STATE OF WASHINGTON

DEPARTMENT OF ENTERPRISE SERVICES

1500 Jefferson Street SE, Olympia, WA 98501

ADDENDUM NO. 1
June 17, 2014

The Washington State Department of Enterprise Services
Project No. 2013-295
Request for Proposal – Design-Build
Pierce County Readiness Center
Camp Murray, Tacoma, WA

This Addendum consists of three parts: (1) responses to eight submitted questions; (2) Owner-issued clarification of ELCCA requirements and additional NGB reporting requirements; and (3) attachments, including new design guidelines for the SIPRNET room, fire flow test results, and geotechnical reports.

1. This following responses are offered to submitted D/B Finalist questions:

#	Date	Reference Section	Question or Comment	DES Response
1	06-06-2014	RFP Section I, 2.0 "PROJECT DESCRIPTION AND RFP INFORMATION," A-5	Please further define how the distribution of the 10 pts indicated for pricing in the scoring section would be handled where the RFP notes that "no preference will be given to Proposers submitting a price proposal below the allocated MADCC". Is the pricing score evaluated on the base proposal or the base proposal plus the alternates?	Proposers shall provide the best overall design within the MADCC funds available. **REMOVE** the sentence "No preference will be given to proposers submitting a price proposal below the allocated MADCC." DES reserves the right to negotiate design details with the successful proposer during the post-award design phase. *The text of Section I-2.0-A-5 should now read:* "Proposers shall provide the best overall design within the MADCC funds available. DES reserves the right to negotiate design details with the successful proposer during the post-award design phase. The pricing is evaluated based on <u>base price plus selected alternates</u> (may or may not be all listed alternates)."

2	06-06-2014	RFP Section I, 4.0 “PROPOSAL CONTENT,” B	Reference is made in the RFP to the outline specifications for the RFP Design Solution Submittals shall be limited to a maximum of 90 sheets double sided (180 pages); please confirm that this page limit is for the outline spec only. Is there a page limit for the overall proposal? Is there a page limit for the design drawings that are to accompany the proposal? Is there a page limit for the design narrative?	Yes, only the outline specifications are limited to 90 sheets double sided (180 pages). There is no page limit for the overall proposal. There is no page limit for the design drawings. There is no page limit for the design narrative.
3	06-06-2014	RFP Section I, 4.0 “PROPOSAL CONTENT,” B-1 through 8	Please define your expectations for the outline spec. Is this a listing of applicable specification sections?	Outline specifications are intended to provide a concise guide for understanding the **intent** and **extent** of proposed design decisions. A listing of applicable specifications sections is insufficient. Outline specifications shall incorporate basic information about products, installation, and quality assurance for all aspects of the work.
4	06-06-2014	Not stated	UFC 1-200-01 para 3-4 requires use of UFGS specs for all projects. Please confirm that Masterformat is the format required.	Yes, Masterformat 2004 is the required format.
5	06-06-2014	RFP Section V, 11.0 “ROOM DATA SHEETS”	Please provide more definition with regard to which entity is to provide elements of fixed equipment and furnishings. For example, in the room data sheets provided, roller shades are noted with "furnishings". Per the responsibility matrix "furnishings" are to be provided by owner and "window coverings" are the responsibility of the D/B contractor. Other areas needing clarification for responsibility under fixed equipment. Shelving (library, storage and other), tack and marker boards, etc.	Under “Furnishings” identified in all room data sheets, the Owner will provide loose furnishings such as tables, desks, chairs, bookcases, lockers identified for use in offices, file and storage cabinets, credenzas, modular office furniture, carrels, and exercise equipment. Items identified as furnishings that are permanently affixed, such as casework, counters, roller shades, lockers identified for use in Locker Room, industrial-duty three-tier storage shelving in Unit Storage, drying benches in Toilet/Showers, and supply cabinets in Toilets, and all markerboards and tackboards shall be provided by the D/B Contractor. As an exception to this general rule, shelving in the Battery Room, Maintenance Supply Room, Tool Room, and Flammable Materials shall be provided by the Owner.
6	06-06-2014	RFP Section V, 11.0 “ROOM DATA SHEETS”	Several room data sheets call for the flooring to be concrete with hardener/sealer but then also indicate liquid-applied epoxy as state funded alternate. We see no reference to an alternate price for epoxy flooring. Please confirm that no alternate pricing is required.	This appears to apply to the Locker Room and Controlled Waste rooms only. In these spaces **DELETE** references to Stated-funded epoxy flooring.

7	06-06-2014	RFP Section I, 2.0 "PROJECT DESCRIPTION AND RFP INFORMATION," and 4.0 "PROPOSAL CONTENT," A-17	Please confirm that the alternates are additive to the base price of $26,683,000 and are not expected to be deductive	The $26,683,000 (which with sales tax totals $29,032,000.00) is the total upper funding limit and cannot be exceeded. This limit includes all alternates as well as the construction contingency.
8	06-06-2014 & 06-12-2014	RFP Section IV - Section 4.0 – SUSTAIN-ABILITY & LEED NARRATIVE	The second paragraph of Section 4.0 (see sheet 13 of 85) states: "Sustainability was discussed in detail during an eco-charrette held during the programming process and the resulting checklist of targeted credits is presented in the Appendix of this RFP." The LEED Checklist included in Appendix 3D is a blank document. Please provide the completed checklist from the eco-charrette.	**DELETE** the sentence "Sustainability was discussed in detail during an eco-charrette held during the programming process and the resulting checklist of targeted credits is presented in the Appendix of this RFP." As stated elsewhere in Section 4.0, some LEED credits are obligatory and some are prohibited. Beyond these minimum expectations, achievement of LEED Silver certification is entirely the responsibility of the D/B Contractor.

2. This following clarify ELCCA requirements and identify additional NGB reporting requirements:

#	Date	Reference Section	Issue	DES Response
9	N/A	RFP Section IV, 10.0 "MECHANICAL SYSTEM GENERAL REQUIRE-MENTS," D-5-a and Appendix 3C Energy Life Cycle Cost Spreadsheet	Life Cycle Cost Analysis.	For the purpose of life cycle cost analysis the following occupancy assumptions should be used: Full time staff of 38 will use the building from 7 am to 5 pm 260 days per year. These individuals will be spread uniformly through the administrative space. All of these individuals will take a 5 minute shower daily. Part time staff of 339 will use the building 38 days per year from 7 am to 5 pm. They will have food cooked for one meal and served to them on reusable dishes which are washed each of those days. All 339 people will shower two additional times per year. The classrooms will have an average use of an additional 60 persons 40 hours per week, May to September.

10	N/A	RFP Section I, 4.0 "PROPOSAL CONTENT," New requirement A-18	NGB Reporting.	NGB requires approval of 35% building design submittals and 100% civil design before they will authorize construction on site. Before building construction can begin NGB requires submittal of 100% building drawings. As part of the contractor submittals from the successful design build contractor we need the following: 1. A spreadsheet showing each space type on the 1391 (attached) the authorized amount and the actual amount. 2. Cost breakdown of the project by asset. The primary facility is one asset and each other item such as sewer lines, sidewalks and fences are individual assets. The complete list of assets cannot be developed until the design is finalized. The attached form is the preliminary list of assets.

3. This following attachments are for the D/B Finalists' use:
    a. New design guidelines for SIPRNET rooms (6 pages)
    b. Fire flow test results (3 pages)
    c. Geotechical Data report prepared by Hart Crowser dated June 17, 2014 (42 pages)
    d. Geotechnical Recommendations Report prepared by Hart Crowser dated June 17, 2014 (25 pages)

This Addendum does not amend the due date or time for Proposals. Proposals continue to be due on July 31, 2014 at 3:00 PM.

New Design Guidelines for SIPRNET Rooms

Enclosure 1.

Secure Room Construction Standards AR-380-5 (Dated 29 SEP 00) Chapter 7, Section III, para. 7-13, page 84

(1) **Floor, Walls, and Roof**. The walls, floor, and roof construction of secure rooms must be of permanent construction materials, i.e., plaster, gypsum wallboard, metal panels, hardboard, wood, plywood, or other materials offering resistance to, and evidence of, unauthorized entry into the area. Walls will be extended to the true ceiling and attached with permanent construction materials, with mesh or 18 gauge expanded steel screen.

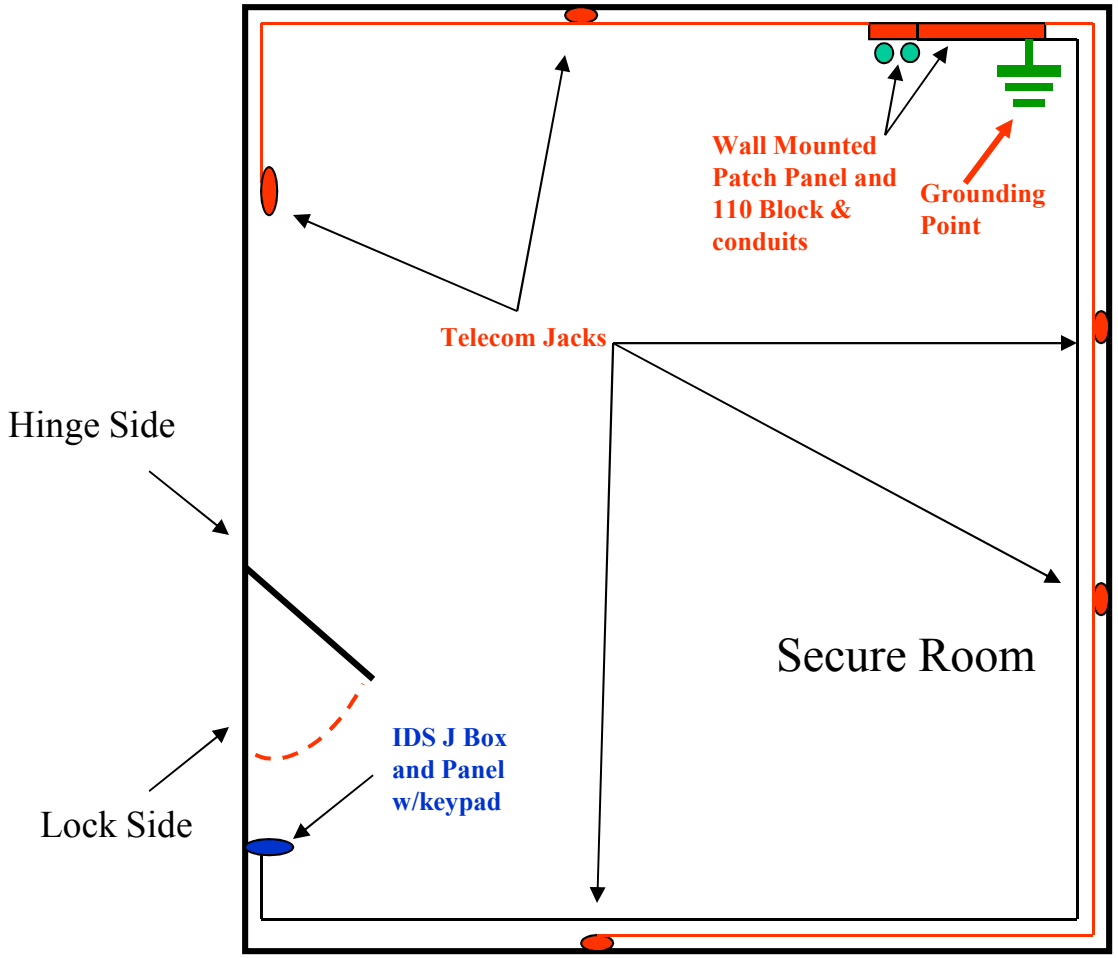
(2) **Ceiling**. The ceiling will be constructed of plaster, gypsum, wallboard material, hardware, or other similar material that the command security manager judges to be of equivalent strength.

(3) **Doors**. The access door to the room will be substantially constructed of wood or metal. The hinge pins of out–swing doors will be pinned, brazed, or spot–welded to prevent removal. The access door will be equipped with a built–in GSA–approved combination lock meeting Federal Specification FF–L–2740A. For open storage areas approved under previous standards, the lock can be the previously approved GSA combination lock. However, upon retrofit, the door must be fitted with a lock meeting Federal Specification FF–L–2740A (See paragraph 7–21 for priorities for replacement of such locks). Doors, other than the access door, will be secured from the inside. For example, by using a dead bolt lock, panic dead bolt lock, or rigid wood or metal bar which extends across the width of the door, or by any other means that will prevent entry from the outside. Key operated locks that can be accessed from the exterior side of the door are not authorized.

(4) **Windows**. Windows which are less than 18 feet above the ground when measured from the bottom of the window, or are easily accessible by means of objects directly beneath the windows, will be constructed from or covered with materials which will provide protection from forced entry. The protection provided to the windows need be no stronger than the strength of the contiguous walls.

(5) **Openings**. Utility openings, such as ducts and vents, will be kept at less than a person–passable, 96 square inches, opening. Openings larger than 96 square inches will be hardened in accordance with Military Handbook 1013/1A, which provides guidance to ensure that appropriate physical security considerations are included in the design of facilities.

Sample Secure Room Plan



Recommended the installation of **two (2) in concrete floor PVC conduits** from the Telecom Room directly to the Secure room and feeding into a **wall mounted backboard** mounted on the wall **INSIDE** the expanded steel mesh (16 gage) of the room, so there are no breaks in the mesh. **The room must have a HardPan ceiling**.

All the **telecom jacks** will be home run from the interior 110 block mounted on the backboard. **The CAT-6 cable will be fed to each jack in 3/4" or 1" EMT in the walls of the secure room directly from the patch panel. EMT will be grounded to the room grounding bus bar.**

Fiber Optic Cable shall be run throught the other conduit and terminated in a fiber patch panel/box.

Recommend one 30 amp ciruit with one outlet and two 20 amp power circuits (dual outlets) for equipment.

The IDS "J Box" will also be fed (CAT-6) through another separate conduit.

The IDS "J BOX" will be mounted **five (5) feet above the floor** of the secure room on the **LOCK Side** of the door in preparation for installing the IDS system and keypad. A 20 Amp circuit must be provided for the IDS system with the receptacle 36 inches from the floor.

The room must be **grounded by a ground rod in addition to being bonded** to the building ground.

Drawn By LTC John Wunsch, DCSIM-TS

CFMO 19 May 2014

MEMORANDUM FOR: Mr. Ron Cross, Project Manager, CFMO-WA

SUBJECT: Pierce County Readiness Center (PCRC) SIPRNET Room Interior Network Cabling Requirements.

1. References: Installation Information Infrastructure Architecture (I3A), TIA/EIA 568B.2-1; SIPRNET Technical Implementation Criteria (STIC) September 2013; CNSSAM 1-13, Army Regulation (AR) 380-5, National Electrical Code (NEC), NSTISSI 7003.

2. The following items describe the network cabling requirements and architecture for the SIPRNET Room construction in addition to the information previously provided from Army Regulation (AR) 380-5.

a. All cabling for SIPRNET network drops will be Category 6 (CAT 6) copper wiring. Wiring configuration will be to TIA/EIA 568-A standard. Distribution will be via metallic cable pathway. All metallic distribution shall be electrically continuous and installed in accordance with the National Electric Code. Electrical Metallic Tubing (EMT) used in lieu of shielded cable shall utilize compression fittings. (CNSSAM 1-13; 3.13). No PVC or plastic cable distribution type/pathway is authorized. All cable raceway shall be metallic and visible for its entire length for security and inspection purposes. It will not be painted, covered with any material, or boxed in. See also paragraph d below.

b. Cabling for Un-Classified telephones and computers will be restricted to the office (s) at one end of the room near the entry door and will in no way enter the main room area housing the SIPRNET. This cabling will also be Category 6 (CAT 6) and will be terminated to 568-A standard. This cabling can be flush mounted and will also be single gang, dual outlet boxes. See paragraph "f" for more details.

c. All SIPRNET network cabling will be completely isolated from any Un-Classified cabling and will comply with the Red/Black Separation requirement of twenty (20) inches from any electrical power source/wiring. (CNSSAM 1-13; 4.4 Table 4). A separation distance of 50 cm shall be provided between RED Equipment and BLACK wirelines that connect to outside the inspectable space through a digital switch (a computerized telephone switch or network router) that is contained within the inspectable space (CNSSAM 1-13; 4.5.1).

d. Network cabling from the SIPRNET network distribution cabinet or Information Processing System (IPS) Safe will be run in surface mounted EMT conduit or HOLOCOM brand cable tray and outlet boxes to each work station location. The cables will leave the cabinet or IPS by a large aggregation junction box (J Box) or applicable HOLOCOM adapter as required if using HOLOCOM products. The Network distribution cabinet/Rack/IPS and the "J Box" and by extension, EMT conduit/HOLOCOM cable tray will be grounded to the Telecommunications Grounding Busbar (TGB) by individual # 6 copper cable runs. The TGB will be connected to the Telecommunications Main Ground Busbar (TMGB).

e. As an additional TEMPEST countermeasures requirement, a CTTA may require the isolation of fortuitous conductors that traverse a space that processes NSI. If required by a CTTA, then all pipes, conduits, ducts, and other metallic distribution systems that leave the inspectable space shall be grounded or isolated at the inside boundary of the inspectable space. Non-conductive sections shall be inserted in each fortuitous conductor, or each conductor shall be grounded. The ground must be contained within the inspectable space. Unused wireline cables that leave the inspectable space shall be removed or shortened to be contained within the inspectable space. Fortuitous conductors may also have a requirement for a non-conductive section for acoustic isolation.

f. The network outlet boxes will also be surface mounted and will be a single gang duplex arrangement. The SIPRNET outlet bezel and network cable will be RED, indicating a classified network outlet. Unclassified network outlet bezels will be GREEN. Unclassified cabling within the SIPRNET Room and office(s) will be GREEN per table 1 (CNSSAM 1-13). This is ensure there is no cross connecting of Classified to Un-Classified systems.

Table 1 – (U//FOUO) Cable Color Scheme

CLASSIFICATION LEVEL	CABLE COLOR
Unclassified	Green
Collateral Secret	Red

g. Power for the SIPRNET room will be provided by a dedicated panel in the SIPRNET room. Power for the electrical service for lighting and power will be dedicated circuits for each, i.e., one or more dedicated circuit(s) for lighting, one or more dedicated circuit(s) for equipment. Each circuit will have the appropriate number of separate circuit breakers for the required load. The IPS or Network Equipment Distribution rack/cabinet will have its own circuit breaker. (STIC 3.5.2).

h. Power in the SIPRNET room (not the office(s) at the end of the room) will also be surface mounted in standard EMT conduit and properly grounded to the panel for Life/ Safety. Be aware that the other side of the wall from the SIPRNET room may house unclassified work stations, so be mindful of the separation distance. The expanded steel mesh in the walls, when properly grounded, will attenuate the risk related to the separation distance.

i. Space and electrical provision shall be made for a large UPS for the network switch, router and a separate UPS for the encryption device.

j. There shall be no transmitters or antennas or antenna cables installed or located within 10 Meters/39 Feet in any direction (360 degrees) from the SIPRNET room perimeter. (CNSSAM1-13; 3.6.4)

k. Grounding requirements. A separate RED and BLACK grounding system is desirable but is not required for TEMPEST unless directed by a CTTA. When power filters or signal filters are required-, or when a ground is required for fortuitous conductors, a grounding system is required. The facility grounding system may be used provided that the grounding system is a multi-point equipotential plane or that the grounding system is single point ground that is contained within the inspectable

space. Consult a CTTA for guidance on grounding. All grounding shall be installed in accordance with the National Electric Code. (CNSSAM 1-13; 3.14)

i. A signal reference ground (Telecommunications Grounding Busbar-TGB) will be used (see paragraph "d" for more information). Grounding wires will be kept as short and straight as possible. (STIC 3.5.5)

Table 2 – (U//FOUO) Electrical Isolation Level

RED SIGNAL TYPE	ISOLATION LEVEL	FREQUENCY RANGE
Analog Voice	100 dB	100 Hz to 5 KHz
Analog signaling, including analog video	80 dB	Lowest signaling rate to maximum signaling rate
Digital Signaling	60 dB	Lowest signaling rate to 10 times the maximum signaling rate

j. Security of the network outlet ports shall be in a lockable metal enclosure such as are commercially available that meet the federal requirements for protected distribution systems as outlined in NSTISSI 7003, such as Holocom, Wiremold, etc. These type systems are highly recommended as they are complete, approved designed systems.

