOCATION: T 10 ,R 28 ,SEC. 15
DISTANCE: N/A FT. FROM N/S SECTION LINE
N/A FT. FROM E/W SECTION LINE
DATUM: GROUND LEVEL
WATER LEVEL ELEVATION: 37.25'
INSTALLED: 6-12-91
DEVELOPED: ON GOING



SCALE: 1" = 10'

PAGE 1 OF 1

ECY 050-12

Separate section requires separate NOT

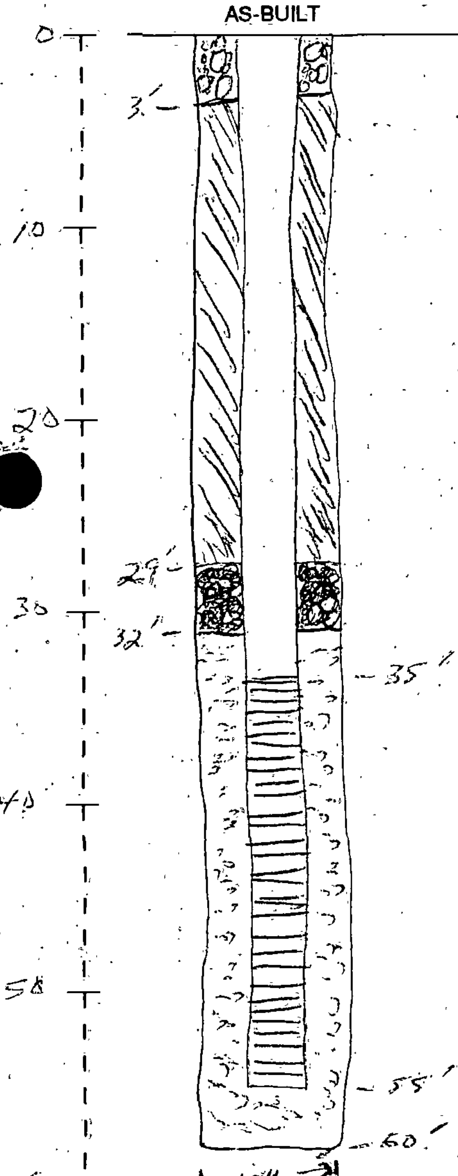
A

RESOURCE PROTECTION WELL REPORT

START CARD NO. 01104

PROJECT NAME: Horn Rapids Landfill - MW Installation
WELL IDENTIFICATION NO. COE - MW 4
DRILLING METHOD: Air rotary
DRILLER: Robert Stadeli
FIRM: Stang Well Services
SIGNATURE: Robert Stadeli
CONSULTING FIRM: Morrison Knudsen Environmental
REPRESENTATIVE: Daniel Whitney

COUNTY: Benton
LOCATION: NE 1/4 NE 1/4 Sec 15 Twn 10N R 28E
STREET ADDRESS OF WELL: Near intersection of George Washington & Stevens Dr - Richland
WATER LEVEL ELEVATION: (39.7' BLS)
GROUND SURFACE ELEVATION:
INSTALLED:
DEVELOPED:

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
 	Annulus: 1) 0-3 ft = Concrete 2) 3-29 ft = Bentonite Chips 3) 29-32 ft = Bentonite Pellets 4) 32-56 ft = 20-40 ~~Sand~~ Colorado Silica Sand Pack Well: 1) Stainless steel casing 2) stainless steel screen: a) 10 slot, 20 feet length b) 35-55 ft. 3) centralizers @ 15 ft, 35 ft, & 55 ft.	0-5' Sand, yellowish brown fn-md. grained 5'-14' Sandy Gravel, pale brown 14'-44.5' Gravel, fn., very dk. grey 44.5'-50' Sandy Gravel, lt. olive grey 50'-51' Sand, lt. olive grey, md-coarse grained 51'-53' Gravel, Coarse, very well rounded 53'-60' Sandy Gravel

SCALE: 1" = 10' (vertical) PAGE 1 OF 1

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OCT 12 1995
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

ECY 050-12 (Rev. 11/89)

File Original and First Copy with Department of Ecology
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Third Copy—Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

2633
Start Card No. 011459

Water Right Permit No. ______

(1) **OWNER:** Name DOE - RL Address 825 JADWIN RICHLAND WA

(2) **LOCATION OF WELL:** County BENTON ___ ¼ NW ¼ Sec. 15 T. 10N N., R. 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) C/D/E/F

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) MW-10
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 4 inches.
Drilled 66 feet. Depth of completed well 48 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 8 " Diam. from +1 ft. to 64 ft.
Welded ☐ ___ " Diam. from ___ ft. to ___ ft.
Liner installed ☐
Threaded ☒ 4 " Diam. from +1 ft. to 48 ft.
STAINLESS STEEL
Perforations: Yes ☐ No ☒
Type of perforator used ______
SIZE of perforations ______ in. by ______ in.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON
Type ______ Model No. ______
Diam. 4 Slot size 10 from 28 ft. to 48 ft.
Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel SAND 20-40
SAND PACK
Gravel placed from 25 ft. to 48 ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal CEMENT GROUT
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

(7) **PUMP:** Manufacturer's Name N/A
Type: ______ H.P. ______

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ______ ft.
Static level 40 ft. below top of well Date 11-9-89
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
" " "
" " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

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JAN [redacted]
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CENTRAL REGIONAL OFFICE

Date of test ______
Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.
Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? Yes ☐ No ☐