Sample showing Holocom product. This particular arrangement separates the classified data cables from the power cables and the unclassified cables and provides inherent security, grounding and shielding using these lockable steel boxes and steel raceway. Note the RED bezels on the outlet port inside the box. The power cabling is approximately 18" from the floor. This is a US Government approved solution. This is NOT a brand endorsement, just a sample.

3. Questions regarding this document can be directed to the undersigned at 253-512-8709, and email at john.h.wunsch.civ@mail.mil .

JOHN H. WUNSCH
Planning and Programming Branch Chief
CFMO-WA

Fire Flow Test Results

EMERALD FIRE LLC
11021 CRAMER RD KPN
GIG HARBOR WA 98329-5511
253 857-2056

License: EMERAFL980MR

Contract Invoice

Invoice#: 140525

Date: 05/09/2014

Billed To: MILITARY DEPT / STATE OF WA
FACILITY ENGINEERING-RON CROSS
CAMP MURRAY-BLDG. 36
TACOMA WA 98430-5052

Project: CAMP MURRAY F-HYDRANT TEST MD?
CAMP MURRAY
2-FIRE HYDRANT FLOW TESTS
CAMP MURRAY WA 98430-5052

Due Date: 06/08/2014 **Terms:** 30DY **Order#** PER RON CROSS

Description	Amount
CAMP MURRAY FIRE HYDRANTS FLOW TESTING, CAMP MURRAY WA	
PERFORMED A FLOW TEST ON THE FIRE HYDRANT ON FIELD ARTILLERY & INFANTRY DR	395.00
PERFORMED A FLOW TEST ON THE FIRE HYDRANT ON INFANTRY DRIVE	275.00
COMPLETED ON 5/1/14	

A service charge of 18.00% per annum will be charged on all amounts overdue on regular statement dates.

Thank you for your prompt payment!

Sales Tax:	0.00
Invoice Total:	670.00
Retention:	0.00
Amount Paid:	0.00
Amount Due	**670.00**

Enclosure 5 – Hydrant Flow Test Form

HYDRANT FLOW TEST DATA & ANNUAL PERFORMANCE EVALUATION

FIRE AND EMERGENCY SERVICES
FORT LEWIS, WASHINGTON

HYDRANT FLOW TEST
DATA & ANNUAL PERFORMANCE EVALUATION

F & ES Number ___ (Fire House)	DATE 5-1-14	TIME 7:30 AM PM	
Address: FIELD ARTILLERY AND INFANTRY DRIVE CAMP MURRAY WA.			
Manufacturer	Model	Year	Main

Procedures:
1. Locate personnel at the test hydrant and at all flow hydrants to be used
2. At the test hydrant (Target) attach the pressure gauge cap with petcock in the open position. After checking the second cap for tightness, open hydrants slowly several turns. Once the air has escaped and a steady stream of water is flowing, the petcock should be closed and the hydrant opened fully.
3. Read and record the static pressure as seen on the pressure gauge.
4. Remove caps from flow hydrants, check record outlets coefficients and the actual inside diameter of the orifice (with in 1/16"). If a nozzle is used on the outlet, its coefficient and diameter should be checked and record.
5. Open flow hydrants as necessary, take and record pitot reading of the velocity pressures. The individual at the test hydrant should simultaneously read and record the residual pressure. Note: the residual pressure should not drop below 20 psi during the test. If this happens, the number of hydrants must be reduced.
6. Slowly close the flow hydrants, one at a time, to prevent water hammer in the mains. After checking for proper drainage, replace and secure all hydrants caps. Report any hydrant defects.
7. Check the test hydrant for the return to the normal operating pressure; and then close it. The petcock valve should be opened to prevent a vacuum on the gauge. Remove the gauge
Note: Enough hydrants should be opened to drop the static pressure by at least 10 psi., if a more accurate results are required, the pressure drop should be as close as possible to 20 psi.

One Hydrant Flow Test (A-1)

Coefficient	Port Size	Pitot Pressure	GPM
/	2½"	17	695

Available Flow

Target Hydrant (B) No.	Static Pressure	Residual Pressure
	64	62

Projected Results @ 20 psi 3688 gpm.

Test Hydrants	A-2	A-3	A-4
Coefficient			
Port Size			
Pitot Size			

Classification of Hydrant	Class AAA Light Blue / > 1500gpm	Class A Green / 1000-1499	Class B Orange / 500 – 999gpm	Class C Red / <500gpm
	☒	☐	☐	☐

Services Order Submitted ☐ Yes ☐ No Roadway Marker ☐ Yes ☐ No

Remarks:

Test Made By MD Date 5-1-14

IAW NFPA 291

Enclosure 5 – Hydrant Flow Test Form

HYDRANT FLOW TEST DATA & ANNUAL PERFORMANCE EVALUATION

FIRE AND EMERGENCY SERVICES
FORT LEWIS, WASHINGTON

HYDRANT FLOW TEST
DATA & ANNUAL PERFORMANCE EVALUATION

P & EI Number ___ (Fire House)	DATE 5-1-14	TIME 7:50 AM PM	
Address: INFANTRY DR. CAMP MURRAY WA			
Manufacturer	Model	Year	Main

Procedures:
1. Locate personnel at the test hydrant and at all flow hydrants to be used.
2. At the test hydrant (Target) attach the pressure gauge cap with petcock in the open position. After checking the second cap for tightness, open hydrants slowly several turns. Once the air has escaped and a steady stream of water is flowing, the petcock should be closed and the hydrant opened fully.
3. Read and record the static pressure as seen on the pressure gauge.
4. Remove caps from flow hydrants, check record outlets coefficients and the actual inside diameter of the orifice (with in 1/16"). If a nozzle is used on the outlet, its coefficient and diameter should be checked and record.
5. Open flow hydrants as necessary, take and record pitot reading of the velocity pressures. The individual at the test hydrant should simultaneously read and record the residual pressure. Note: the residual pressure should not drop below 20 psi during the test. If this happens, the number of hydrants must be reduced.
6. Slowly close the flow hydrants, one at a time, to prevent water hammer in the mains. After checking for proper drainage, replace and secure all hydrants caps. Report any hydrant defects.
7. Check the test hydrant for the return to the normal operating pressure; and, then close it. The petcock valve should be opened to prevent a vacuum on the gauge. Remove the gauge.
Note: Enough hydrants should be opened to drop the static pressure by at least 10 psi., if a more accurate results are required, the pressure drop should be as close as possible to 20 psi.

One Hydrant Flow Test (A-1)

Coefficient	Port Size	Pitot Pressure	GPM
1	2 1/2"	18	716

Available Flow

Target Hydrant (B) No.	Static Pressure	Residual Pressure
	64	61

Projected Results @ 20 psi: 3052 gpm.

Test Hydrants	A-2	A-3	A-4
Coefficient			
Port Size			
Pitot Size			

Classification of Hydrant	Class AAA Light Blue / > 1500gpm	Class A Green / 1000-1499	Class B Orange / 500 – 999gpm	Class C Red / <500gpm
	☒	☐	☐	☐

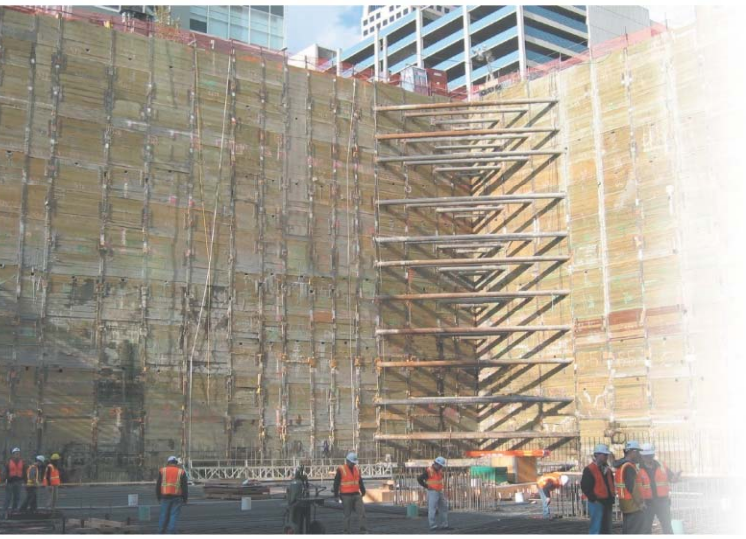
Services Order Submitted ☐ Yes ☐ No | Roadway Marker ☐ Yes ☐ No

Remarks:

Test Made By MD | Date 5-1-14

IAW NFPA 291

Geotechnical Data Report



Geotechnical Data Report

Pierce County Readiness Center

Camp Murray, Washington

Prepared for

Schreiber, Starling & Lane Architects

June 2, 2014

17981-00

HARTCROWSER

HARTCROWSER

www.hartcrowser.com

Geotechnical Data Report

Pierce County Readiness Center

Camp Murray, Washington

Prepared for

Schreiber, Starling & Lane Architects

June 2, 2014

17981-00

Prepared by

Hart Crowser, Inc.

BARRY SHIYO CHEN
STATE OF WASHINGTON
34053
REGISTERED
PROFESSIONAL ENGINEER

6/2/14

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Pilot Infiltration Test Results – Current Study

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Previous Explorations and Laboratory Test Results by Hart Crowser

Geotechnical Data Report

Pierce County Readiness Center

Camp Murray, Washington

1.0 INTRODUCTION

This Geotechnical Data Report describes the procedures and presents the results of field explorations, field tests, and laboratory tests completed during the preliminary geotechnical investigation for the Pierce County Readiness Center (PCRC) project at Camp Murray, Washington. The purpose of these investigations was to identify subsurface conditions within the proposed project area. This report is organized as follows:

- Introduction;
- Purpose, Scope, and the Use of This Report;
- Site and Project Descriptions;
- Geotechnical Exploration and Field Testing Program;
- Geotechnical Laboratory Testing Program;
- Subsurface Conditions; and
- References.

Tables and figures are presented following the text. Figure 1 shows the project location on a Vicinity Map. Figures 2a, 2b, and 2c are Site and Exploration Plans, showing locations of explorations performed for this study with respect to existing site features and proposed development. The exploration logs prepared for the current study are presented in Appendix A. Appendix B presents the results of laboratory tests performed for the current study. Appendix C presents the result of field pilot infiltration testing for the current study. Hart Crowser exploration logs and laboratory test data from a previous study near the project site are presented in Appendix D.

This data report contains only the factual data.

2.0 PURPOSE, SCOPE, AND THE USE OF THIS REPORT

2.1 Purpose

The purpose of our work is to identify subsurface conditions at test pit locations within the footprint of the proposed PCRC development.

2.2 Scope

The scope of work included the following items:

- Compile and review available subsurface information including soil conditions and groundwater levels;
- Conduct subsurface explorations based on proposed PCRC facility locations;
- Perform a pilot infiltration test (PIT) based on proposed PCRC facility locations;
- Perform laboratory tests on selected soil samples from the subsurface explorations; and
- Present the results of our work in this Geotechnical Data Report.

2.3 The Use of This Report

The scope of work was completed in accordance with our agreement with Schreiber Starling & Lane Architects, PS dated August 28, 2013, and our revised scope for the Camp Murray site provided on January 27, 2014. This report is for the exclusive use of Schreiber, Starling & Lane Architects PC, Washington Military Department, and their consultants for specific application to the subject project and site. This Geotechnical Data Report was prepared in accordance with generally accepted geotechnical practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, express or implied.

3.0 SITE AND PROJECT DESCRIPTIONS

3.1 Site Description

The proposed PCRC site is a previously developed parcel at the heart of 226-acre Camp Murray. It is bounded by Infantry Drive to the north, 41st Division Way to the east, and Field Artillery Trail to the west. The PCRC development covers approximately 12.5 acres and includes adequate space for future development of a 120,000-gross-square-foot Joint Force Headquarters. Figure 1 shows the project location on a Vicinity Map.

The previous site development included several one- to two-story buildings, a combination of asphalt and gravel parking areas, and a stormwater infiltration facility. Buildings within the proposed PCRC development area had been demolished before the current subsurface explorations were completed on May 5 and May 6, 2014. The existing stormwater infiltration facility remains, as shown on Figure 2a, and may be used as part of the PCRC site development. No previous testing or design information related to the existing infiltration facility was available for review.

The site topography is relatively flat with elevations generally ranging between 260 and 266 feet, based on the survey provided by AHBL (see Figure 2a).

3.2 Project Description

Our understanding is that the proposed PCRC will include a three-story readiness center building (48,100 square feet), a storage and fuel bay building (19,600 square feet), two privately owned vehicle parking areas, and a military vehicle parking area.

4.0 GEOTECHNICAL EXPLORATION AND FIELD TESTING PROGRAM

The data provided in this report is based on:

- Exploration logs from a previous study conducted at a site near the proposed PCRC;
- Explorations conducted at discrete locations as part of this study;
- Field infiltration testing; and
- Laboratory testing of soil samples obtained from the explorations.

4.1 Explorations from Previous Projects

Hart Crowser reviewed historical exploration logs from our 2002 Geotechnical Engineering Design Study, Proposed Building Addition to Building 34, Camp Murray, Washington. These exploration logs provide additional information regarding general subsurface conditions near the project site.

The historical test pit locations are located approximately 1,000 feet northeast of the project site and are not shown on Figures 2a, b, or c. The historical boring logs and laboratory test data are presented in Appendix D, as they appeared in their original reports. Additional information about the exploration and test procedures can be found in Hart Crowser (2002).

4.2 Explorations for Current Study

4.2.1 Exploration program

Hart Crowser performed 10 geotechnical test pits, designated TP-1 through TP-10. The test pits were excavated on May 5 and May 6, 2014. These explorations were generally located to better characterize the subsurface conditions beneath the proposed readiness center building footprint, vehicle storage and fuel bay building area, and parking areas. The test pit explorations were excavated between depths of 8 to 12 feet below ground surface (bgs).

The test pit logs presented in Appendix A present observations of the test pit excavations, sampling depths, and laboratory testing data. The logs also indicate the depths where the soils change. Note that in some cases, the change in soil may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1, Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

4.2.2 Exploration Locations

Figures 2a, b, and c show the locations of explorations relative to the pre-demolition site plan and/or proposed PCRC facilities. In the field, explorations were located by tape measuring from existing physical features. This report presents estimated locations based on our field measurements and ground surface elevations based on the site survey provided by AHBL (see Figure 2a). Vertical positions are reported as elevations according to the Nation Geodetic Vertical Datum of 1929 (NGVD 29).

4.2.3 The Use of Geotechnical Test Pits

Test pits TP-1, TP-2, and TP-7 through TP-10 were excavated to 8 feet bgs, and TP-3 through TP-6 were excavated to 12 feet bgs. The test pits were excavated by a trackhoe subcontracted by Hart Crowser. The sides of these excavated pits offer direct observation of the subgrade soils. The test pits were located by and excavated under the direction of an engineering geologist from Hart Crowser. The geologist observed the soil exposed in the test pits and reported the findings on a field log. The geologist took representative samples of soil types for testing at Hart Crowser's laboratory. If encountered, groundwater levels or seepage were noted during excavation. The density/consistency of the soils (as presented parenthetically on the test pit logs to indicate their having been estimated) is based on visual observation only as disturbed soils cannot be measured for in-place density in the laboratory. The test pit locations are shown on Figures 2a, b, and c, and the actual logs are presented in Appendix A.

4.2.4 Pilot Infiltration Test (PIT)

Two PITs were performed near the center of the project site and near the existing infiltration facility, as shown on Figures 2a, b, and c. Soils were logged during excavation activities and the Test Pit Logs PIT-1 and PIT-2 are provided in Appendix A.

PIT test details and recorded data recorded are presented in Appendix C.

5.0 GEOTECHNICAL LABORATORY TESTING PROGRAM

A laboratory testing program was performed for this preliminary study to evaluate the index properties of the site soils. The tests performed and the procedures followed are outlined below.

5.1 Soil Classification

Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment in general accordance with ASTM D 2488. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by grain size analysis. Classifications were made in general accordance with the Unified Soil Classification System (USCS), ASTM D 2487, as presented on Figure B-1.

Important. Grain size analyses presented in Appendix B only represent grain sizes smaller than 3 inches in diameter (i.e., fine gravel size and smaller). Percent cobbles or boulders were not measured in the laboratory but were visually estimated in the field, as shown on the test pit logs in Appendix A. Thus, soil descriptions from the field and laboratory tests provided in the logs are relative to the portion of the sample that is gravel size and smaller, and the estimated percentage of cobble or boulders relative to the *total* volume of soil particles is noted after the soils description.

5.2 Water Content Determination

Water content was determined for select samples recovered in the explorations in general accordance with ASTM D 2216, as soon as possible following their arrival in our laboratory. The results of these tests are shown at the respective sample depth on the exploration logs.

5.3 Grain Size Analysis (GS)

Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the US No. 200 mesh sieve. The results of the tests are presented as curves on Figures B-2 through B-5 plotting percent finer by weight versus grain size. See the note in Section 5.1 regarding cobbles and boulders.

6.0 SUBSURFACE CONDITIONS

Subsurface soil and groundwater conditions observed in explorations near the proposed PCRC facility and soil properties inferred from field observations, field testing, and laboratory testing formed the basis for the data provided in this report. The nature and extent of variations between the explorations may not become evident until additional explorations are performed and/or construction begins. If variations then appear, it will be necessary to consider this additional data along with the data provided in this report.

6.1 Regional and Site Geology

The Puget Lowland is nestled between the Cascade Mountains and Olympic Mountains/Coast Range in western Washington. This area has been subjected to several major glaciations, which have left behind a complex sequence of glacially derived and interglacial sediment. These glaciations are characterized by an intricate sequence of lacustrine deposits, glaciomarine drift, till, and recessional outwash.

The geology of the Puget Lowland is further complicated with the erosion and deposition of sediment during succeeding nonglacial and glacial intervals. During the most recent glaciation, the Vashon Glaciation, the Puget Sound area was covered with 3,000 feet of ice about 15,000 years ago.

The project site is located in an area where shallow subsurface soils are typically a recessional outwash unit, referred to as Steilacoom Gravel, which was deposited during the last glacial retreat. Steilacoom Gravel is generally a sandy gravel with cobbles and boulders.

6.2 Soil Conditions

The soil layers observed during the field exploration program were categorized based on their USCS group as shown on the test pit logs in Appendix A. General soil units were identified based on soil composition and relative density to provide a summary of subsurface conditions and are described in detail in the following sections.