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
COBBLES + SAND	0	9½
NO WATER		
GRAY SAND	9½	15
NO WATER		
BOULDERS COBBLES	15	18½
+ SAND NO WATER		
CONSOLIDATED GRAVEL	18½	40
+ CLAY NO WATER		
SANDY GRAVEL	40	54
WATER		
LIGHT COLORED	54	61
COARSE TO FINE SAND		
WATER		
GRAVEL + SAND	61	64
WATER		
OLIVE COLORED CLAY	64	66
NO WATER		
ALL 8" CARBON STEEL		
CASING REMOVED		

Work started 11-6-89, 19__ Completed 12-29, 1989

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

ENTERED

NAME KAISER ENGINEERS HANFORD
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 888 RICHLAND WA 99352
(Signed) R. Dave Thomas License No. 867
(WELL DRILLER)
Contractor's Registration No. LIAISON REPRESENTATIVE 1224 Date 1-3, 1990

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10-87) 1329

450268

RESOURCE PROTECTION WELL REPORT

START CARD NO. 01104

PROJECT NAME: Horn Rapids Landfill - MW Install

WELL IDENTIFICATION NO. COE-MW3

DRILLING METHOD: Air Rotary

DRILLER: Robert Stadeli

FIRM: Staco Well Services, Inc.

SIGNATURE: [signature]

CONSULTING FIRM: Morrison Knudsen Corporation

REPRESENTATIVE: Daniel Whitney

COUNTY: Benton

LOCATION: NE ¼ SE ¼ Sec 10 Twn 10N R 28E

STREET ADDRESS OF WELL: Near intersection of George Washington & Stevens Dr. - Richland

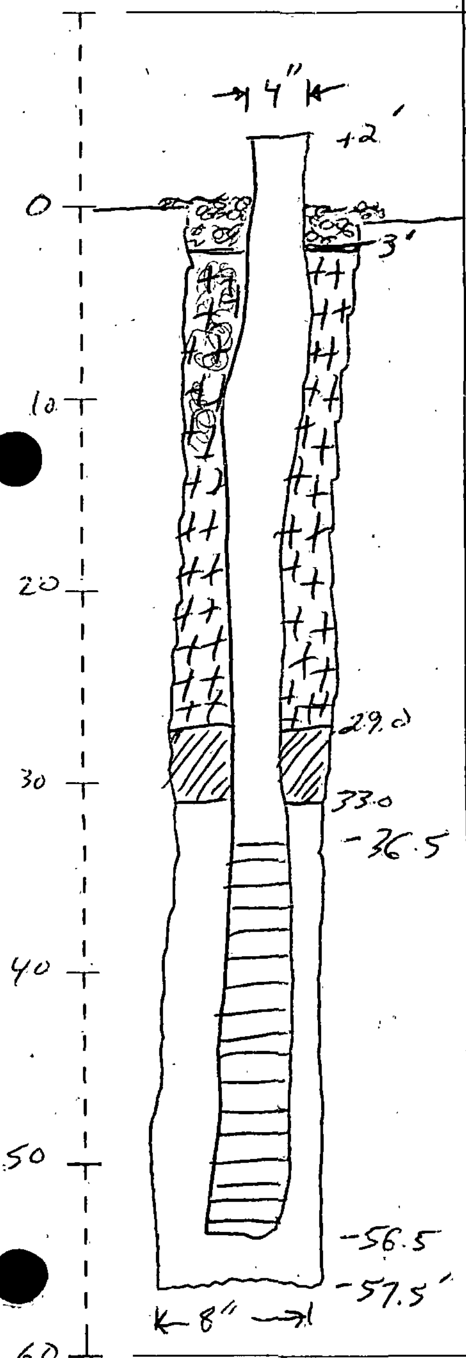
WATER LEVEL ELEVATION: (~41.5 bls)

GROUND SURFACE ELEVATION:

INSTALLED: 8/28/95

DEVELOPED:

AS-BUILT



WELL DATA

1) +2 to -36.5 Stainless steel Casing 4"

2) 36.5-56.5: 10 slot 4" S.S. SCREEN

0-3': cement

3-29': Bentonite Chips

centralizer 16.5'

29-33: Bentonite Pellets

33-57.5: 20-40 sand pack

Centralizers 37' & 56'

FORMATION DESCRIPTION

0-3 → Sand, brown, fn-md grained.

3-9 → Sandy gravel, pale brown fn-md. gr. sand fn gravel

9-10 Silty Sand, pale brown

10-57.5' Sandy gravel, dk grey, fn to coarse sand, fn gravel.

- Basalt boulders at 16 ft.

RECEIVED
OCT 12 1995
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

SCALE: 1" = 10'

PAGE 1 OF 1

ECY 050-12 (Rev. 11/89)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No 2884 011484

Water Right Permit No Monitor Well

(1) **OWNER:** Name Dept. of Energy Address 825 Jadwin Richland, WA

(2) **LOCATION OF WELL:** County Benton ¼ NW ¼ Sec. 15 T. 10 N., R. 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) Richland, WA

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) MW-11
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 4" inches.
Drilled 58.5 feet. Depth of completed well 57.8 ft.

(6) **CONSTRUCTION DETAILS:**
Casing Installed: 4" Diam. from 57. ft. to surface ft.
Welded ☐ Liner installed ☐ Threaded ☒
___ " Diam. from ___ ft. to ___ ft.
___ " Diam. from ___ ft. to ___ ft.

Perforations: Yes ☐ No ☒
Type of perforator used ___
SIZE of perforations ___ in. by ___ in.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.
___ perforations from ___ ft. to ___ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Channel Pack Model No. 304
Diam 4" Slot size .010 from 34.4 ft. to 54.4 ft.
Diam. ___ Slot size ___ from ___ ft. to ___ ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 20-40
Gravel placed from 57.8' ft. to 31.3' ft.