6.2.1 Fill and Topsoil

Engineered and non-engineered soil placed by humans is classified as fill. Fill soils generally have variable properties and may contain debris and organic matter. In general, the Fill consisted of medium dense slightly silty to silty, sandy Gravel with cobbles. Occasionally, the Fill contained various materials including concrete and steel debris.

The Topsoil generally appears dark brown to black in color, characteristic of the organic silt or clay fraction of the soil, and contains organic material (roots). The topsoil at the site is predominantly a medium dense silty, sandy, Gravel with organic material (roots), cobbles, and an organic silt fraction.

In the Fill and Topsoil, the gravels and cobbles were observed to be angular to subrounded.

All test pits except TP-4 encountered the Fill and Topsoil. These soils were observed to be 0.5 to 3 feet thick below existing ground surface.

6.2.2 Medium Dense to Dense Sandy Gravel

This layer generally consists of medium dense to dense, light brown, sandy to very sandy Gravel with trace silt and cobbles. This layer is estimated to contain about 20 to 30 percent cobbles. Gravel and cobbles were observed to be well rounded.

This soil layer was encountered below the Fill and Topsoil unit, with the exception of TP-4 where it was encountered at ground surface. This layer was observed to range from 1 foot to over 8 feet thick.

6.2.3 Dense to Very Dense Sandy Gravel

This layer generally consists of gray, sandy Gravel with trace silt and cobbles and occasional boulders. This layer is estimated to contain about 40 to 45 percent cobbles and boulders. The boulders ranged from 1 to 1.5 feet in diameter. Gravel, cobbles, and boulders were generally well rounded.

This soil layer was observed in explorations TP-1, TP-2, TP-3, TP-4, TP-5, TP-7, and TP-8. This soil unit was encountered beneath the Medium Dense to Dense Sandy Gravel. The test pit explorations were terminated in this layer at depth, where encountered.

6.3 Groundwater

Groundwater was encountered in TP-6 at 10 feet bgs (elevation 254 feet). Other test pits excavated to a similar elevation did not encounter groundwater; however, soil moisture increased from moist to wet near the base of test pits TP-5 and TP-10 (elevation 253.5 feet and 256 feet, respectively). Note

that American Lake is approximately 0.3 mile northwest of the PCRC site and has an average water level elevation of 235 feet (WDFW 2014 and USGS, Steilacoom Quadrangle, 1997 Topographic Map).

Our review of historical exploration logs in the area indicated that groundwater was not encountered in test pit explorations located northeast of the project site (Hart Crowser 2002).

Measured groundwater levels are representative for the time indicated on the test pit logs. Fluctuations in groundwater levels may be caused by variations in rainfall, temperature, seasons, and other factors.

7.0 REGIONAL AND SITE SEISMIC SETTING

The seismicity of western Washington is dominated by the Cascadia Subduction Zone, where the offshore Juan de Fuca plate subducts beneath the continental North American plate. Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound area clearly indicate a distinct shallow zone of crustal seismicity (e.g., the Tacoma Fault Zone), which may have surficial expressions and can extend to depths of 16 to 19 miles. A deeper zone is associated with the subducting Juan de Fuca plate and produces intraplate earthquakes at depths of 25 to 43 miles beneath the Puget Sound region (e.g., the 1949, 1964, and 2001 earthquakes) and interplate earthquakes at shallow depths near the Washington coast (e.g., the 1700 earthquake with an approximate magnitude of 9.0).

Geologic maps indicate the southern-most splay of the Tacoma Fault Zone is about 12 miles north-northeast of the site in plan view (Washington State DNR 2014).

8.0 REFERENCES

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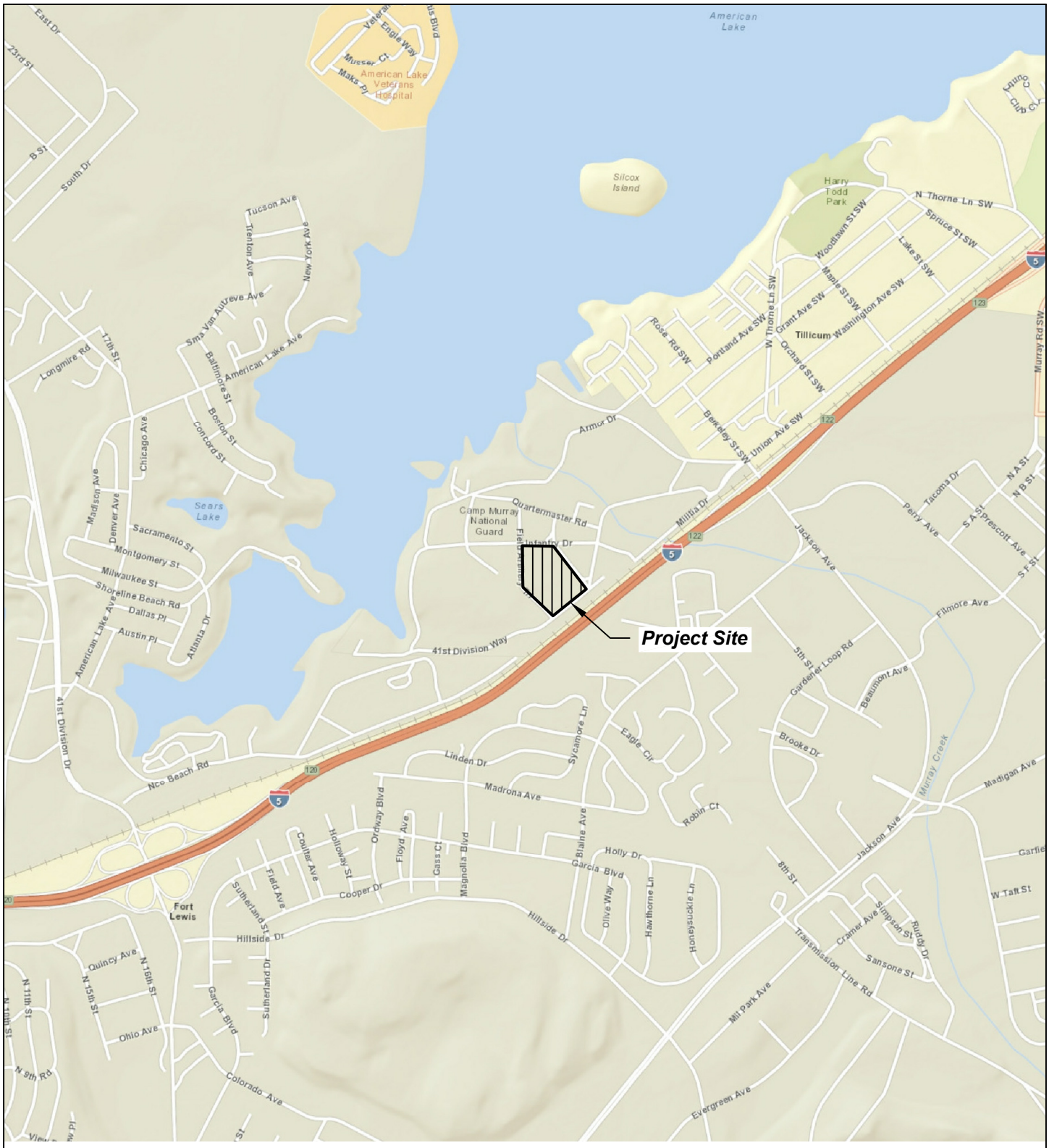
Washington State Department of Natural Resources 2014. Washington State Geologic Information Portal – Washington State Interactive Geologic Map. http//www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/geology_portal.aspx. Accessed May 2014.

Washington Department of Fish and Wildlife (WDFW) 2014. American Lake and Species Information. http://wdfw.wa.gov/fishing/washington/153. Accessed May 2014.

L:\Jobs\1798100\Data Report\Draft\Draft PCRC Geotech Data Report.docx



Source: Base map prepared from ArcGIS Online, 2013.

Pierce County Readiness Center
Camp Murray, Washington

Vicinity Map

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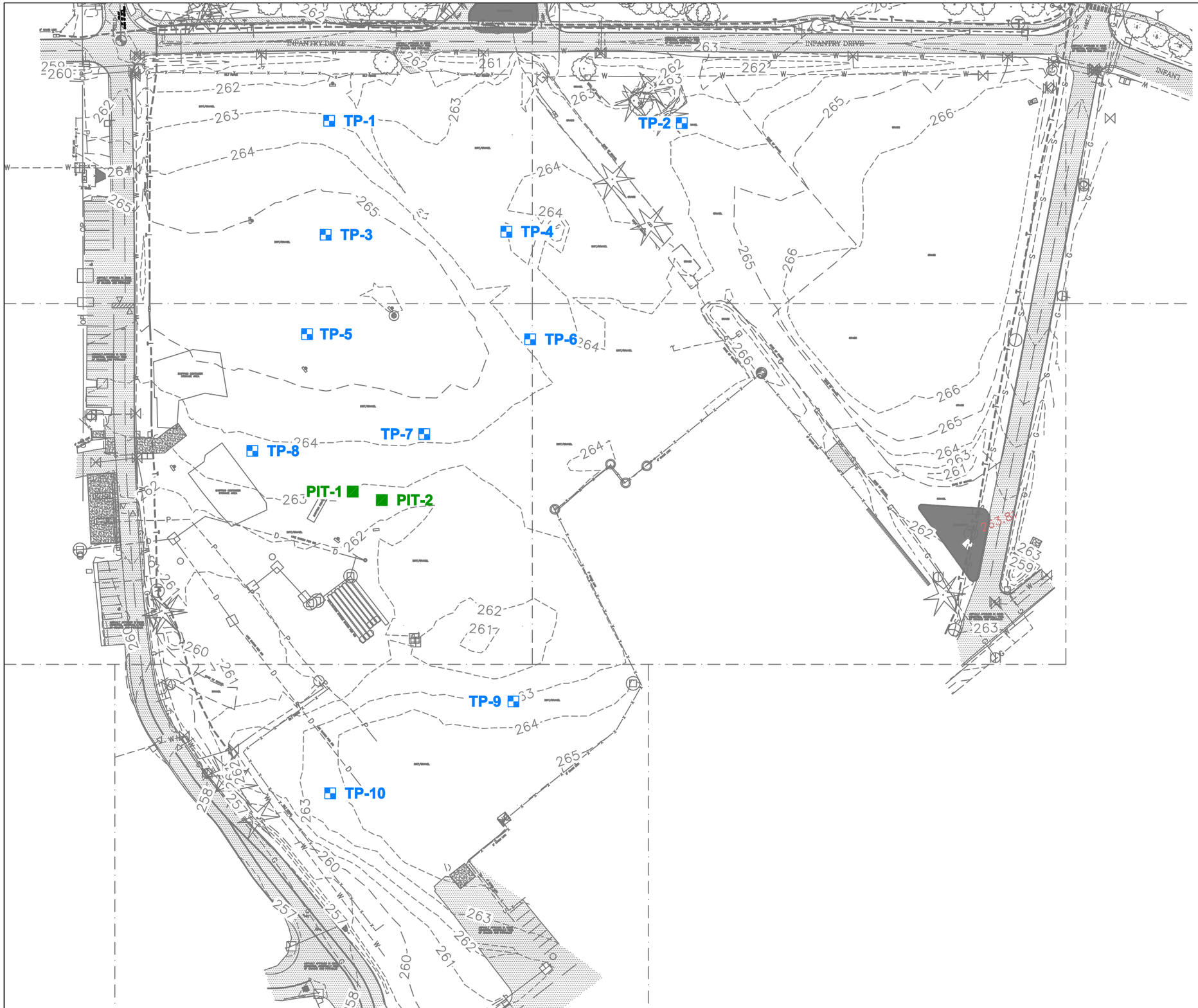
Figure
1

EAL 05/13/14 1798100-005.dwg



TP-1 Test Pit Location and Number

PIT-1 PIT Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Existing Conditions

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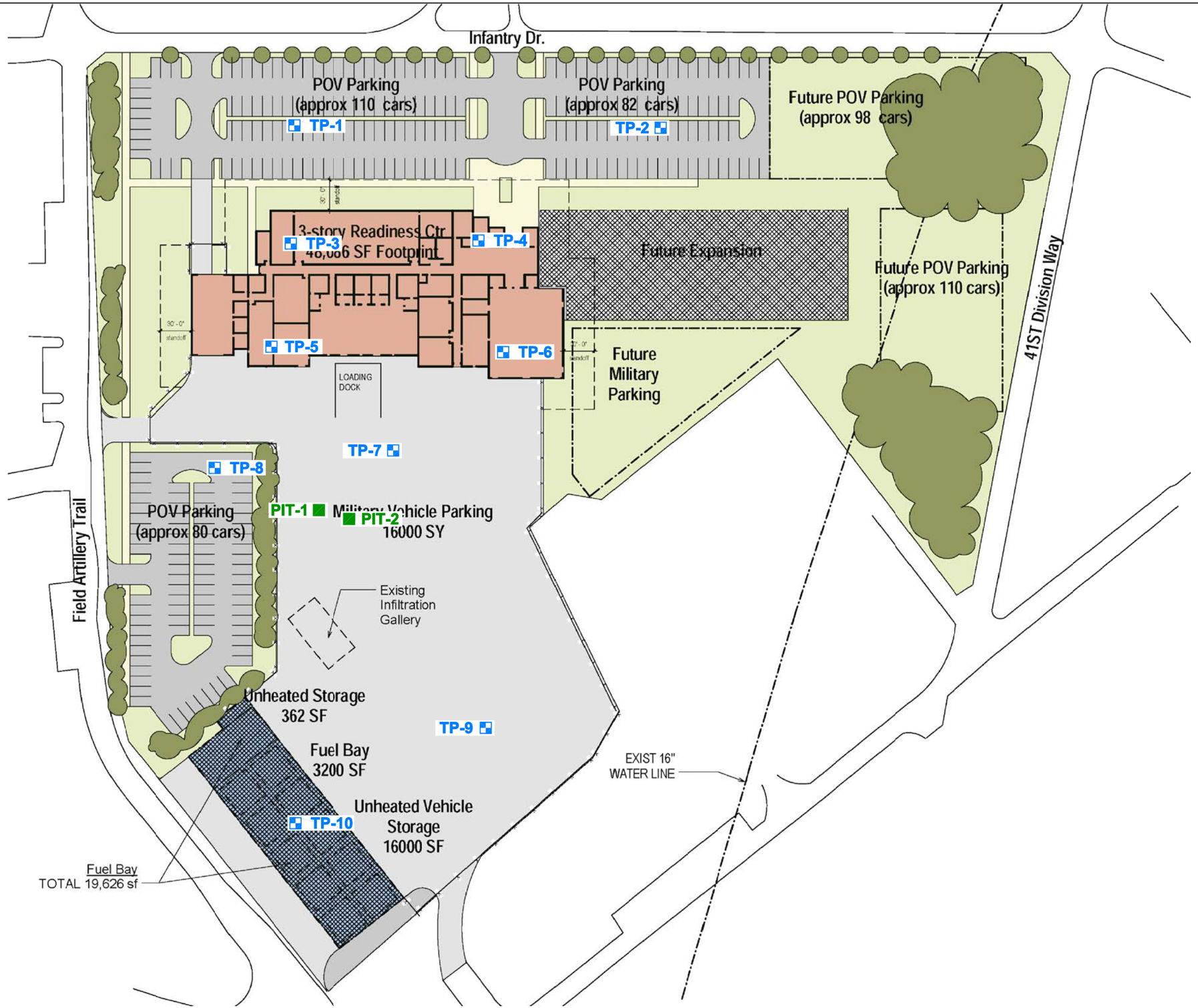
Figure

2a

EAL 06/2/14 1798100-006.dwg



TP-1 Test Pit Location and Number

PIT-1 PIT Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Proposed

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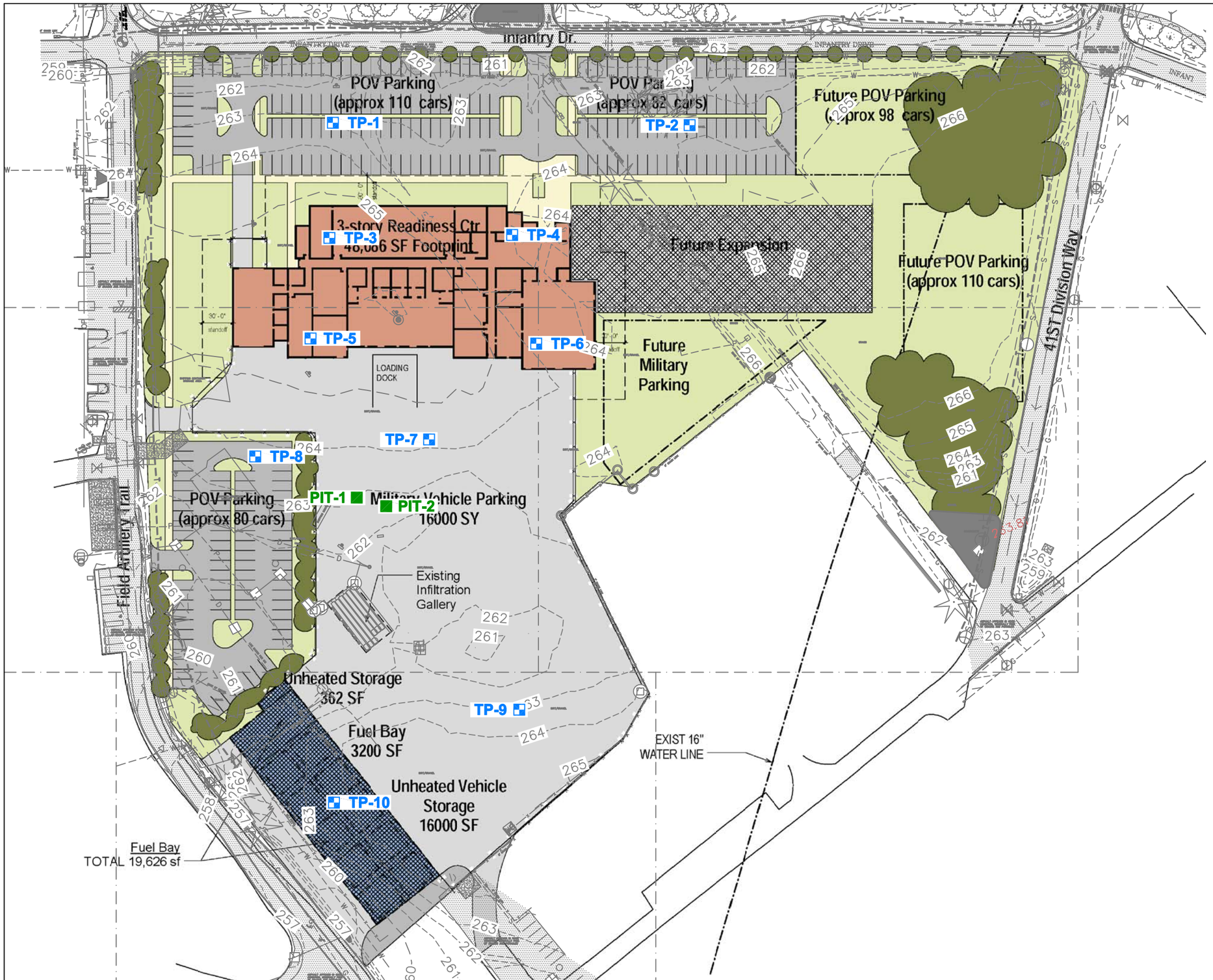
Figure

2b

EAL 06/2/14 1798100-007.dwg



TP-1 Test Pit Location and Number

PIT-1 PIT Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Overlay

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Figure

2c

EAL 05/24/14 1798100-008.dwg

APPENDIX A
Test Pit Logs – Current Study

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits Water Content in Percent Liquid Limit Natural Plastic Limit
PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF
OT	Tests by Others

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key

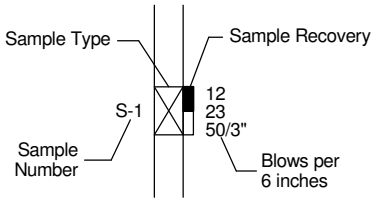

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Figure A-1

KEY SHEET 1798100-TP.GPJ HC_CORP.GDT 6/2/14

Test Pit Log TP- 1

Location: See Figure 2.
Approximate Ground Surface Elevation: 263 Feet
Logged By: M. Smith Reviewed By: B. Cook

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), damp, black, silty, sandy GRAVEL with organic material (roots); approximately 20% cobbles, silt fraction organic.	0	S-1			
GP		(Medium dense), damp, light brown, sandy GRAVEL, trace silt; approximately 25% cobbles, well-rounded gravels.	5	S-2			
GP		(Dense), moist, gray, sandy GRAVEL, trace silt; approximately 40% cobbles, occasional boulders.		S-3			
		Bottom of Test Pit at 8.0 Feet. Started 05/06/14. Completed 05/06/14.	10				
			15				

Test Pit Log TP- 2

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: M. Smith Reviewed By: B. Cook

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), damp, black, silty, sandy GRAVEL with organic material (roots); approximately 20% cobbles, silt fraction organic. (FILL)	0	S-1			
GP		(Dense), light brown, damp, sandy GRAVEL, trace silt; approximately 25% cobbles, well-rounded gravels.	5	S-2			
GP		(Dense), moist, gray, sandy GRAVEL, trace silt; approximately 40% cobbles, occasional boulders.		S-3			
		Bottom of Test Pit at 8.0 Feet. Started 05/06/14. Completed 05/06/14.	10				
			15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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17981-00 *5/14*

Figure A-2

Test Pit Log TP- 3

Location: See Figure 2.
Approximate Ground Surface Elevation: 265.5 Feet
Logged By: M. Smith Reviewed By: B. Cook

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), moist, dark brown/black, silty, sandy GRAVEL; approximately 25% cobbles. (FILL)	0	S-1			
GP		(Medium dense), moist, light brown, sandy GRAVEL, trace silt; approximately 25% cobbles, well-rounded gravels.		S-2			
			5				
GP		(Dense), moist, gray, sandy GRAVEL, trace silt; approximately 40% cobbles, occasional boulders.					
			10	S-3			
		Bottom of Test Pit at 12.0 Feet. Started 05/06/14. Completed 05/06/14.	15				

Test Pit Log TP- 4

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: M. Smith Reviewed By: B. Cook

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), damp, light brown, sandy GRAVEL, trace silt; approximately 25% cobbles.	0	S-1			
GW		(Dense), moist, gray, very sandy GRAVEL, trace silt; approximately 45% cobbles.					
			5	S-2	5		GS
			10	S-3			
		Bottom of Test Pit at 12.0 Feet. Started 05/06/14. Completed 05/06/14.	15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-3

Test Pit Log TP- 5

Location: See Figure 2.
Approximate Ground Surface Elevation: 265.5 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM	(Medium dense), moist, black, silty, sandy GRAVEL with organic material (roots); approximately 30% cobbles, angular and rounded gravels, silt fraction organic. (FILL)	0	S-1			
GW	(Medium dense), moist, light brown, very sandy GRAVEL, trace silt; approximately 20% cobbles, well-rounded gravels.		S-2	3		GS
GW	(Very dense), moist to wet, gray, sandy GRAVEL, trace silt; approximately 40% cobbles, well-rounded gravels.	5				
			S-3	4		GS
		10	S-4			
	Bottom of Test Pit at 12.0 Feet. Started 05/05/14. Completed 05/05/14.	15				

Test Pit Log TP- 6

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GP-GM	(Medium dense), moist, dark brown, slightly silty, sandy GRAVEL; approximately 30% cobbles, occasional rebar and concrete debris. (FILL)	0	S-1			
GP	(Dense), light brown, moist, sandy GRAVEL, trace silt; approximately 20% cobbles.		S-2			
		5	S-3			
	12-inch-thick lens of GRAVEL, trace silt; well-rounded and poorly sorted.					
GP	(Dense), gray-brown, moist to wet, slightly sandy GRAVEL, trace silt; approximately 30% cobbles.					
		10 ATD	S-4			
	Bottom of Test Pit at 12.0 Feet. Started 05/05/14. Completed 05/05/14.	15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

HARTCROWSER

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log TP- 7

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), moist, black, silty, fine sandy GRAVEL; approximately 30% cobbles, silt fraction organic. (FILL)	0	S-1			
GP		(Medium dense), moist, reddish light brown, sandy GRAVEL, trace silt; approximately 25% cobbles, well-rounded gravels.		S-2	6		GS
GP		(Very dense), moist, gray, sandy GRAVEL, trace silt; approximately 40% cobbles, occasional boulders.	5	S-3 S-4	3		GS
		Bottom of Test Pit at 8.0 Feet. Started 05/05/14. Completed 05/05/14.	10				
			15				

Test Pit Log TP- 8

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), moist, black, silty, sandy GRAVEL; approximately 30% cobbles, silt fraction organic. (FILL)	0	S-1			
GP		(Medium dense), moist, light brown, sandy GRAVEL, trace silt; approximately 20% cobbles, well-rounded gravels.		S-2	5		GS
GW		(Very dense), moist, gray, very sandy GRAVEL, trace silt; approximately 40% cobbles.	5	S-3	3		GS
		Bottom of Test Pit at 8.0 Feet. Started 05/05/14. Completed 05/05/14.	10				
			15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

HARTCROWSER

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log TP- 9

Location: See Figure 2.
Approximate Ground Surface Elevation: 263 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GP-GM	(Medium dense), moist, black, slightly silty, sandy GRAVEL; crushed gravels. (FILL)	0	S-1			
GP			S-2			
GP	(Medium dense), moist, dark brown, sandy GRAVEL, trace silt; approximately 30% cobbles.		S-3	3		GS
	(Dense), moist, light brown, slightly sandy GRAVEL, trace silt; approximately 15% cobbles, well-rounded gravels.	5				
			S-4	2		GS
	Bottom of Test Pit at 8.0 Feet. Started 05/05/14. Completed 05/05/14.	10				
		15				

Test Pit Log TP-10

Location: See Figure 2.
Approximate Ground Surface Elevation: 264 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM	(Medium dense), moist, black, silty, sandy GRAVEL; approximately 30% cobbles, silt fraction organic. (FILL)	0	S-1			
GP	(Medium dense), moist, light brown, sandy GRAVEL, trace silt; approximately 20% cobbles.					
GP-GM	(Dense), moist to wet, gray-brown, slightly silty, sandy GRAVEL, trace silt; approximately 20% cobbles.		S-2			
		5	S-3			
	Bottom of Test Pit at 8.0 Feet. Started 05/05/14. Completed 05/05/14.	10				
		15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

HARTCROWSER

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log PIT-1

Location: See Figure 2.
Approximate Ground Surface Elevation: 262.5 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), moist, black, silty, sandy GRAVEL; approximately 30% cobbles, silt fraction organic. (FILL)	0				
GP		(Medium dense), moist, light brown, sandy GRAVEL, trace silt; approximately 20% cobbles, well-rounded gravels.		S-1	4		GS
		PIT test performed at 3 feet.					
		Bottom of Test Pit at 3.0 Feet.					
		Started 05/05/14.					
		Completed 05/05/14.	5				
			10				
			15				

Test Pit Log PIT-2

Location: See Figure 2.
Approximate Ground Surface Elevation: 263 Feet
Logged By: B. Cook Reviewed By: A. Wade

Horizontal Datum:
Vertical Datum: NGVD29

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GM		(Medium dense), moist, black, silty, sandy GRAVEL; approximately 30% cobbles, silt fraction organic. (FILL)	0				
GP		(Medium dense), moist, light brown, sandy GRAVEL, trace silt; approximately 20% cobbles, well-rounded gravels.					
GP		(Very dense), moist, gray, sandy GRAVEL, trace silt; approximately 40% cobbles.	5				
		PIT test performed at 5 feet.					
		Bottom of Test Pit at 5.0 Feet.					
		Started 05/06/14.					
		Completed 05/06/14.					
			10				
			15				

NEW TEST PIT LOG 1798100-TP.GPJ HC_CORP.GDT 6/17/14

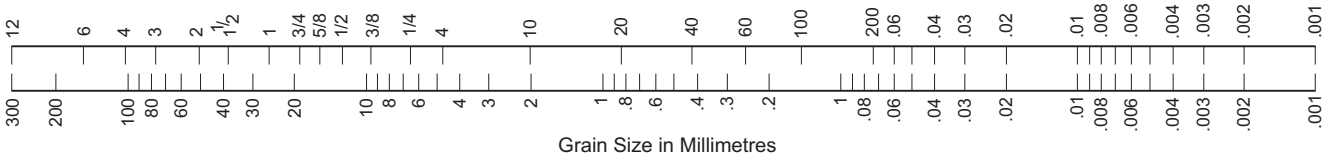
HARTCROWSER

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

APPENDIX B
Laboratory Test Results – Current Study

Unified Soil Classification (USC) System
Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						

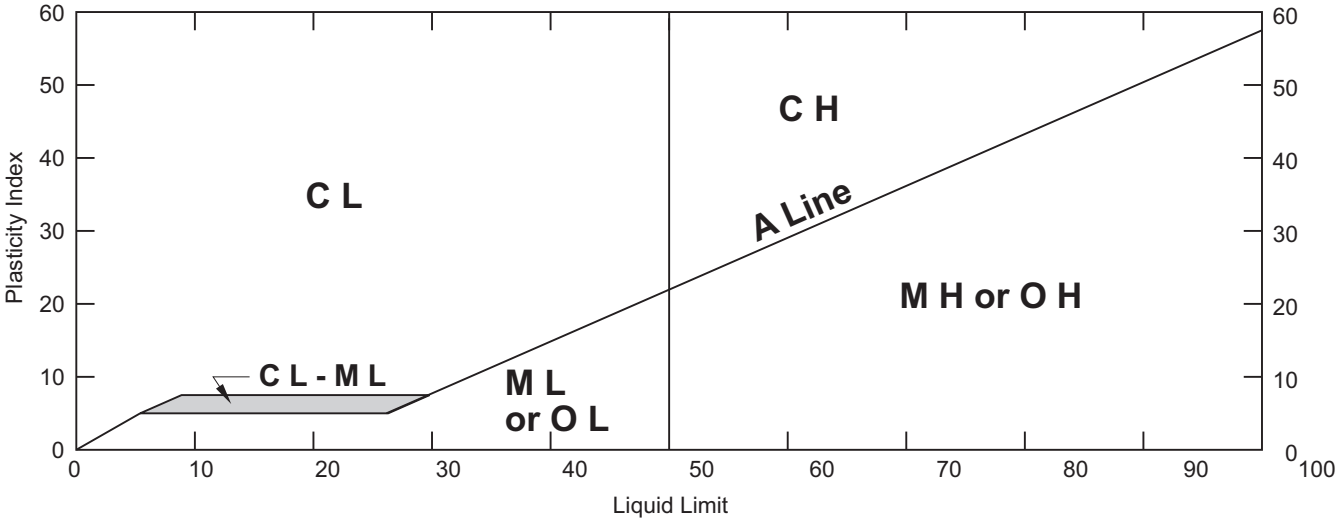


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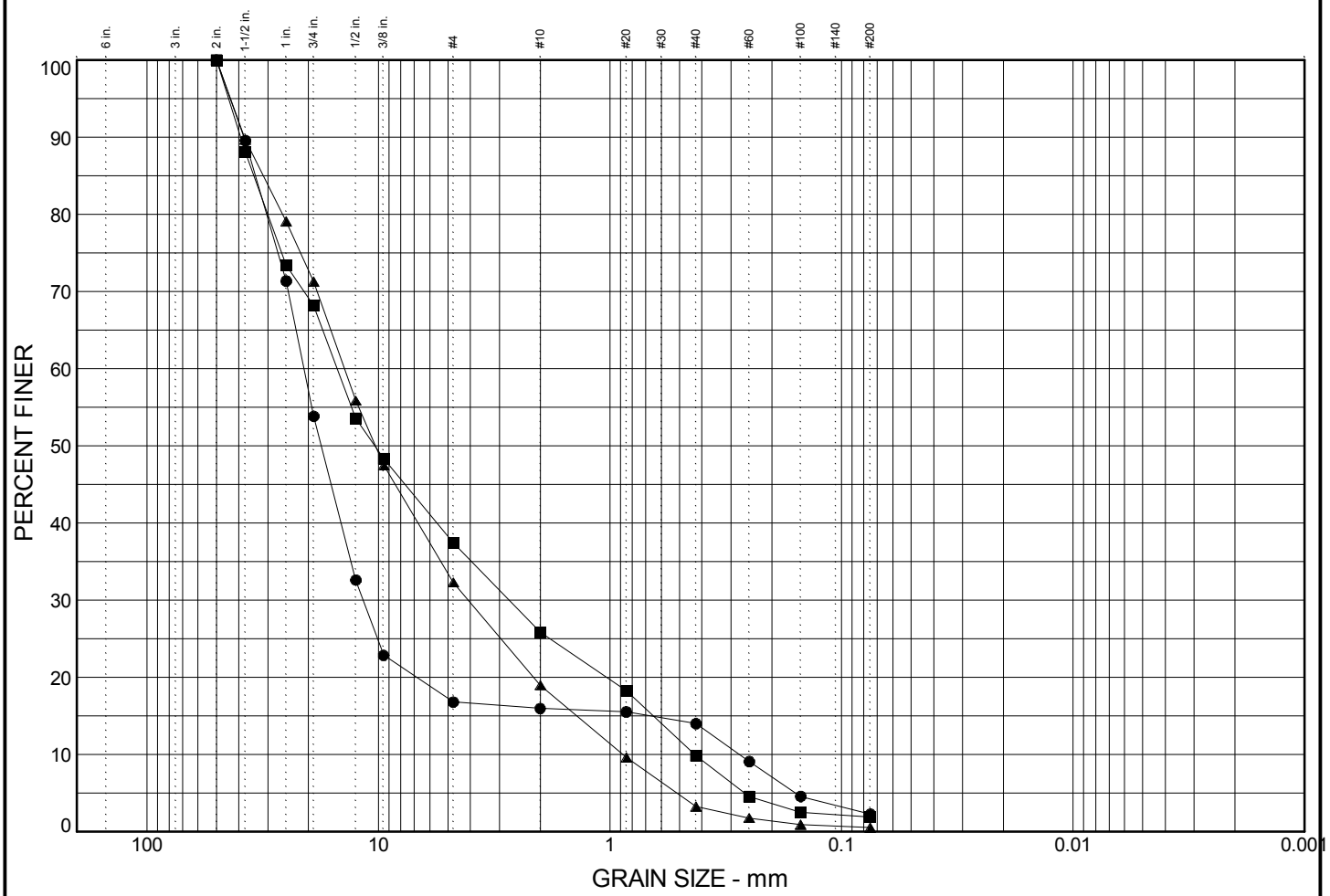
Figure B-1

SRF Grain Size (B-1).cdr 3/06

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	83.2	14.5	2.3	
■	0.0	62.6	35.5	1.9	
▲	0.0	67.7	31.8	0.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			33.872	20.924	17.614	11.615	0.67	0.276	23.35	75.76
■			34.4	15.033	10.374	2.73	0.651	0.43	1.15	34.96
▲			31.315	13.976	10.315	4.09	1.39	0.88	1.36	15.89

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● sandy GRAVEL, trace silt	GP	3.6%
■ very sandy GRAVEL, trace silt	GW	5.2%
▲ very sandy GRAVEL	GW	2.6%

Remarks:

●

■

▲

Project: PCRC

Client:

● Source: PIT-1	Sample No.: S-1	Depth: 2.0 to 3.0
■ Source: TP- 4	Sample No.: S-2	Depth: 5.5 to 6.5
▲ Source: TP- 5	Sample No.: S-2	Depth: 2.0 to 3.0

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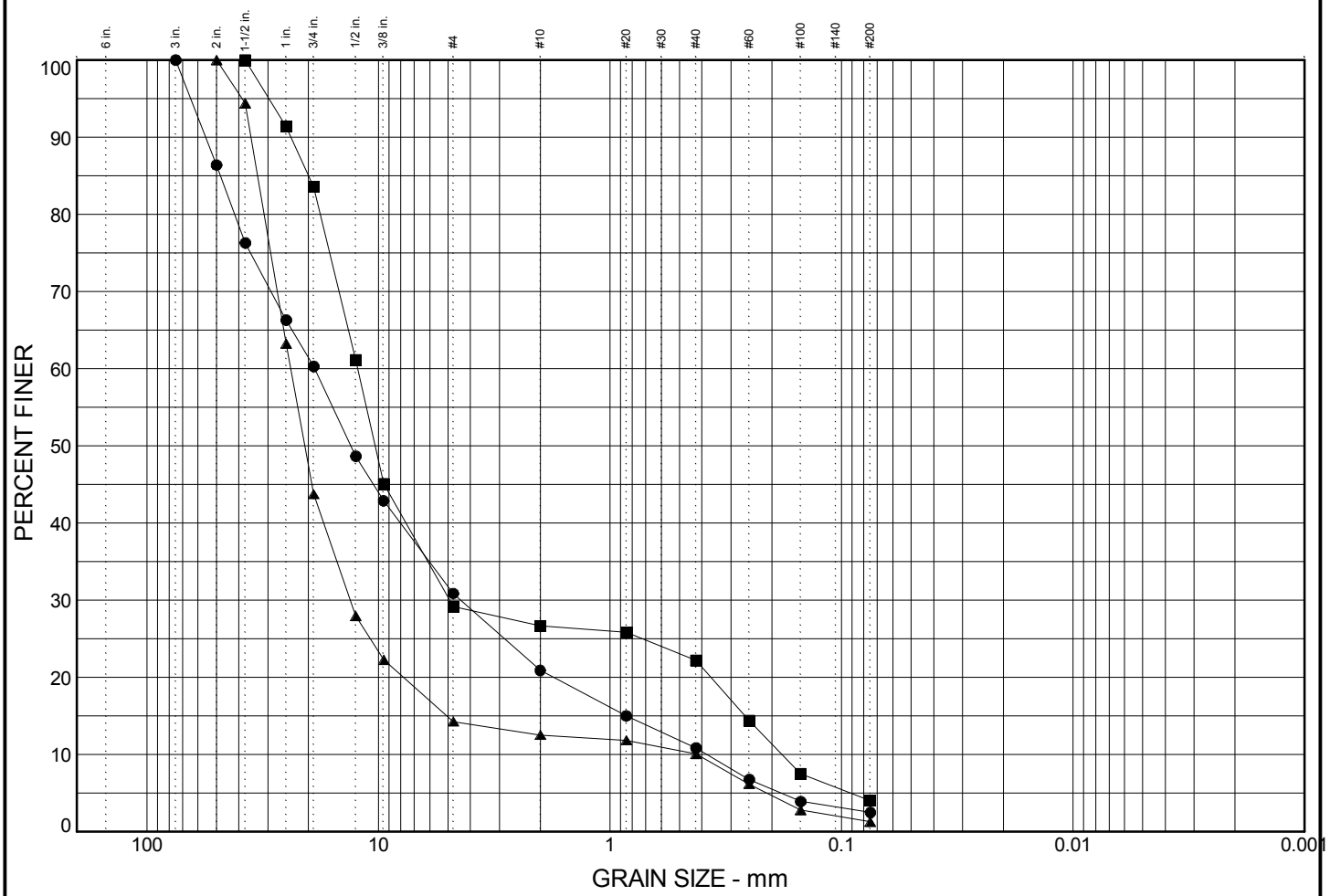
Figure B-2