Surface seal: Yes ☒ No ☐ To what depth? 26.5 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ___ Depth of strata ___
Method of sealing strata off ___

(7) **PUMP:** Manufacturer's Name ___
Type: ___ H.P. ___

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ___ ft.
Static level 41 ft. below top of well Date ___
Artesian pressure ___ lbs. per square inch Date ___
Artesian water is controlled by ___ (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ___
Yield: ___ gal./min. with ___ ft. drawdown after ___ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ___
Bailer test ___ gal./min. with ___ ft. drawdown after ___ hrs.
Airtest ___ gal./min. with stem set at ___ ft. for ___ hrs.
Artesian flow ___ g.p.m. Date ___
Temperature of water ___ Was a chemical analysis made? Yes ☐ No ☒

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Silty sand, brown	0	2.7'
Gravelly sand	2.7	5.6
Sandy Gravel	5.6	26.0'
Gradual increase in silt		
Silty sandy gravel	26.0	52.0
Sandy Gravel	52.0	58.5'

ENTERED

APR 12 1990

Work started 11/6/89, 19. Completed 12/22/89, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Onwego Drilling Co., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address Kennewick, WA 99337

(Signed) [signature] (WELL DRILLER) License No. 066

Contractor's Registration No. ONWEGDC120B8 Date 3/13, 19 90

(USE ADDITIONAL SHEETS IF NECESSARY)

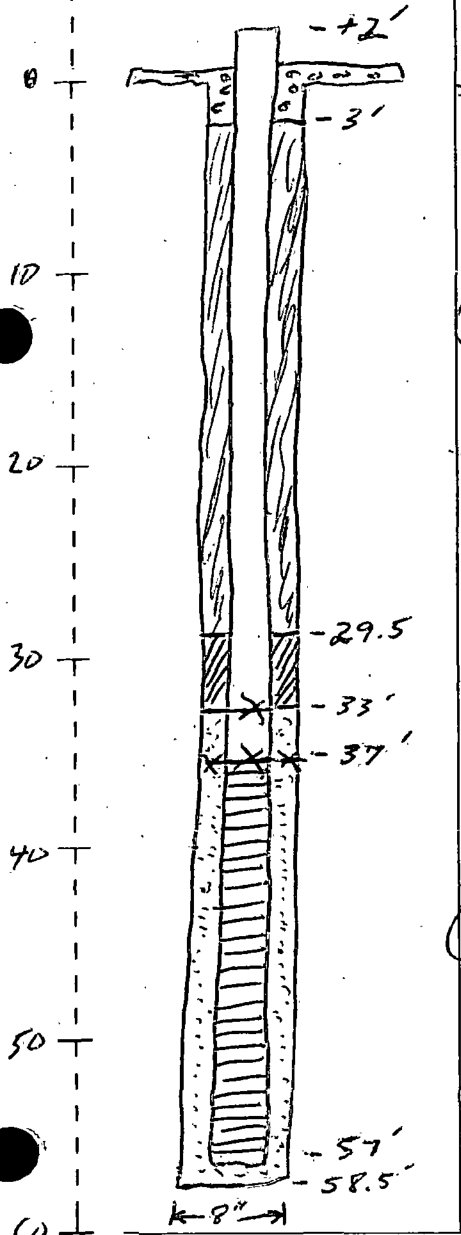
ECY 050-1-20 (10/87) -1329

Separate Section
Separate
NOT required
D

RESOURCE PROTECTION WELL REPORT

START CARD NO. ~~O1104~~

PROJECT NAME: Horn Rapids Landfill-MW Install	COUNTY: Benton
WELL IDENTIFICATION NO. COE-MW1	LOCATION: NW 1/4 NW 1/4 Sec 14 Twn 10N R 28E
DRILLING METHOD: Air Dual Rotary - Down hole hammer	STREET ADDRESS OF WELL: Near intersection of George Washington & Stevens Dr - Richland
DRILLER: Robert Stadeli	
FIRM: Stacy Well Service	WATER LEVEL ELEVATION: (~ 42.3' bls)
SIGNATURE:	GROUND SURFACE ELEVATION:
CONSULTING FIRM: Morrison Knudsen Corp.	INSTALLED: 9/5/95
REPRESENTATIVE: Daniel Whitney	DEVELOPED:

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	from 0-3' Concrete from 3'-29.5' ⇒ Bentonite Chips (Casing = Stainless steel 4" dia.) centralizer @ ~ 17' from 29.5-33 ⇒ Bentonite Pellets from 33-58.5' ⇒ sand Pack 20-40 Colorado Silica Sand (Screen = Stainless Steel 10 slot, 4" dia.) Centralizers: 37.5' & 56.5'	0-4 Sand, yellowish brn 4-7.5 Sandy gravel, pale brn 7.5-9 Sand, v. dk. gray 9-12.5 Sandy gravel, dk gray 12.5-15.0 Gravel, dk gray 15-36.0 Sandy gravel, dk gray 36-44 Gravel/cobbles, lt brnish gray. 44-57' Sandy Gravel, lt brnish gray 57-58.5 Silty Clay, lt olive brn

SCALE: 1" = 10' PAGE 1 OF 1

ECY 050-12 (Rev. 11/89)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

different Section requires different NOI

RESOURCE PROTECTION WELL REPORT

START CARD NO. ~~01104~~

PROJECT NAME: Horn Rapids Landfill - MW Install.