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	69.1	28.4	2.5	
■	0.0	70.8	25.2	4.0	
▲	0.0	85.7	13.0	1.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			48.046	18.793	13.116	4.404	0.849	0.381	2.71	49.37
■			19.983	12.255	10.328	4.92	0.261	0.18	10.96	68.02
▲			33.185	23.878	20.741	13.199	5.057	0.419	17.40	56.93

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● sandy GRAVEL, trace silt	GW	4.3%
■ sandy GRAVEL, trace silt	GP	5.8%
▲ sandy GRAVEL, trace silt	GP	3.1%

Remarks:

●

■

▲

Project: PCRC

Client:

● Source: TP- 5 Sample No.: S-3 Depth: 8.0 to 9.0
■ Source: TP- 7 Sample No.: S-2 Depth: 2.0 to 3.0
▲ Source: TP- 7 Sample No.: S-3 Depth: 4.0 to 5.0

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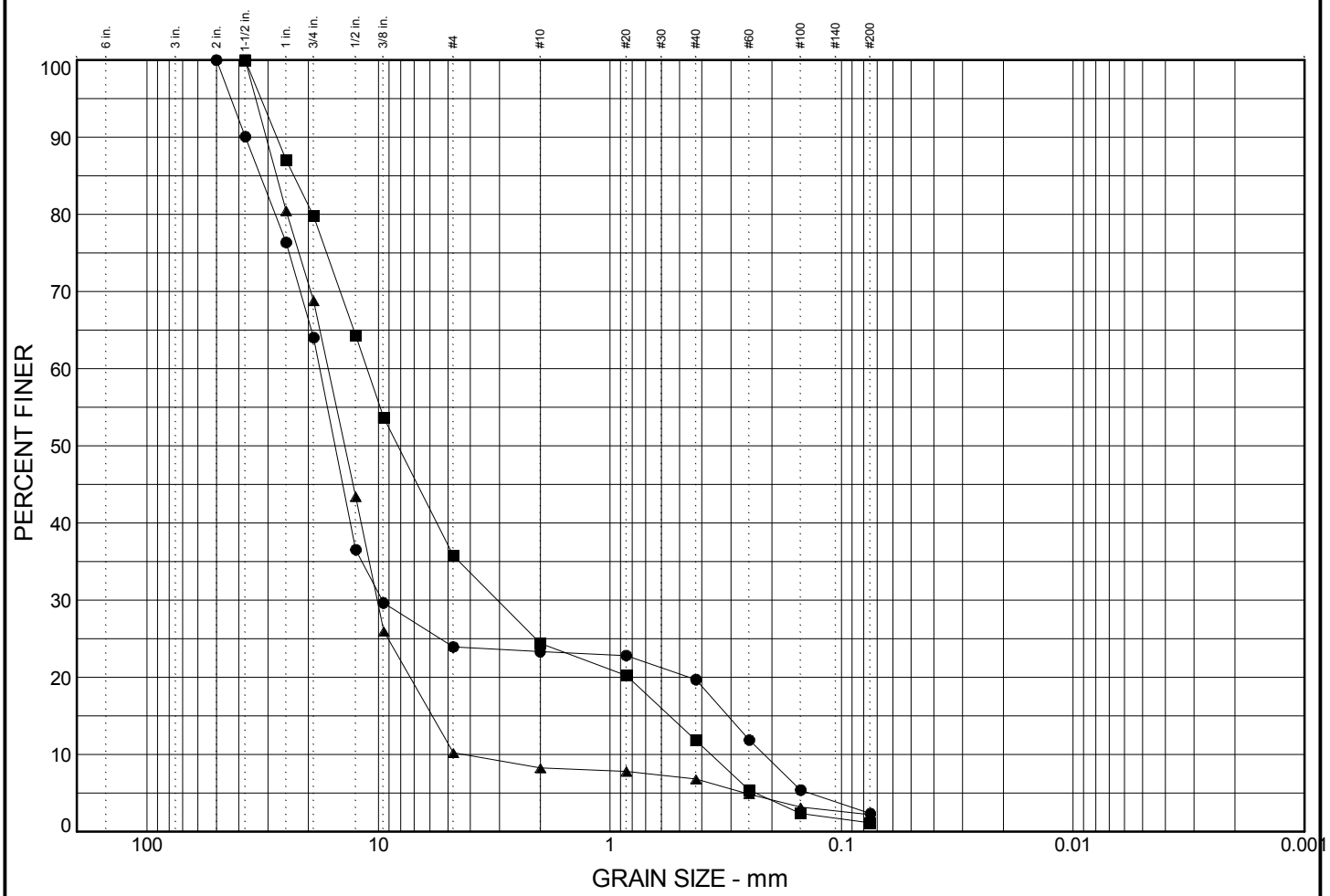
Figure B-3

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	76.1	21.6	2.4	
■	0.0	64.2	34.7	1.1	
▲	0.0	89.8	8.0	2.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			32.27	17.869	15.344	9.639	0.309	0.216	24.12	82.89
■			23.164	11.179	8.247	3.061	0.552	0.366	2.29	30.56
▲			27.46	16.438	13.937	10.123	5.866	4.346	1.43	3.78

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● sandy GRAVEL, trace silt	GP	4.6%
■ very sandy GRAVEL, trace silt	GW	3.1%
▲ slightly sandy GRAVEL, trace silt	GP	2.7%

Remarks:

●

■

▲

Project: PCRC

Client:

● Source: TP- 8	Sample No.: S-2	Depth: 3.0 to 4.0
■ Source: TP- 8	Sample No.: S-3	Depth: 7.0 to 8.0
▲ Source: TP- 9	Sample No.: S-3	Depth: 2.0 to 3.0

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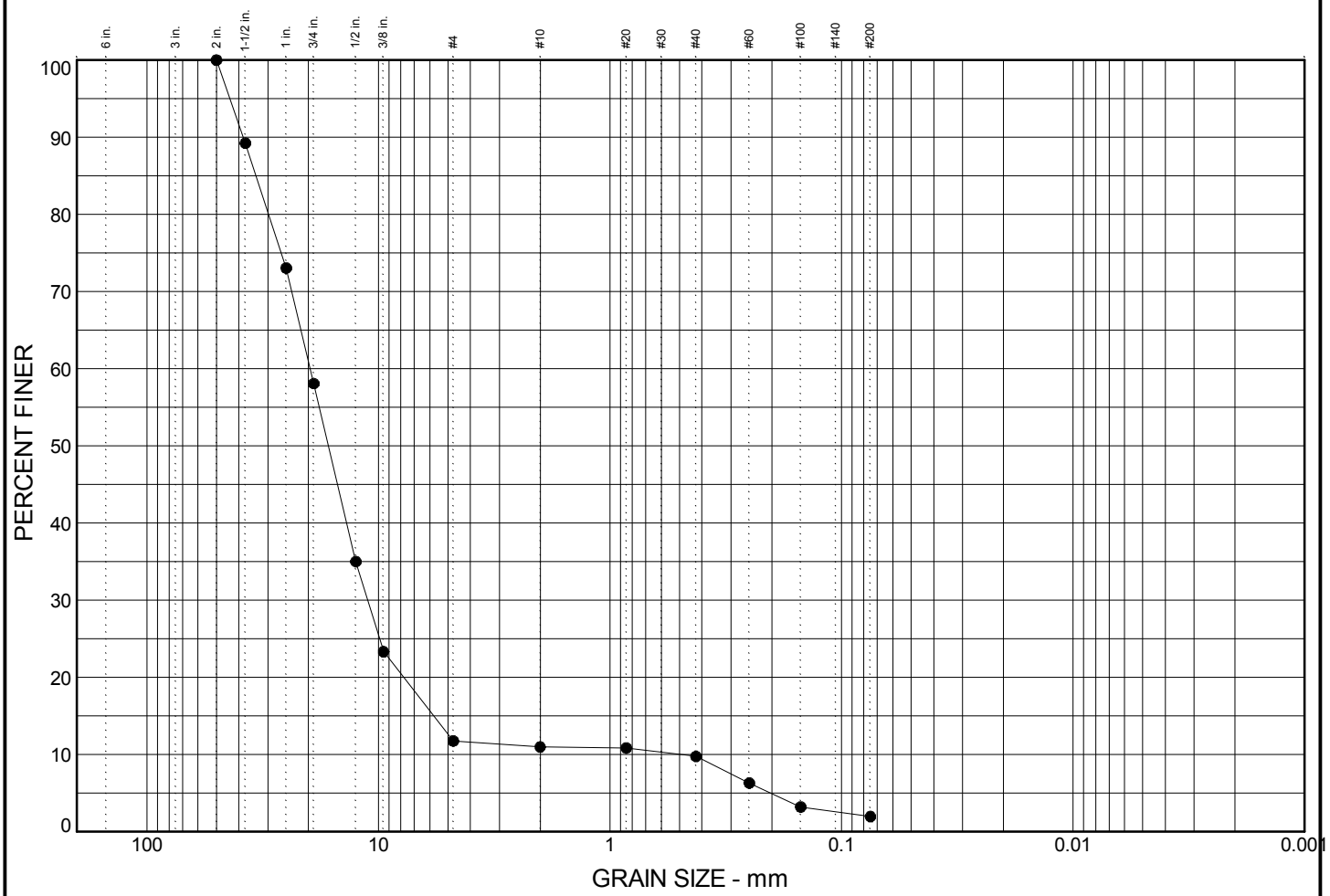
Figure B-4

GRAIN SIZE 1798100-TP.GPJ HC_CORP.GDT 5/22/14

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	88.2	9.8	2.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			33.722	19.681	16.409	11.112	5.769	0.496	12.64	39.66

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly sandy GRAVEL, trace silt	GP	2.5%

Remarks:

●

Project: PCRC

Client:

● Source: TP- 9 Sample No.: S-4 Depth: 7.0 to 8.0

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17981-00 *5/14*

Figure B-5

GRAIN SIZE 1798100-TP.GPJ HC_CORP.GDT 5/22/14

APPENDIX C
Pilot Infiltration Test Results – Current Study

APPENDIX C
PILOT INFILTRATION TEST RESULTS – CURRENT STUDY

Hart Crowser performed on-site infiltration tests to support design of the Pierce County Readiness Center at Camp Murray, Washington. The purpose of infiltration tests is determine infiltration rates for design of stormwater infiltration facilities.

General Procedure – Infiltration Tests

The field infiltration tests were conducted in general accordance with the pilot infiltration test (PIT) described in the Washington Department of Ecology 2012 Stormwater Management Manual for Western Washington. The general procedures for the infiltration tests used in this study are presented below.

- Excavate a test pit using an excavator to the depth of the bottom of the proposed infiltration test. A plywood shoring system was used to prevent the side walls from unraveling into the test pit. The dimensions of the shoring system is 5 feet wide by 5 feet long corresponding to area of the bottom of the test pit of approximately 25 square feet.

- Document soil conditions observed during excavation and along the side walls of the excavation. Record the size and geometry of the test pit before beginning the field test.

- Install a vertical measuring rod marked in half-inch increments in the pit bottom. The rod was used to record water levels in the test pit.

- Use a rigid 6-inch-diameter pipe with a splash plate on the bottom to convey water to the pit and reduce side wall erosion or excessive disturbance of the pond bottom.

- Conduct the constant head portion of the test by adding water to the test pit at a rate that will maintain a water level between 1 and 2 feet above the bottom of the pit. A flow meter verified with a bucket test was used to measure the flow rate into the pit.

- Record the cumulative volume and instantaneous flow rate in gallons per minute (gpm) necessary to maintain the water level at the same point (between 1 and 2 feet) on the vertical measuring rod. Water levels in the test pits were also monitored with a pressure transducer.

- Continue adding water to the pit while maintaining constant water level in the test pit from 4 to 12 hours until steady state flow are achieved.

- At the end of the constant head test, water flow into the test pit is turned off and the drop in water level is recorded. This phase of the infiltration test is referred to as the falling head test.

Test Results

Two infiltration tests were completed at the site on May 6, 2014. The locations of the infiltration test pits are shown on Figures 2a, b, and c. The results of the individual infiltrations tests are summarized below.

Infiltration Test 1

- The dimensions of Infiltration Test Pit PIT-1 were about 5 by 5 feet and 3 feet deep. Soils observed in the test pit are summarized on Test Pit Log PIT-1 in Appendix A. The infiltration test was conducted in the Medium Dense to Dense Sandy Gravel at depth of 3 feet.

- Infiltration Test 1 was conducted on May 6, 2014. The constant head test conducted for less than an hour starting at 08:52 and ending at 09:47.

- During the constant head test, the water level in the test pit ranged from about 1 to 2 feet. The initial flow rate was about 78 gpm and lowered to about 8 gpm at the end of the test. The PIT-1 test was terminated because the infiltration rate was less than expected. Based on our experience at nearby sites located on Joint Base Lewis McCord, field infiltration rates in similar gravel units are significantly higher. A second infiltration test was performed in the underlying Dense to Very Dense Sandy Gravel.

- The results of the PIT-1 infiltration test were not analyzed for field infiltration rate because of the limited duration of the test.

Infiltration Test 2

- A second infiltration test (PIT-2) was conducted on the deeper Dense to Very Dense Sandy Gravel about 25 feet from the PIT-1 test site. The dimensions of Infiltration Test Pit PIT-2 were about 5 by 5 feet and 5 feet deep. The soil profile observed in PIT-2 test pit is summarized on Test Pit Log PIT-2 in Appendix A and was similar to the soil profile observed in PIT-1.

- Infiltration Test 2 was conducted on May 6, 2014, for 4 hours and 40 minutes starting at 11:00 and ending at 16:42. The following falling head test was monitored was from 16:42 until 18:50.

- Water levels were maintain at approximately 1 to 1.2 feet at a flow rate of 2.7 gpm during the constant head test. Water levels during the PIT-2 test are presented on Figure C-1.

- During the falling head test, water levels dropped from 1.75 to 0.5 feet in about 140 minutes.

The results of Infiltration Test 2 are summarized in Tables C-1 and C-2. The constant head test indicates that at a constant head of 1 foot, the field infiltration rate is 0.11 gpm/ft^2 or 10 in./hr.

Note infiltration rates are head dependent. The higher the head, the higher the infiltration rate. The infiltration rate calculated in this study is based on a 1-foot head. Infiltration systems designed with head greater than 1 to 2 feet will experience higher infiltration rates.

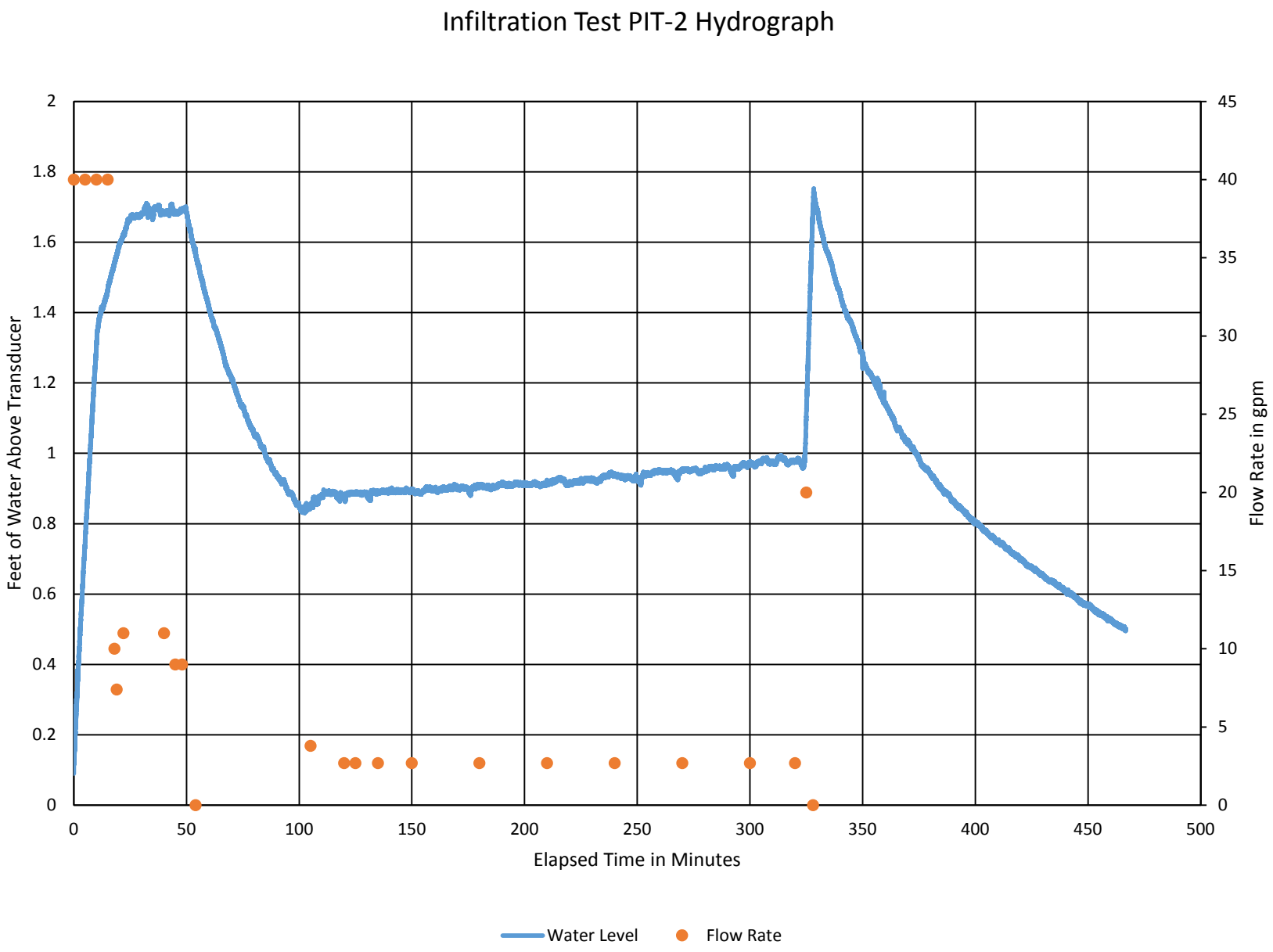
Table C-1: PIT-2 Constant Head Infiltration Test Results
Pierce County Readiness Center - Camp Murray

Infiltration Test Number	Length (Ft)	Width (Ft)	Area (ft^2)	Steady-State Head (ft)	Steady-State Flow (gpm)	Infiltration Rate (gpm/ft^2)	Field Infiltration Rate (in/hr)	Correction Factor	Scaled Infiltration Rate (in/hr)
PIT-2	5	5	25	1	2.7	0.11	10	4	3

Table C-2: PIT-2 Falling Head Infiltration Test Results
Pierce County Readiness Center - Camy Murray

Test	Elapsed Time (minutes)	Estimated Water Level above Bottom (feet)	Estimated Water Level above Bottom (inches)	Total Drop (inches)	Interval Drop (inches)	Total Time (hour)	Interval Time (hour)	Total Drop Rate (in/hr)	Interval Drop Rate (in/hr)	Equialvent Flow Rate (gpm)
PIT-2	0	1.75	21	0	0	0	0	0	0	0
	9	1.50	18	3	3	0.15	0.15	20	20	5.2
	22	1.25	15	6	3	0.37	0.22	16	14	3.6
	46	1.00	12	9	3	0.77	0.40	12	8	1.9
	82	0.75	9	12	3	1.37	0.60	9	5	1.3
	132	0.50	6	15	3	2.20	0.83	7	4	0.9

AJG 05/19/14 L:\Project Notebook\Pierce County Readiness Center\Camp Murray Site\Field\PIT\PIT-1 and PIT-2(ms)



Pierce County Readiness Center
Camp Murray, Washington

Infiltration Test PIT-2 Hydrograph

17970-00

5/14

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Figure

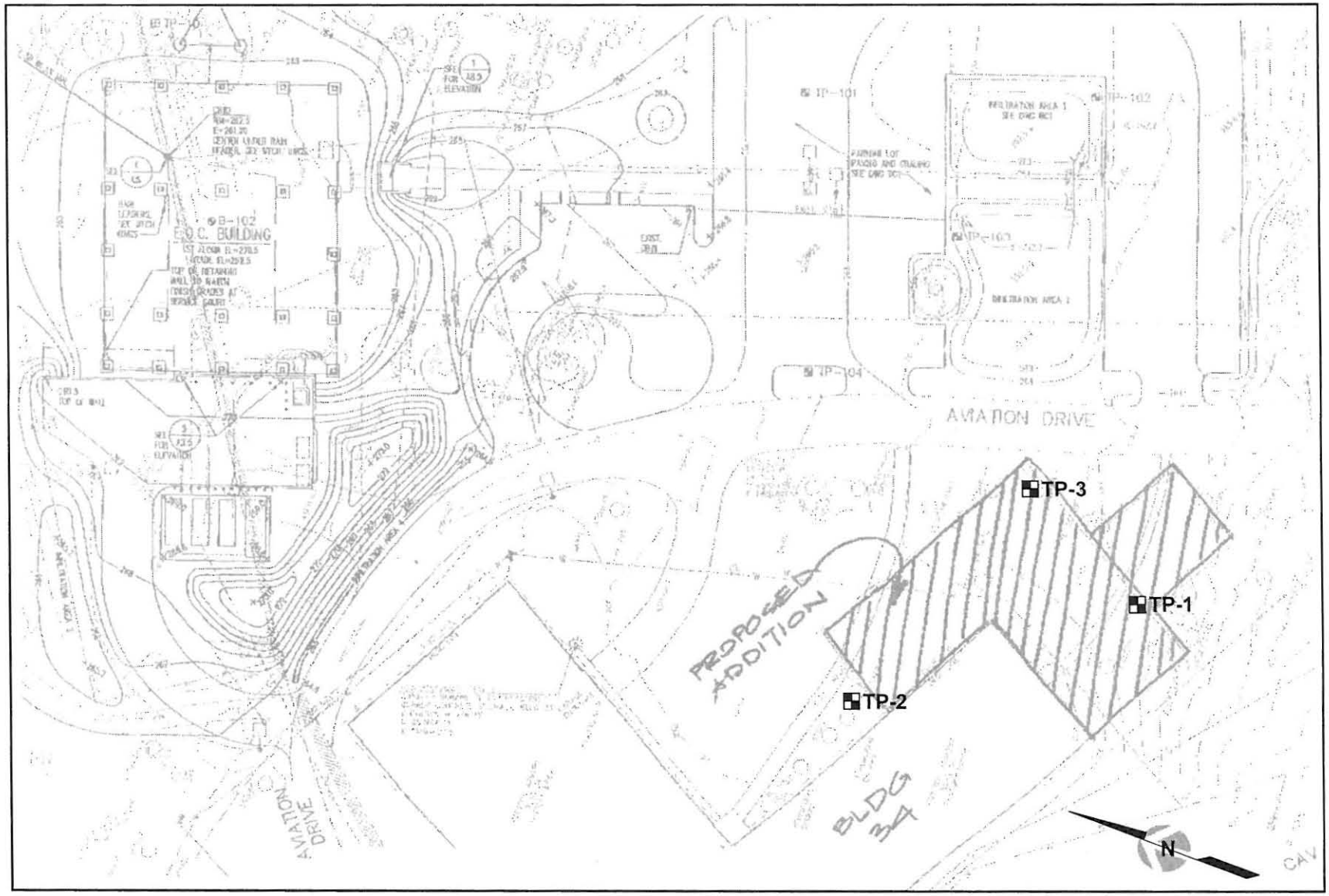
C-1

APPENDIX D
Previous Explorations and Laboratory Test Results by Hart Crowser

APPENDIX D
PREVIOUS EXPLORATIONS AND LABORATORY TEST RESULTS BY HART CROWSER

We have included test pit logs and laboratory test results from a previous geotechnical study by Hart Crowser approximately 1000 feet northeast of the PCRC site at Camp Murray (Hart Crowser 2002). These logs and laboratory test results are presented in their original form for reference only.

Site and Exploration
Camp Murray



Note: Base map prepared from drawing provided by Washington State Military Department.

Not to Scale

Legend:

TP-1 Test Pit Number and Location

7735a.cdr HEL 4/46/02

HARTCROWSER
7735
Figure 1
4/02

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance.
Soil density/consistency in test pits is estimated on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	< 0.125
Loose	4 - 10	Medium stiff	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Very stiff	15 - 30	0.5 - 1.0
Very dense	> 50	Hard	> 30	> 2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

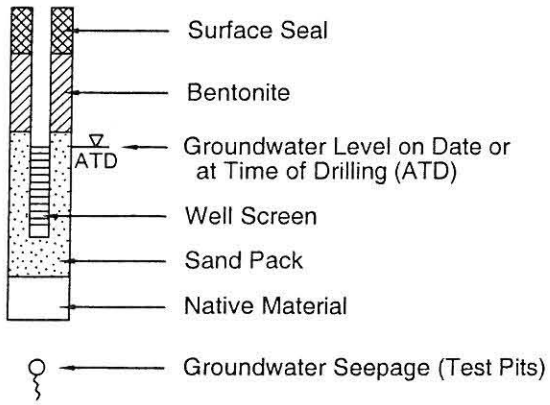
Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling Test Symbols

Boring Samples	Test Pit Samples
☒ Split Spoon	☒ Grab (Jar)
⧅ Shelby Tube	⧄ Bag
▥ Cuttings	⧅ Shelby Tube
◫ Core Run	
* No Sample Recovery	
P Tube Pushed, Not Driven	

Groundwater Observation Wells



Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits

PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	*In Situ* Density Test

HC Standards\Standard Report Figures\A-1's\A-1 Standard

HARTCROWSER

7735 *5/02*

Figure A-1

Test Pit Log TP-1

Sample	Water Content	Lab Tests
S-1		
S-2		
S-3	14	GS
S-4		
S-5		
S-6	4	
S-7	6	
S-8		
S-9		
S-10		

Depth in Feet	SOIL DESCRIPTIONS
0–1	(Loose), moist, brown, very sandy GRAVEL with abundant organic material (roots).
1–3	(Medium dense), moist, brown, silty, sandy GRAVEL with abundant organic material (roots) and 30% to 40% COBBLES.
3	Becomes dense.
3–4	(Dense), light brown, silty, sandy GRAVEL with organic material (roots) and 30% to 40% COBBLES.
4–7	(Very dense), moist, light brown, slightly silty, sandy GRAVEL with trace organic material (roots) and 30% to 40% COBBLES.
7	Layer of non-silty, slightly sandy GRAVEL from a depth of 7 to 8 feet.
8–10	Bottom of Exploration at 8.5 Feet. Completed 04/05/02.

Test Pit Log TP-2

Sample	Water Content
S-1	
S-2	
S-3	
S-4	6
S-5	
S-6	4

Depth in Feet	SOIL DESCRIPTIONS
0–1	(Loose), moist, brown, slightly silty, very sandy GRAVEL with abundant organic material (roots).
1–3	(Medium dense), moist, brown, slightly silty, sandy GRAVEL with organic material (roots) and 40% to 50% COBBLES below 1.5 feet.
3–6	(Dense), moist, light brown, slightly silty, sandy GRAVEL and approximately 30% COBBLES.
6–10	Bottom of Exploration at 6.0 Feet. Completed 04/05/02.

Test Pit Log TP-3

Sample	Water Content
S-1	
S-2	
S-3	15
S-4	3
S-5	
S-6	

Depth in Feet	SOIL DESCRIPTIONS
0–1	(Loose), moist, brown, silty, very gravelly SAND to very sandy GRAVEL with abundant organic material (roots).
1–3	(Medium dense), moist, brown, silty, sandy GRAVEL with organic material (roots) and 30 to 40% COBBLES.
3–5	(Dense), moist, light brown, very sandy GRAVEL and approximately 20% COBBLES.
5–10	Bottom of Exploration at 5.5 Feet. Completed 04/05/02.

3 LOGS PER PAGE 7735TP.GPJ HC_CORP.GDT 5/8/02

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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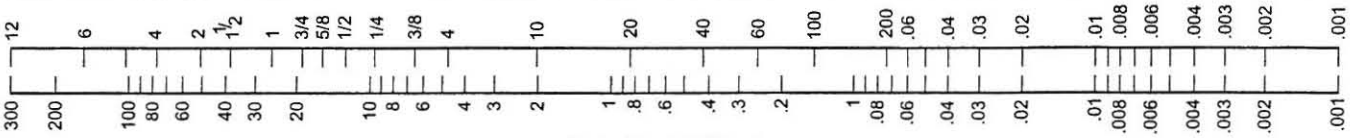
Figure A-2

Unified Soil Classification (USC) System
Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

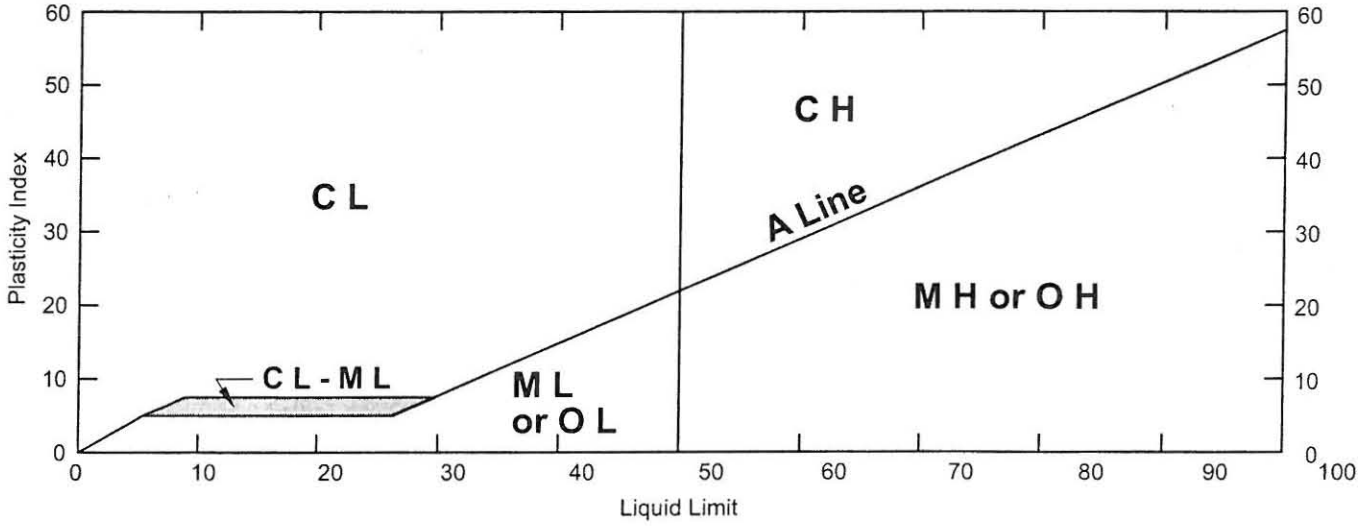
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases required use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



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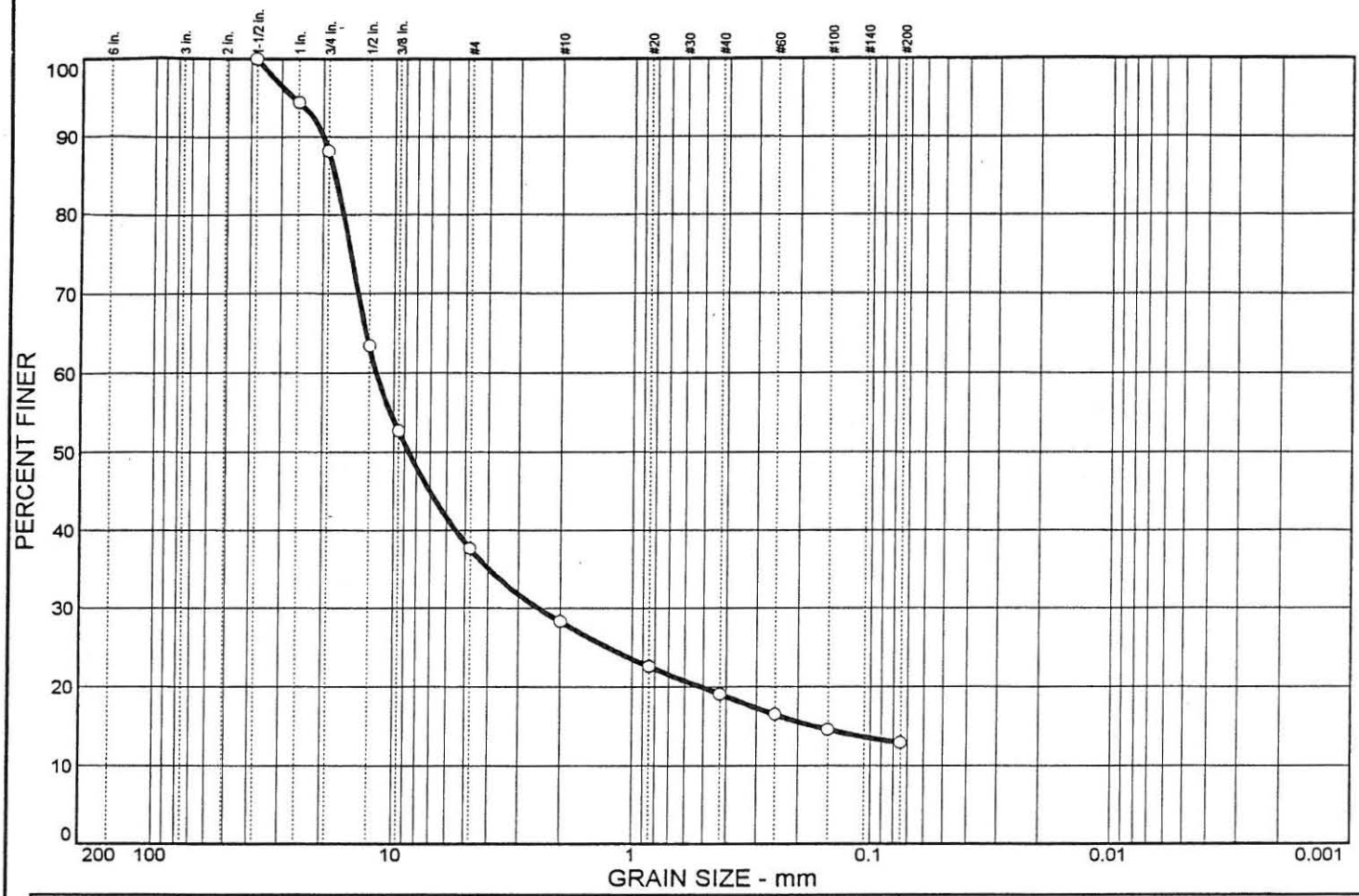
HC Standards\Standard Report Figures/Grain Size (B-1).CDR

7735 4/02

Figure B-1

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	11.8	50.6	9.3	9.2	6.2	12.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			17.8	11.8	8.61	2.47	0.170			

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
○ Silty sandy GRAVEL	GM	14%

Remarks:

○ Small sample size

Project: Camp Murray

Client:

○ **Source:** TP-1 **Sample No.:** S-3

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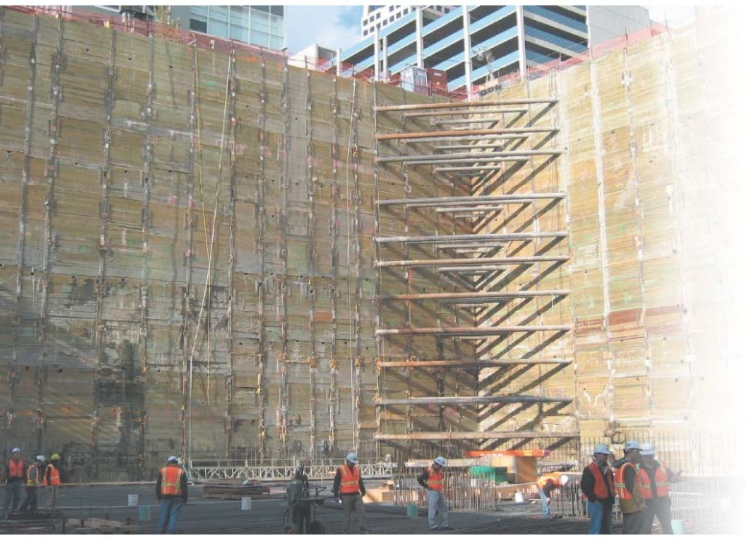
7735 4/18/2002

Figure No. B-2

Geotechnical Recommendations Report



Preliminary Geotechnical Recommendations Report

Pierce County Readiness Center

Camp Murray, Washington

Prepared for

Schreiber Starling & Lane Architects, PS

June 13, 2014

17981-00

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Preliminary Geotechnical Recommendations Report

Pierce County Readiness Center

Camp Murray, Washington

Prepared for

Schreiber Starling & Lane Architects, PS

June 13, 2014
17981-00

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ATTACHMENT 1

Declaration of Soil Bearing Capacity

Pierce County Readiness Center

Camp Murray, Washington

1.0 INTRODUCTION

This Preliminary Geotechnical Design Recommendations report presents our preliminary geotechnical engineering recommendations for design of the proposed Pierce County Readiness Center (PCRC) facility in Camp Murray, Washington.

This report provides our analysis methods, engineering recommendations, and conclusions for preliminary design considerations. We recommend this report be provided as a reference document to the design-build contract. This report is organized as follows:

- Introduction;
- Purpose, Scope, and Use of This Report;
- Site and Project Descriptions;
- Subsurface Conditions;
- Seismic Considerations;
- Geotechnical Engineering Design Recommendations;
- Construction Considerations; and
- References.

Tables are presented in the text unless otherwise noted and figures are presented following the text. Appendices are presented following the report figures.

The results of field explorations and laboratory tests are provided in a separate report titled "Geotechnical Data Report," dated June 2, 2014 (draft). That report, referred to as the Geotechnical Data Report (GDR), should be referenced for specific subsurface information.

2.0 PURPOSE, SCOPE, AND USE OF THIS REPORT

The purpose of our work is to: (1) assess subsurface conditions at the proposed PCRC site; and (2) provide geotechnical engineering recommendations for the preliminary design and construction of the PCRC.