WELL IDENTIFICATION NO. COE - MW2

DRILLING METHOD: Air Dual Rotary - Down Hole hammer

DRILLER: Robert Stadeli

FIRM: Staco Well Services

SIGNATURE: [illegible]

CONSULTING FIRM: Morrison Knudsen Corp.

REPRESENTATIVE: Daniel Whitney

COUNTY: Benton

LOCATION SW ¼ SW ¼ Sec 11 Twn 10N R 28E

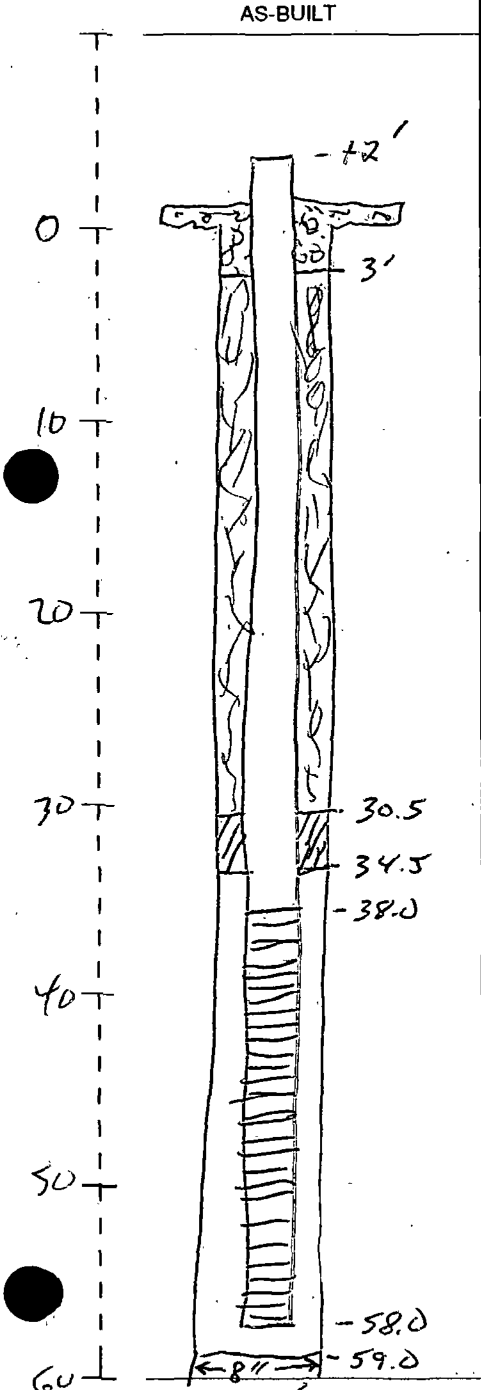
STREET ADDRESS OF WELL: Near intersection of George Washington & Stevens Dr - Richland

WATER LEVEL ELEVATION: (≈ 43.5' bls)

GROUND SURFACE ELEVATION:

INSTALLED: 9/6/95

DEVELOPED: N

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	0-3 Concrete 3-30.5 Bentonite Chips (Casing: Stainless Steel 4" dia. centralizer C ≈ 18') 30.5-34.5 Bent. Pellets 34.5-59 20-40 Colorado Silica Sand Screen: Stainless steel 10 slot 4" dia	0-7 Sand, brown 7-21 Sandy Gravel, dk gray 21.0-21.5 Sand lens, dk gray 21.5-37 Sandy gravel, lt olive gray 37-38 Clay lens, lt olive brn. 38-55.5 Gravel, lt olive brn 55.5-59 Clayey Silt, yellowish brn.

SCALE: 1" = 10'

PAGE 1 OF 1

ECY 050-12 (Rev. 11/89)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission (*"x" in circle*) 346753

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____

CURRENT
Notice of Intent No. WE09438

Unique Ecology Well ID Tag No. ALE-907

Water Right Permit No. PRELIM. PERMIT G4-35179

Property Owner Name Battelle

Well Street Address 3300 Stevens DR

City Richland County Benton

Location NW1/4-1/4 NW1/4 Sec 14 Twn 10 R28 (EWM) or WWM circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No 140830000002008

PROPOSED USE: ☐ Domestic ☒ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ____

TYPE OF WORK: Owner's number of well (if more than one) 5

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☒ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 12 inches, drilled 108 ft.
Depth of completed well 108 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 12" Diam. from +2 ft. to 108 ft.
☐ Liner installed ____" Diam. from ____ ft. to ____ ft.
☐ Threaded ____" Diam. from ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used ____
SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location 80-106, 37-63
Manufacturer's Name Johnson
Type Stainless steal Model No. hi-flow
Diam. 12 Slot size 60 from 37 ft. to 63 ft.
Diam. 12 Slot size 100 from 80 ft. to 106 ft.

Gravel/Filter packed: ☒ Yes ☐ No ☐ Size of gravel/sand 3/8, 8-12
Materials placed from 80-106 ft. to 37-63 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 30 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 47 ft. below top of well Date 6-19-09
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test 40 gal./min. with 0 ft. drawdown after 1 hrs.
Airtest ____ gal./min. with stem set at ____ ft. for ____ hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water 58° Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
top soil	0	3
cobbles	3	65
sand	65	83
med gravel	83	107
Brown clay	107	108

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JUL 07 2009
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 6-1-09 Completed Date 6-17-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Blake Harding
Driller/Engineer/Trainee Signature Blake Harding
Driller or trainee License No. 2852

If TRAINEE,
Driller's Licensed No. ____
Driller's Signature ____

Drilling Company Carpenter drilling
Address 11 S goose gap
City, State, Zip Benton, WA 99320
Contractor's Registration No. carped #944R2 Date 6-19-08

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 347706
[x] Construction
○ Decommission ORIGINAL INSTALLATION Notice of Intent Number ______

CURRENT
Notice of Intent No. WE09436
Unique Ecology Well ID Tag No. ALE 911
Water Right Permit No. ______
Property Owner Name Battelle
Well Street Address 3300 Stevens DR
City richland County Benton
Location NW 1/4-1/4 NW 1/4 Sec 4 Twn 10 R28 EWM or WWM (circle one)
Lat/Long (s, t, r Still REQUIRED) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec ______
Tax Parcel No. 114083000002008

PROPOSED USE: ☐ Domestic [x] Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) #3
[x] New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven [x] Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 12 inches, drilled 125 ft.
Depth of completed well 125 ft.