The scope of work for this Preliminary Geotechnical Design Recommendations report included:

- Interpretation of subsurface conditions at the proposed site;
- Developing seismic parameters for preliminary design;
- Providing geotechnical engineering recommendations for preliminary design of the PCRC Building; and
- Presenting the results of our work in this report.

The scope of work was completed in accordance with our service agreement with Schreiber Starling & Lane Architects, PS dated August 28, 2013, and our revised scope for the Camp Murray site provided on January 27, 2014. This report is for the exclusive use of Schreiber, Starling & Lane Architects PC, Washington Military Department, and their consultants for specific application to the subject project and site. This Geotechnical Data Report was prepared in accordance with generally accepted geotechnical practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, express or implied.

3.0 SITE AND PROJECT DESCRIPTIONS

The proposed PCRC site is a previously developed parcel at the heart of 226-acre Camp Murray. It is bounded by Infantry Drive to the north, 41st Division Way to the east, and Field Artillery Trail to the west. The PCRC development covers approximately 12.5 acres and includes adequate space for future development of a 120,000-gross-square-foot Joint Force Headquarters. Figure 1 shows the project location on a Vicinity Map.

The previous site development included several one- to two-story buildings, a combination of asphalt and gravel parking areas, and a stormwater infiltration facility. Buildings within the proposed PCRC development area had been demolished before the current subsurface explorations were completed on May 5 and May 6, 2014. The existing stormwater infiltration facility remains, as shown on Figure 2a, and may be used as part of the PCRC site development. No previous testing or design information about the existing infiltration facility was available for review.

The site topography is relatively flat with elevations generally ranging between 260 and 266 feet, based on the survey provided by AHBL (see Figure 2a).

We understand that the proposed PCRC will include a three-story readiness center building (48,100 square feet), a storage and fuel bay building (19,600 square feet), two privately owned vehicle parking areas, and a military vehicle parking area.

We performed our analysis and prepared this report in general accordance with the 2012 International Building Code (2012 IBC).

4.0 SUBSURFACE CONDITIONS

Subsurface soil and groundwater conditions observed in explorations near the proposed PCRC facility and soil properties inferred from field observations, field testing, and laboratory testing formed the basis for the data provided in this report. The nature and extent of variations between the explorations may not become evident until additional explorations are performed and/or construction begins. If variations then appear, it will be necessary to consider this additional data along with the data provided in this report.

The locations of the test pit explorations conducted for this study are shown on Figures 2a, 2b, and 2c. For a more detailed explanation of subsurface conditions, refer to the GDR.

4.1 Soil

The soil layers observed in each of our field explorations program were divided into three generalized soil units. Those generalized soil units are summarized in the following sections, from the ground surface downward.

Fill and Topsoil. Engineered and non-engineered soil placed by humans is classified as fill. Fill soils generally have variable properties and may contain debris and organic matter. In general, the Fill consisted of medium dense slightly silty to silty, sandy Gravel with cobbles. Occasionally, the Fill contained various materials including concrete and steel debris.

The Topsoil generally appears dark brown to black in color, characteristic of the organic silt or clay fraction of the soil, and contains organic material (e.g., roots). The topsoil at the site is predominantly a medium dense silty, sandy, Gravel with organic material (roots), cobbles, and an organic silt fraction.

In the Fill and Topsoil, the gravel and cobbles were observed to be angular to subrounded.

All test pits encountered the Fill and Topsoil except TP-4, which was excavated below the location of a previous building on site. The Fill and Topsoil was observed to be 0.5 to 3 feet thick below existing ground surface with an average/typical thickness of 1 to 1.5 feet.

Medium Dense to Dense Sandy Gravel. This layer generally consists of medium dense to dense, light brown, sandy to very sandy Gravel with trace silt and cobbles. This layer is estimated to contain about 20 to 30 percent cobbles. Gravel and cobbles were observed to be well rounded.

This soil layer was encountered below the Fill and Topsoil unit, with the exception of TP-4 where it was encountered at ground surface. This layer was observed to range from 1 foot to over 8 feet thick.

Dense to Very Dense Sandy Gravel. This layer generally consists of gray, sandy Gravel with trace silt and cobbles and occasional boulders. This layer is estimated to contain about 40 to 45 percent cobbles and boulders. The boulders ranged from 1 to 1.5 feet in diameter. Gravel, cobbles, and boulders were generally well rounded.

This soil layer was observed in explorations TP-1, TP-2, TP-3, TP-4, TP-5, TP-7, and TP-8. This soil unit was encountered beneath the Medium Dense to Dense Sandy Gravel. The test pit explorations were terminated in this layer at depth, where encountered. We were not able to ascertain any spatial trends regarding depth at which this soil layer was encountered in our explorations. As such, the top of this layer is assumed to undulate beneath the project site.

4.2 Groundwater

Groundwater was encountered in TP-6 at 10 feet bgs (elevation 254 feet). Other test pits excavated to a similar elevation did not encounter groundwater; however, soil moisture increased from moist to wet near the base of test pits TP-5 and TP-10 (elevation 253.5 feet and 256 feet, respectively). Note that American Lake is approximately 0.3 mile northwest of the PCRC site and has an average water level elevation of 235 feet (WDFW 2014 and USGS, Steilacoom Quadrangle, 1997 Topographic Map).

Our review of historical exploration logs in the area indicated that groundwater was not encountered in test pit explorations located northeast of the project site (Hart Crowser 2002).

Measured groundwater levels are representative for the time indicated on the test pit logs. Fluctuations in groundwater levels may be caused by variations in rainfall, temperature, seasons, and other factors.

5.0 SEISMIC CONSIDERATIONS

The site is located in a seismically active area. In this section, we describe the seismic setting at the project site, provide seismic design parameters, and discuss earthquake-induced geotechnical hazards.

5.1 Seismic Basis of Design

We understand that the PCRC must meet the seismic design requirements of the 2012 IBC. The basis of structural design for the IBC is two-thirds of the hazard associated with the Risk-Targeted Maximum Considered Earthquake (MCE_R). The basis of soil liquefaction evaluation for the IBC is the Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Acceleration (PGA), which is not adjusted for targeted risk. The Maximum Considered Earthquake for IBC is a seismic event with 2 percent probability of exceedance in 50 years, which corresponds to an average return period of 2,475 years (often referred to as the 2,500-year event). The probability for such an event to occur during the design life of the structure is considered low. A design objective for the IBC earthquake is that if this event occurs, the structure may experience a major failure but still maintain life safety. Therefore, the structure should be designed to have adequate strength and ductility to prevent collapse.

5.2 Seismic Design Parameters

We obtained the seismic hazard parameters for the MCE_R and MCE_G from the United States Geologic Survey U.S. Seismic Design Maps (USGS 2013) for the site location at Latitude 47.1150 and Longitude −122.5686. Below, we provide the seismic design parameters in accordance with IBC 2012. Note that these parameters correspond to *Soil Site Class B and should be adjusted for the actual site soil*.

- MCE_R Seismic Parameters for Structural Design
  - Spectral Response Acceleration at short periods, S_S = 1.290 g
  - Spectral Response Acceleration at 1-Second Period, S_1 = 0.510 g
  - Site Class C, assumed for preliminary design – see discussion below
- MCE_G Seismic Parameters for Liquefaction Evaluation
  - PGA = 0.500 g
  - Magnitude = 6.98 – mean magnitude from USGS (2008) hazard deaggregation
  - Site Class C, assumed for preliminary design – see discussion below

Seismic Site Class is generally determined using either blow counts from standard penetration tests (SPT) or shear wave velocity measurements. Based on our knowledge of the site geology and the large area and shallow depth of the proposed PCRC development, test pits explorations were chosen as the best method for characterizing subsurface conditions. Since SPT or shear wave velocity testing was not performed, our recommended Site Class is based on density observations during our test pit explorations at the site, mapped seismic site class provided by the Washington State Department of Natural Resources (DNR) (Washington State DNR 2014), and our previous experience with design and construction in the Steilacoom Gravel.

5.3 Seismically Induced Geotechnical Hazards

Potential seismically induced geotechnical hazards may include surface rupture, liquefaction, lateral spreading, and landslides. Our review of these hazards is based on the soils encountered in our explorations, regional experience, DNR maps, and our knowledge of local seismicity.

5.3.1 Surface Rupture

Geologic maps indicate the southern-most splay of the Tacoma Fault Zone is about 12 miles north-northeast of the site in plan view (Washington State DNR 2014). The probability for surface rupture at the site is considered low.

5.3.2 Liquefaction Potential

When cyclic loading occurs during an earthquake, the shaking can increase the pore pressure in loose to medium dense saturated sand and non-plastic silt and cause liquefaction, or temporary loss of soil strength. This can lead to surface settlement and slope displacement among other potential effects.

Groundwater was only encountered in one test pit and was present within dense material. Regional groundwater is anticipated to be present in dense to very dense soils below the base of the test pit excavations completed for this project. Based on our field observations and DNR liquefaction hazard mapping, liquefaction potential at the site is considered low.

5.3.3 Lateral Spreading

Lateral spreading is typically associated with lateral movement on sloping ground caused by liquefaction or a reduction of shear strength of soils within or under the slope. Lateral spreading can affect a structure by increasing the lateral force exerted on the subsurface walls or within pile foundations. Given the generally flat site gradient, the risk of lateral spreading is considered low.

5.3.4 Landslides

Based on the site location, slope inclination, and lack of reported landslides in the area, the landslide hazard at the site is considered low.

6.0 GEOTECHNICAL ENGINEERING DESIGN RECOMMENDATIONS

This section of the report presents our preliminary geotechnical engineering recommendations for design of the proposed PCRC facility. This includes our preliminary conclusions and recommendations for the geotechnical engineering aspects of:

- Site Preparation;
- Foundations;
- Shallow Foundations – Spread Footings;
- Floor Slabs;
- Permanent Drainage;
- Infiltration Potential Evaluation;
- Pavement; and
- Structural Fill Selection, Placement, and Compaction.

We have developed these recommendations based on our current understanding of the project and on the subsurface conditions interpreted from the new and existing subsurface explorations. If there appear to be differences between our assumptions and the actual design, or if the design considerations change after the completion of this report, it will be necessary to change or confirm our recommendations.

6.1 Site Preparation

Demolition and removal of existing buildings, foundations, and pavement across the project site had already occurred prior to performing our field explorations and preparing this preliminary design report. However, removal of other potential obstructions within the site subgrade may be required to prevent interference with new construction. We recommend that organic material (sod, humus,

roots, and/or other plant material), debris, and other unsuitable material be removed from subgrade areas. Site grading, paving, and any utility trenching be conducted during relatively dry weather.

Portions of the Fill and Topsoil unit will need to be removed and replaced or re-compacted, depending on the presence of debris and the amount organic material (roots and organic silt) in the soil. For planning purposes, we recommend assuming—at a minimum—the upper 1 foot of material will need to be removed. More or less material may need to be removed depending on the variability in the thickness and composition of the Fill and Topsoil, as wells as load consideration for development of that area (e.g., privately owned vehicle parking, military vehicle parking, foundations, slabs on grade).

It may be necessary to relocate or abandon some utilities. These utility lines will likely be excavated in fill materials. Abandoned underground utilities should be removed, completely grouted, or their ends sealed to prevent piping of soil or water into the utility pipe. Soft or loose trench backfill material associated with abandoned utilities should be removed, and all excavations should be backfilled according to the recommendations presented in Section 6.8.

6.2 Foundations

6.2.1 Shallow Foundations

We recommend that the proposed three-story PCRC building and ancillary structures be supported on shallow spread and/or continuous footings bearing on native Medium Dense to Dense Sandy Gravel or Dense to Very Dense Sandy Gravel.

We make the following recommendations for design of shallow footings:

- A maximum net allowable bearing pressure of 4 kips per square foot (ksf) is recommended for design of footings bearing on native Medium Dense to Dense Sandy Gravel or Dense to Very Dense Sandy Gravel.
- Isolated and strip footings should have a minimum width of 24 and 18 inches, respectively. Place the base of all footings at least 18 inches below the lowest adjacent grade for consideration of frost protection.
- Allowable bearing pressure may be increased by up to one-third for loads of short duration (e.g., wind or seismic loads).
- Use an allowable coefficient of friction against sliding equal to 0.3 for footings poured neat against the native bearing soil. This value includes a factor of safety of at least 1.5.
- Use an allowable passive equivalent fluid unit weight of 300 pcf. This value includes a factor of safety of at least 1.5.
- Compact all exposed subgrades to a firm, non-yielding condition. We recommend proof rolling subgrades to verify a firm, non-yielding condition has been achieved.

- It may be necessary to locally overexcavate beneath individual footings to expose the native bearing soil. Localized overexcavation may be needed if loose or soft material is encountered below the base of the footing. If overexcavation beneath footings is necessary, backfill the overexcavated zone with structural fill or lean concrete. Overexcavation should extend outward and downward from the outer edges of the footing to the top of the native material no steeper than 1H:2V.

- Depth of footings should also ensure that they are founded outside of an imaginary 1H:1V plane projected upward from the nearest bottom edge of adjacent footings or utility trenches.

- A qualified geotechnical representative should be on site to assess and document the suitability of the subgrade during construction, prior to placement of footings or concrete.

6.2.2 Settlement Estimates

For foundations designed and constructed as described above, we estimate that the total static settlement of individual footings will be less than approximately 1 inch. We estimate that differential settlement between adjacent footings will be about one-half of the total settlement. Considering the low fines contents of the sandy Gravels encountered in our explorations, we anticipate that the static settlement will essentially occur as loads are applied.

The foundation settlement estimated herein assumes that careful preparation and protection of the exposed subgrade will occur before concrete placement. Any loosening of the materials during construction or the presence of loose material beneath footings could result in larger settlement than those estimated herein. It is very important that all foundation excavations be cleaned of loose or disturbed soil prior to placing any concrete and that there be no standing water in any foundation excavation.

6.2.3 Modulus of Subgrade Reaction

Modulus of subgrade reaction (k_1) based on a 1-foot by 1-foot square plate of 200 pounds per cubic inch (pci) may be used for foundations supported on native bearing soils or compacted structural fill. Note that this k_1 value must be adjusted depending on the size of the footings and the nature of the foundation soils. The following equations should be used in order to correct for different foundation sizes.

For square footing:

$$k_{(B\times B)} = k_1 \left(\frac{B+1}{2B} \right)^2$$

For rectangular footing:

$$k = \frac{k_{(BxB)} \left(1 + 0.5 \frac{B}{L} \right)}{1.5}$$

Where:

k = modulus of subgrade reaction of footing (square or rectangular) in pci;

$k_{(\mathrm{B}xB)}$ = modulus of subgrade reaction of square footing measuring B inches x B inches;

B = footing width in inches; and

L = footing length in inches

6.3 Floor Slab

We anticipate that the floor slab for the PCRC building will be constructed as a slab-on-grade over a capillary break layer and the native bearing soils. The Fill and Topsoil varied from 0 to 1.5 feet thick in our explorations within the proposed building footprint. Where encountered, we recommend overexcavating the portions of the Fill and Topsoil unit that contain debris or organic material (roots and organic silt) up to 18 inches deep below the bottom of the slab and replacing with structural fill (includes the thickness of the capillary break/drainage layer). Subgrade conditions should be verified in the field by proof-rolling the subgrade soils. If soft spots are encountered during preparation of the subgrade, they should be overexcavated and replaced with structural fill. We make the following recommendations:

- Compact the capillary break/drainage layer beneath the slab-on-grade as described in the Section 6.7.
- A modulus of subgrade reaction of 200 pci is appropriate for design of floor slabs on the undisturbed native soils or on structural fill. This assumes that the construction is accomplished as described above and that the capillary break layer is underlain by a well-prepared subgrade.
- Sliding friction between the slab and subgrade may be determined using an allowable coefficient of 0.3.
- Note that if the bottom of the floor slab excavation is soft, wet, or disturbed, the contractor should be prepared to place a temporary working surface. This surface cannot count as part of the capillary break.

The above recommendations are based on anticipated conditions and should be confirmed in the field. It should be noted that many variables, including weather conditions and construction techniques could affect the suitability of *in situ* soil as slab support.

6.4 Permanent Drainage

Regional groundwater is anticipated to be below the elevation of the proposed development. Perched groundwater was encountered in one test pit within the proposed building footprint at a depth of 10 feet (elevation 254 feet). Groundwater levels may fluctuate, posing a potential issue that can be readily handled by following the recommendations below.

6.4.1 Foundation and Under Slab Drainage

We recommend the following for permanent drainage of the floor slab around the structure.

- Install perimeter drains near the base of the perimeter wall footings. The perimeter drains should be a minimum 4-inch-diameter perforated pipe and should be surrounded by at least 6 inches of drainage material. All drainage pipes should be sloped to drain.
- All slabs should be underlain directly by a capillary break/drainage layer at least 4 inches thick hydraulically connected to the perimeter drains.
- The capillary break/drainage layer should consist of well-graded, free-draining sand and gravel with less than 3 percent fines based on the minus 3/4-inch fraction. This layer is intended to reduce the potential buildup of hydrostatic pressures beneath the slab and to provide a hydraulic connection to the perimeter drains.
- Compact the capillary break/drainage layer to the criteria of structural fill in Section 6.7.
- Based on grain size analyses performed for this project, the native Medium Dense to Dense Sandy Gravel or Dense to Very Dense Sandy Gravel met the criteria for the capillary break/drainage layer in half of the samples tested. In areas where the *in situ* soil meets the criteria for capillary break/drainage layer to 4 inches below the slab, the capillary break/drainage layer does not need to be installed. We recommend grain size analyses be performed after exposing the slab subgrade to confirm if *in situ* soil meet the capillary break/drainage layer criteria.

6.4.2 Site Drainage

Final grades should be sloped to carry surface water runoff away from structures to prevent water from infiltrating near the foundation walls. Roof drainage and new pavement drainage should not be tied into the subsurface drainage system.

6.5 Infiltration Potential Evaluation

Two pilot infiltration test (PITs) were performed near the center of the project site and near the existing infiltration facility, as shown on Figures 2a, b, and c. Test methods and data are presented in the GDR.

6.5.1 Grain Size Analysis

Ten selected soil samples of the outwash gravel were performed, and samples were typically classified as sandy gravel with trace silt. Silt content ranged from 0.5 to 4 percent averaging about 2 percent.[1].

[1] Note percent silt (i.e., fines) based on total sample weight, not the minus 3/4-inch fraction referenced for capillary break/drainage layer.

The D_{10} size for the samples ranged from 0.18 to 4.346 mm with an average of 0.4 mm. For developing preliminary design infiltration rates, we estimated a design infiltration rate of about 9 inches per hour (in./hr) (2005 Ecology Stormwater Manual Table 3.8) based on the D_{10} size. Design infiltration estimated from grain size must be verified with a field infiltration testing program.

6.5.2 Field Infiltration Testing

Infiltration Test 1 (PIT-1) was conducted in the Medium Dense to Dense Sandy Gravel at depth of 3 feet. Infiltration Test 2 (PIT-2) was conducted on the deeper Dense to Very Dense Sandy Gravel about 25 feet from the PIT-1 test site (see Figures 2a, b, c) at a depth of 5 feet.

PIT-1 was terminated early in the field and the results were not analyzed because the infiltration rate was less than expected. Based on our experience at nearby sites located on Joint Base Lewis McCord, field infiltration rates in similar gravel units are significantly higher.