CONSTRUCTION DETAILS
Casing Installed: [x] Welded 12" Diam. from +2 ft. to 121 ft.
☐ Liner installed ______" Diam. from ______ ft. to ______ ft.
☐ Threaded ______" Diam. from ______ ft. to ______ ft.

Perforations: ☐ Yes [x] No
Type of perforator used ______
SIZE of perfs ______ in. by ______ in. and no. of perfs ______ from ______ ft. to ______ ft.

Screens: [x] Yes ☐ No ☐ K-Pac Location 51-61, 81-121
Manufacturer's Name Johnson
Type Stainless Model No. Hi-flow
Diam. 12 Slot size 60 from 51 ft. to 61 ft.
Diam. 12 Slot size 80 from 81 ft. to 121 ft.

Gravel/Filter packed: [x] Yes ☐ No ☐ Size of gravel/sand pea gravel #6-9
Materials placed from 121 ft. to 30 ft.

Surface Seal: [x] Yes ☐ No To what depth? 30 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes [x] No
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

PUMP: Manufacturer's Name ______
Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ______ ft.
Static level 47 ft. below top of well Date 7-31-09
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes [x] No If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test 40 gal./min. with 0 ft. drawdown after 1 hrs.
Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water 58 Was a chemical analysis made? ☐ Yes [x] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top soil	0	5
gravel-cobbles	5	60
Sand	60	75
med gravel	75	110
green clay	110	125

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AUG 04 2009
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 6-22-09 Completed Date 7-31-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[x] Driller ☐ Engineer ☐ Trainee Name (Print) Blake Harding
Driller/Engineer/Trainee Signature Blake Harding
Driller or trainee License No. 2852

If TRAINEE,
Driller's Licensed No: ______
Driller's Signature ______

Drilling Company Carpenter Drilling
Address 11 S goose gap
City, State, Zip Benton, WA 99320
Contractor's Registration No. CARPED*944RZ Date 7-31-09

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ECY 050-1-20 (Rev 3/05)

34211

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

ECOLOGY

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____

CURRENT
Notice of Intent No. W256436

RECEIVED
MAY 27 2009
Water Resources Program
Department of Ecology

Unique Ecology Well ID Tag No. BAE-703

Water Right Permit No. ____

Property Owner Name Battelle

Well Street Address 3300 Stevens Drive

City Richland County Benton

Location SW1/4-1/4 NW1/4 Sec 14 Twn 10 R 28E EWM ☐ or WWM ☑ (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec m

Tax Parcel No. 114083000002008

PROPOSED USE: ☐ Domestic ☑ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☑ Test Well ☐ Other

TYPE OF WORK: Owner's number of well (if more than one) WELL # 1

☑ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☑ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 12 inches, drilled 109 ft.
Depth of completed well 107 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 12 " Diam. from +1 ft. to 50 ft.
☐ Liner installed ____ " Diam. from ____ ft. to ____ ft.
☐ Threaded ____ " Diam. from ____ ft. to ____ ft.

Perforations: ☐ Yes ☑ No

Type of perforator used ____

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☑ Yes ☐ No ☐ K-Pac Location ____

Manufacturer's Name Johnson Sreens

Type SS Model No. ____

Diam. 10" Slot size 80 from 54.3 ft. to 65 ft.
Diam. 10" Slot size 10-30 from 65to78 ft. to &89to96 ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand ____
Materials placed from ____ ft. to ____ ft.

Surface Seal: ☑ Yes ☐ No To what depth? 19 ft.

Material used in seal Bentonite Chips

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? ____ Depth of strata ____

Method of sealing strata off ____

PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level 401 ft.
Static level 48 ft. below top of well Date 03/07/09
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☑ Yes ☐ No If yes, by whom? Lanye Pump

Yield: ~900 (?) gal./min. with 12.5 ft. drawdown after 8 hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest ____ gal./min. with stem set at ____ ft. for ____ hrs.

Artesian flow ____ g.p.m. Date ____

Temperature of water ____ Was a chemical analysis made? ☐ Yes ☑ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Sand and Gravel	0	55
Brown sandy gravel	55	67
Brown gravelly sand to sand (f-m micaceaous sand)	67	73
Cemented brown sandy gravel	73	81
Mafic-dominated sandy gravel	81	102
(~60% rnd mafic peb/cob; ~40% m felsic sand)		
Massive consolidated blue silt/clay	102	109 (TD)
Ringold Contact not documented, but above 55 ft bgs.		

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JUN 01 2009
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Notes:

- Geology documented from observation of driller's samples collected in 5 ft intervals and temporarily preserved on site.

- Screen placement and total well depth verified with a downhole camera.

- Discharge rate of 900 gal/min. during pump test was not verified with a properly calibrated flow meter actual discharge rate is suspected to be much lower.

Start Date ____ Completed Date ____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Jeremy

Driller/Engineer/Trainee Signature ____

Driller or trainee License No. ____

If TRAINEE,
Driller's Licensed No. ____
Driller's Signature ____

Drilling Company Nelsen Well Drilling

Address ____

City, State, Zip Kennewick, WA, 99337

Contractor's Registration No. ____ Date ____

Ecology is an Equal Opportunity Employer.

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

ECOLOGY

Construction/Decommission (*"x" in circle*) 346852

- [x] Construction
- [ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT Notice of Intent No. WE 09435

Unique Ecology Well ID Tag No. APG742

Water Right Permit No. PRELIMINARY PERMIT

Property Owner Name BATTELE (Well 2) 64-35179

Well Street Address 3300 STEVENS DRIVE

City RICHLAND County BENTON

Location SW1/4-1/4 NW1/4 Sec 14 Twn 10 R 28E EWM or WWM (circle one): WWM [x]

Lat/Long (s, t, r Still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. 114083000002008

PROPOSED USE: [ ] Domestic [x] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [x] Test Well [ ] Other ____

TYPE OF WORK: Owner's number of well (if more than one) 2

[x] New well [ ] Reconditioned [ ] Deepened *Method:* [ ] Dug [ ] Bored [ ] Driven [ ] Cable [x] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 16 inches, drilled 103 ft. Depth of completed well 102 ft.

CONSTRUCTION DETAILS

Casing Installed: [x] Welded 16 " Diam. from +2 ft. to 38 ft.
[x] Liner installed 12 " Diam. from +2 ft. to 102 ft.
[ ] Threaded ____ " Diam. from ____ ft. to ____ ft.

Perforations: [ ] Yes [x] No

Type of perforator used ____

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: [x] Yes [ ] No [ ] K-Pac Location ____

Manufacturer's Name JOHNSON HI FLOW/PVC SLOTTED

Type 316SS Model No. ____

Diam. 12" Slot size 60 PVC from 39 ft. to 57 ft.

Diam. 12" Slot size 80 SS from 68 ft. to 99 ft.

Gravel/Filter packed: [ ] Yes [x] No [ ] Size of gravel/sand ____

Materials placed from ____ ft. to ____ ft.

Surface Seal: [x] Yes [ ] No To what depth? 38 ft.

Material used in seal CEMENT

Did any strata contain unusable water? [ ] Yes [x] No

Type of water? ____ Depth of strata ____

Method of sealing strata off ____

PUMP: Manufacturer's Name ____ Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level ~400ft ft.

Static level 48 ft. below top of well Date 3-18-09

Artesian pressure ____ lbs. per square inch Date ____

Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [x] No If yes, by whom? ____

Yield: 447 gal./min. with 6 ft. drawdown after 48 hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest 250/450 gal./min. with stem set at 100 ft. for 8 hrs.

Artesian flow ____ g.p.m. Date ____

Temperature of water ____ Was a chemical analysis made? [x] Yes [ ] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TOP SOIL AND COBLES	0	6
SAND AND GRAVEL 5/8	6	23
SAND AND GRAVEL 1/4 BLACK BASALTIC	23	28
GRAVEL AND SAND COARSE WITH FINES	28	34
SAND AND GRAVEL 5/8-3/4 + cobbles	34	37
GRAVEL + cobbles AND SAND TAN LOOSE	37	45
SAND AND GRAVEL 5/8 + cobbles	45	55
MOISTER PICKED UP AT	46	
LIGHT WATER SAND AND GRAVEL	55	65
SAND COARSE WITH LITTLIE FINES	65	70
TAN SAND AND 5/8 GRAVEL MORE SAND	70	80
BLACK AND COURSE AND FINE PACKED	80	85
PACKED SAND AND GRAVEL BASALTIC	85	90
BLACK GRAVEL 1/2-1" PACKED	90	98
black sand	98	103
blue clay	103	
PVC WELL CASING	+2	39
60 SLOT PVC SLOTTED CASING	39	57
PVC WELL CASING	57	69
SS SCREEN 80 SLOT	69	99
SUMP SS	99	102
PLATE SS		102

RECEIVED
JUL 21 2009
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 2-16-09 Completed Date 3-02-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[ ] Driller [ ] Engineer [ ] Trainee Name (Print) Thomas St. George

Driller/Engineer/Trainee Signature ____

Driller or trainee License No. 2781

Drilling Company St. George Well Drilling Co.

Address 701 S 45th Ave.

City, State, Zip West Richland, Wa, 99353

Contractor's Registration No. stgeogel935bd Date 01-01-2011

If TRAINEE, Driller's Licensed No. ____

Driller's Signature ____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

WELL SUMMARY SHEET

Boring or Well No. 300-FF-5 #5B

Sheet 1 of 1

[redacted]ation NORTHEAST OF VITRIFICATION PLANT

Elevation 397.67

Driller D. ROSSMAN

Prepared By MD SWEENEY (Sign/Print Name) Date 12/23/91

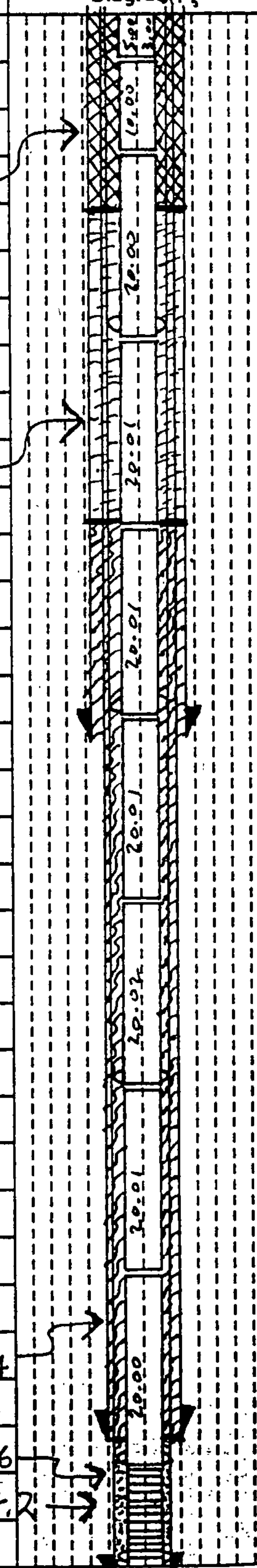
Project 300-FF-5

Drilling Contractor KEH / JENSEN DRILLING

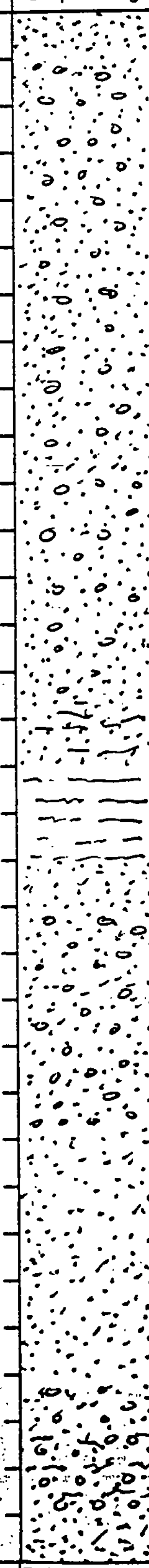
Drilling Method and Equipment CABLE TOOL

Reviewed By G. Kelty / G. Kelty (Sign/Print Name) Date 2/1/92

CONSTRUCTION DATA — Diagram



GEOLOGIC/HYDROLOGIC DATA — Graphic Log



Description (Construction Data)	Depth in Feet	Lithologic Description
10" ID CS CASING	5	SAND
SET @ 76'	10	
Portland Cement	15	
19.6 - 0.5	20	SANDY GRAVEL
8" ID CS CASING	25	
SET @ 151.25'	30	
	35	
6" ID CS CASING	40	
SET @ 166.0'	45	
Bent Crumbles	50	
19.6 - 54.4	55	
[redacted]	60	water at 54.3 BLS.
	65	
8-12 SAND PACK 165-154.2	70	
10-20 SAND PACK 152.2-150.6	75	
BENTONITE GROUT 150.6 - 54.4	80	SILTY SAND
BENTONITE CRUMBLES 54.4 - 19.6	85	
PORTLAND CEMENT 19.6 - 0.5	90	SILTY CLAY
	95	SAND
	100	
304 SS CHANNEL PACK SCREEN	105	SANDY GRAVEL
0.010 SLOT, 10.81' IN LENGTH	110	
SET @ 165'-154.2'	115	
	120	DRAFT
	125	
	130	
	135	SAND
	140	
[redacted]t. Grout 150.6-54.4	145	
[redacted]	150	SILTY SANDY GRAVEL
10-20 Sand 152.2-150.6	155	
8-12 Sand 168-154.2	160	
	165	SAND TD = 168'
		MI Silt

A-6000-384 (04/90)

RESOURCE PROTECTION WELL REPORT

Notice of Intent No. RE04741

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

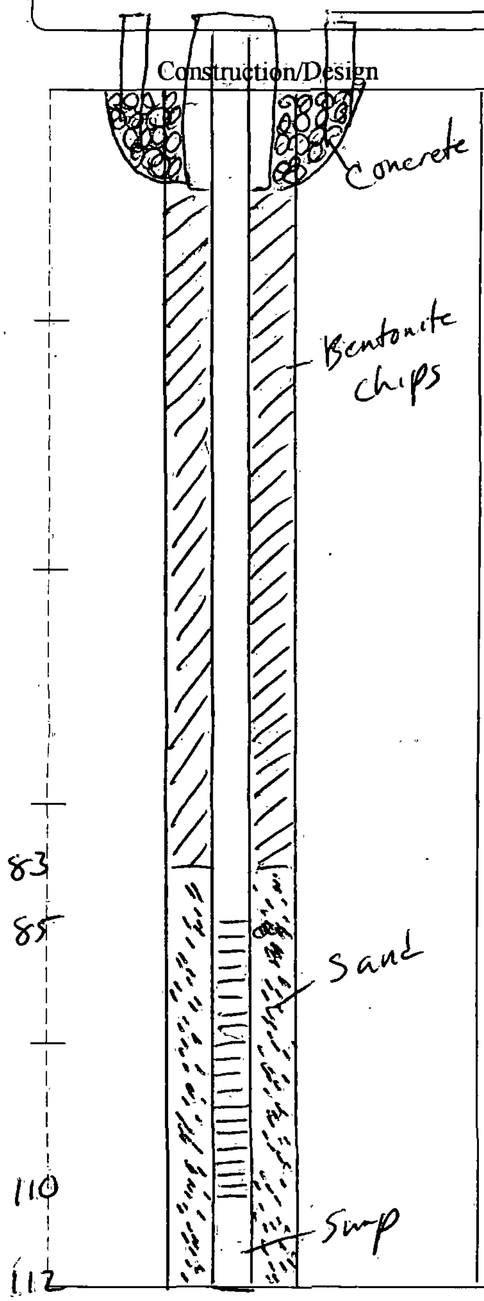
Construction/Decommission *("x" in circle)*
☒ Construction 381115
○ Decommission *Original Construction Notice of Intent Number* ______

Type of Well *("x" in circle)*
● Resource Protection
○ Geotech Soil Boring

Property Owner: Centurian Propetties III
Unique Ecology Well ID Tag No.: #BCL 376 MW-1
Consulting Firm: GSI water Solutions
Driller or Trainee Name: Timothy S. Smith
Driller or Trainee Signature: [signature]
Driller or Trainee License No.: 2837

If trainee, licensed driller's Signature and License no. ______

Site Address: 3350 Q. ave
City: Richland County: Benton
Location NE 1/4-1/4 SW 1/4 Sec 14 Twn 10 R 28 (EWM circle one) or WWM
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____
Long Deg ____ Long Min/Sec ____
Tax Parcel No. 140830000002005
Cased or Uncased Diameter 4" Static Level 57
Work/Decommission Start Date 7-12-2010
Work/Decommission Completed Date 7-12-2010

Construction/Design	Well Data	Formation Description
	Drill method - Air Rotary Casing - 4" sch 40 PVC +2.5 - 85 110 - 112 Screen - 4" sch 40 PVC (V-wrap) 85' - 110' Sand - 10/20 silica 83 - 112 Seal - Bentonite chips 2.5 - 83 Concrete 0 - 2.5' 8" Above ground w/Posts	0-3' sandy silT 3-45 Sandy gravel 45-47 gravel 47-69' Sand w/some gravel 69-73 silty gravel 73-89 gravel w/coarse sand 89-93 sand 93-97 gravelly sand 97-112 Sandy gravel

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Scale 1"=______ Page ____ of ____

RESOURCE PROTECTION WELL REPORT

Notice of Intent No. RE04741

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)* 381114

- ⊗ Construction
- ○ Decommission *Original Construction Notice of Intent Number* ______

Type of Well *("x" in circle)*

- ⊗ Resource Protection
- ○ Geotech Soil Boring

Property Owner: Centurian Properties III

Unique Ecology Well ID Tag No. BCL 377 MW-2

Consulting Firm: GSI water Solutions

Driller or Trainee Name: Timothy S. Smith

Driller or Trainee Signature: [signature]

Driller or Trainee License No: 2837

If trainee, licensed driller's Signature and License no. ______

Site Address: 3350 Q ave

City: Richland County: Benton

Location NE 1/4- 1/4 SW 1/4 Sec 14 Twn 10 R 28 EWM or WWM *circle one*

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

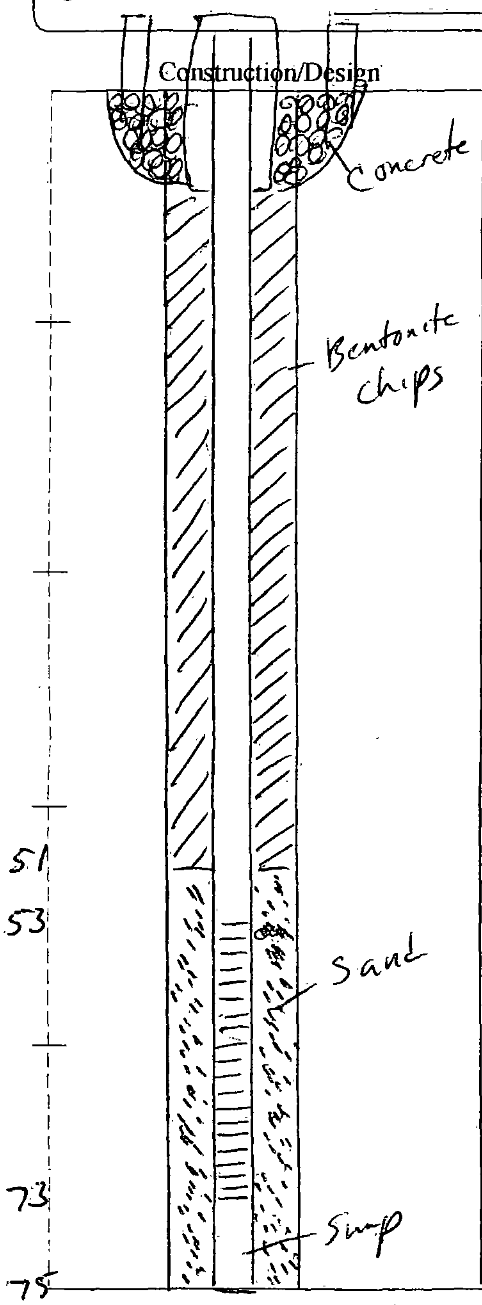
Tax Parcel No. 140830000002005

Cased or Uncased Diameter 4"

Static Level 57

Work/Decommission Start Date 7-13-2010

Work/Decommission Completed Date 7-13-2010

Construction/Design	Well Data	Formation Description
	Drill method - Air Rotary Casing - 4" sch 40 PVC +2.5 - 53 Screen - 4" sch 40 PVC (V-wrap) 53 - 73 73 - 75' Sand - 10/20 silica 51 - 75 Seal - Bentonite chips 2.5 - 51 concrete 0 - 2.5' 8" Above ground w/Posts	0-19' Sandy Gravel 19-21' gravelly Sand 21-27' Sand 27-29 Sandy Gravel 29-35' gravelly silty Sand 35-39 gravelly sand 39-41 silty Sand 41-66 Sand w/some gravel 66-71' gravel 71-75' Sand w/some gravel

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Scale 1"= ______ Page ____ of ____