PIT-2 indicated the field infiltration rate is 0.11 gpm/ft2 or 10 in./hr.

6.5.3 Design Recommendations

Note infiltration rates are head dependent. The higher the head, the higher the infiltration rate. The infiltration rate calculated in this study is based on a 1-foot head. Infiltration systems designed with a head greater than 1 to 2 feet will experience higher infiltration rates.

For preliminary design purposes, we recommend a correction factor of 4 be used to adjust the field infiltration rate of 10 in./hr to develop a long-term, or design, infiltration rate for the top of the outwash gravel unit. This results in a recommended long-term infiltration rate of 3 in./hr.

Infiltration tests on the upper soil unit were not conducted. It is likely that the infiltration rate of the upper soil unit will be lower because of the presence of organic material than the infiltration rate of the underlying outwash gravel unit.

6.6 Pavement

We recommend that all pavement sections be constructed over a subgrade surface consisting of either non-yielding native bearing soil or compacted structural fill. The Fill and Topsoil varied from 0.5 to 1.5 feet thick in our explorations below parking areas south of the proposed PCRC building. The Fill and Topsoil was 3 feet thick in our exploration below the privately owned vehicle (POV) parking areas to the north of the proposed PCRC building. Where encountered, we recommend overexcavating the portions of the Fill and Topsoil unit that contain debris or organic material (roots and organic silt) up to 2 feet deep below the bottom of the pavement and replacing with structural fill.

It has been our experience that proof rolling with overexcavation of soft near-surface soils prior to pavement construction works well. In the event that loose or soft spots are encountered, overexcavate up to 2 feet of the fill soil and replace it with compacted structural fill as recommended in this report.

We recommend a qualified geotechnical representative observe proof rolling of the pavement subgrades to confirm that a firm and non-yielding surface exists for pavement support.

For preliminary design of pavement sections, we recommend the subgrade and base parameters provided in Table 1. These parameters assume subgrades are prepared as described above and base materials are compacted to the degree recommended for structural fill in Section 6.7.

Table 1 – Pavement Subgrade and Base Design Parameters

Material	Subgrade Modulus in pci	Resilient Modulus (MR) in psi
Medium Dense Existing Fill (Free of Organics)	100	7,000
Medium Dense to Dense Existing Sandy Gravel	200	20,000
Structural Fill	200	20,000
Crushed Surfacing Base Course (CSBC)	250	28,000

Vehicle loads and traffic data were not available at the time of preparing this report. We can evaluate and provide design pavement sections, if necessary, when this data is available.

6.7 Structural Fill Selection, Placement, and Compaction

Backfill placed within the building area or below paved areas should be considered structural fill. The following sections include our recommendations for structural fill selection, placement, and compaction.

6.7.1 Selection of Structural Fill

We recommend using a non-silty, well-graded sand or sand and gravel with less than 5 percent passing the US No. 200 sieve by dry weight (based on the minus 3/4-inch fraction). This type of material would generally be suitable for use even during periods of wet-weather construction. Compaction of material containing more than about 5 percent fine material may be difficult if the material is wet or becomes wet during rainy weather. During dry weather, structural fill may contain 20 to 30 percent by weight passing the No. 200 mesh sieve (based on the minus 3/4-inch fraction) provided it is compacted at a moisture content within 2 percent of the optimum moisture content.

In wet subgrade areas, clean material with a gravel content (material coarser than a US No. 4 sieve) of at least 30 to 35 percent may be necessary. In areas where free-draining material is necessary, such as behind retaining walls or around drainage pipes, we recommend using a free-draining (less than 3 percent passing the No. 200 sieve), well-graded sand and gravel.

The maximum particle size of any fill material should be limited to 1/3 of the lift thickness.

6.7.2 Use of On-Site Soils as Structural Fill

The suitability of excavated site soil for compacted structural fill will depend upon the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the No. 200 sieve) increases, the soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. Soil containing more than about 5 percent fines cannot be consistently compacted to a dense non-yielding condition when the water content is greater than about 2 percent above or below optimum. Reusable soil must also be free of organic and other unsuitable material.

In general, our explorations indicated that the native sandy Gravel soils are suitable for use as structural fill. The shallow Fill and Topsoil is generally not suitable for reuse as structural fill due to higher fines content, debris inclusions, and organic content.

6.7.3 Placement and Compaction of Structural Fill

We make the following recommendations for the placement and compaction of structural fill:

- Place structural fill only on dense, non-yielding subgrade soils.
- Maintain moisture content within 2 percent of the optimum moisture content, as determined by the modified Proctor test method (ASTM D 1557).
- Place and compact all structural fill in even horizontal lifts with a loose thickness no greater than 8 to 10 inches. If small, hand-operated compaction equipment is used to compact structural fill, fill lifts should not exceed 6 to 8 inches in loose thickness.
- In the upper 2 feet below pavement sections, compact structural fill to at least 95 percent of the maximum dry density as determined by the modified Proctor test method (ASTM D 1557). More than 2 feet beneath pavement sections, the degree of compaction may be reduced to 92 percent of the modified Proctor maximum dry density.
- The compacted densities of all lifts should be verified by testing. Any material being considered for use as structural fill should be sampled and tested, to determine its maximum dry density and gradation.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 General Considerations

The soil conditions encountered in the borings, in combination with our experience near this project, suggest that the contractor should expect obstructions during excavation. Debris is typically encountered in fill soil, and cobbles and even boulders typically occur regularly in the underlying native soils.

A qualified geotechnical representative should be on site to note compliance with the design concepts, specifications, or recommendations, and to allow design changes or evaluation of appropriate construction measures in the event that subsurface conditions differ from those anticipated prior to the start of construction. At a minimum, the representative should observe:

- Excavation and preparation of subgrade for pavement, shallow foundations, and floor slabs.
- Placement and testing of compacted material.
- Installation of the permanent drainage system.

The purpose of these observations and services is to note compliance with the design concepts, specifications, or recommendations, and to allow design changes or evaluation of appropriate construction measures in the event that subsurface conditions differ from those anticipated before construction starts.

7.2 Temporary Open Cuts

The safe slope for temporary cuts will depend, in part, on the following factors:

- The type and density of the soil;
- The presence and amount of water seepage including rainfall;
- The depth of cut;
- Proximity of the cut to any surcharge loads near the top of the cut, such as stockpiled material, traffic, structures, etc., and the magnitude of these surcharges;
- Duration of the open excavation; and
- Care and methods used by the contractor.

For planning purposes, we recommend that temporary open cuts in the fill soils be no steeper than 1.5H:1V. This should not be interpreted to mean that cuts at these slopes are safe. There are many factors that determine slope stability including those presented herein. We also make the following recommendations for open cuts:

- Protect the slope from erosion by using plastic sheeting.
- Limit the maximum duration of the open excavation to the shortest time possible.
- Keep surcharge loads (equipment, materials, etc.) a safe distance from the top of the slope.

Because of the many variables involved, actual slope inclinations required for stability in temporary cut areas can only be estimated prior to construction. We recommend that stability of the temporary

slopes be the responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the subsurface. All excavations should be made in accordance with all local, state, and federal safety requirements.

Construction activity should be maintained a safe distance back from the top of temporary slopes. The contractor will need to take precautions to minimize slope erosion from rainfall and potential danger from loose, rolling cobbles or debris.

7.3 Protection of Utilities

The contractor should be responsible for the protection of existing utilities and utilities installed for the PCRC during construction. Shallow utilities should be protected against heavy construction loads. Vibration, settlement, and lateral deformation requirements should be established by the owner and the utility owners.

8.0 REFERENCES

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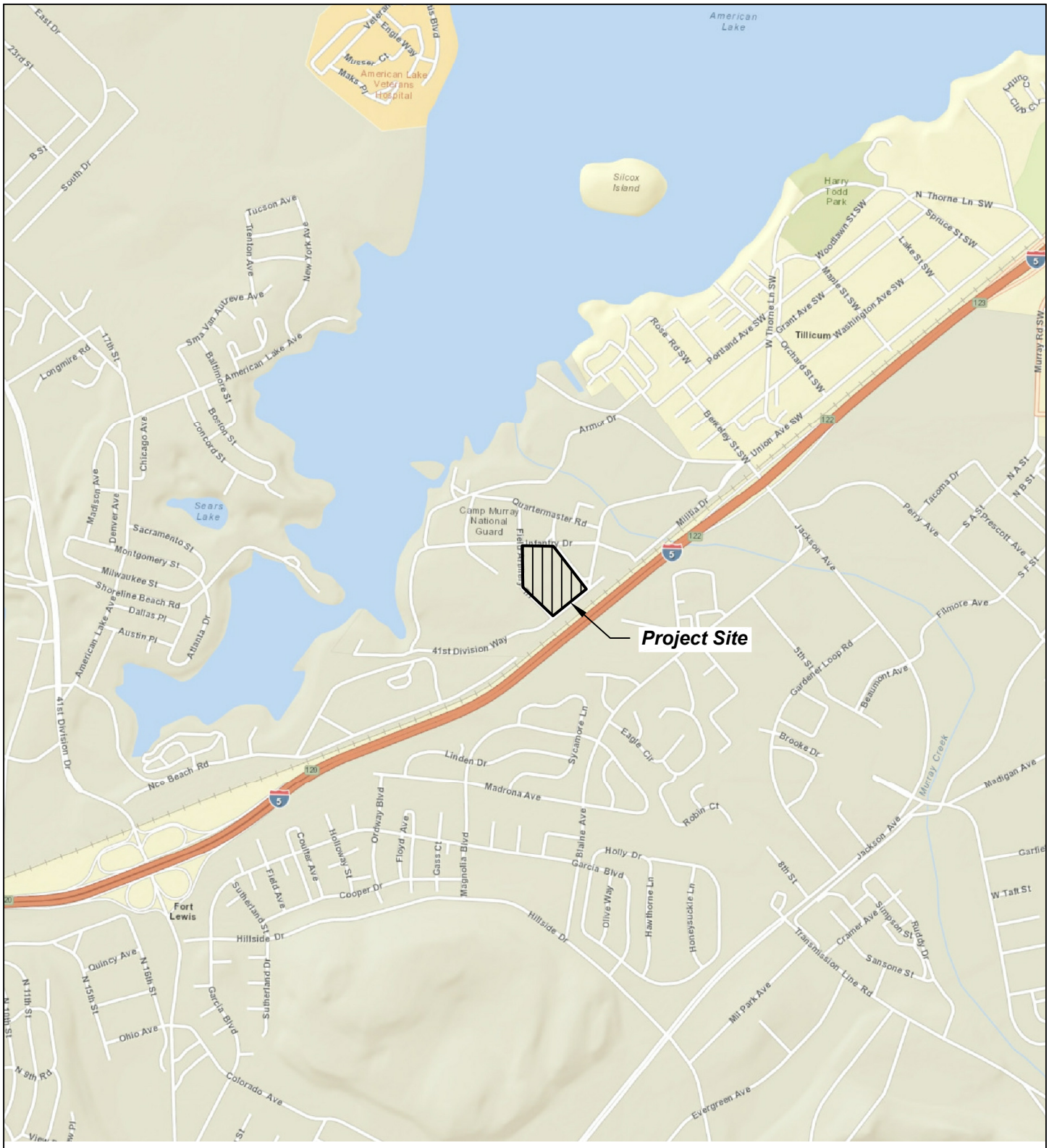

Source: Base map prepared from ArcGIS Online, 2013.

Pierce County Readiness Center
Camp Murray, Washington

Vicinity Map

17981-00 5/14

HARTCROWSER

Figure
1

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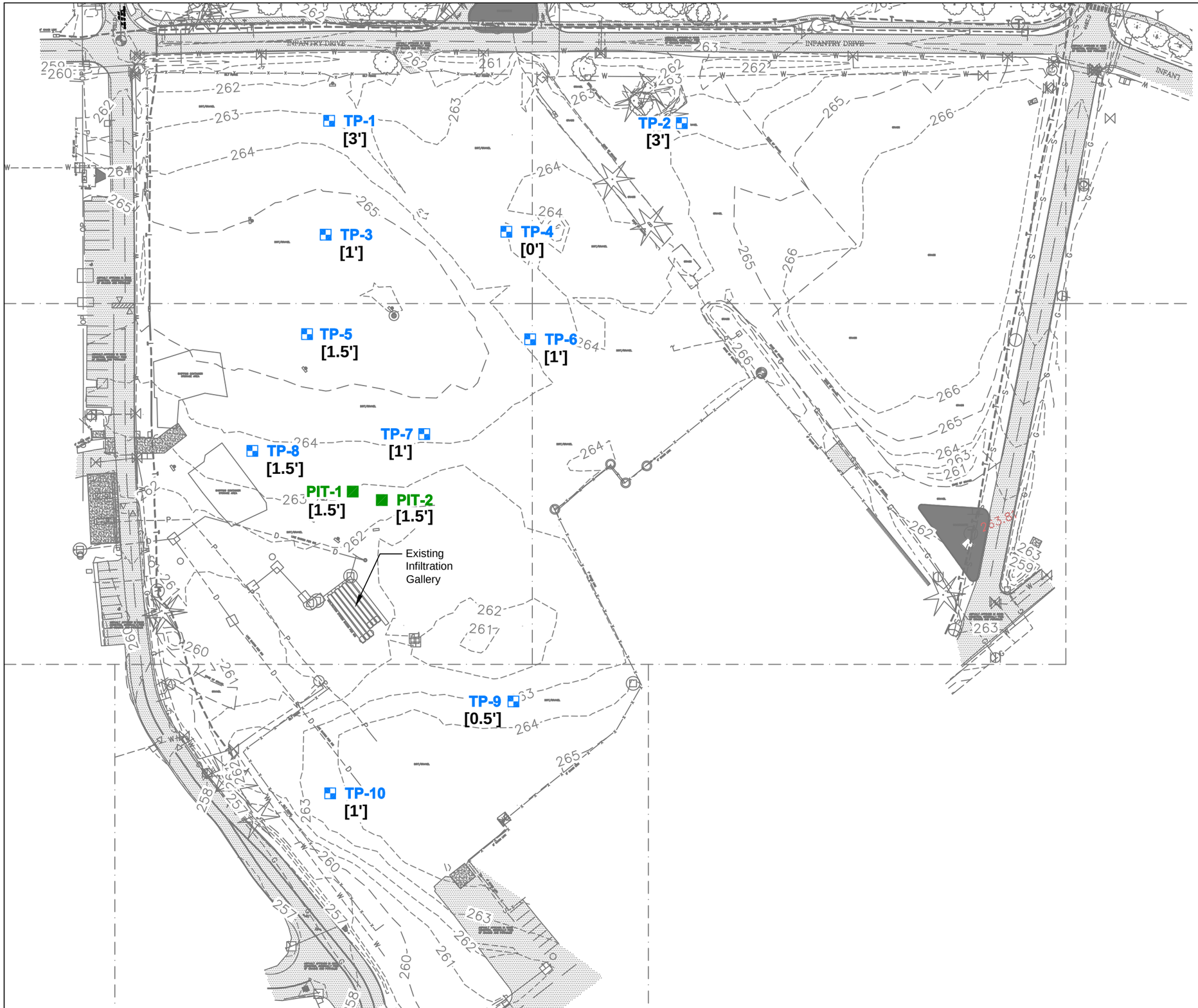

TP-1 Test Pit Location and Number

[3] Fill and Topsoil Thickness in Feet

PIT-1 Pit Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Existing Conditions

17981-00 6/14

HARTCROWSER

Figure

2a

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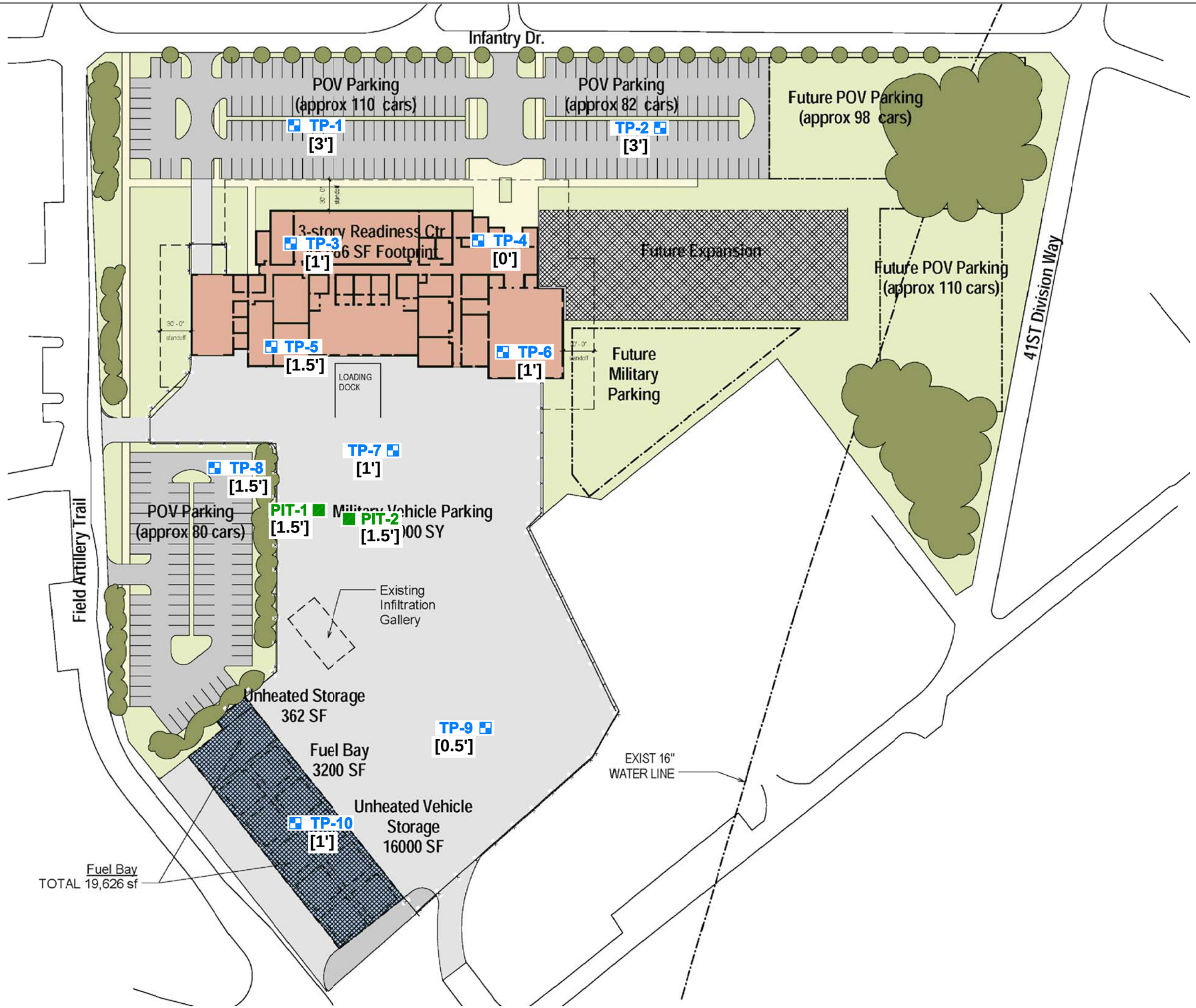

TP-1 Test Pit Location and Number

[3] Fill and Topsoil Thickness in Feet

PIT-1 Pit Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Proposed Development

17981-00 6/14

HARTCROWSER

Figure

2b

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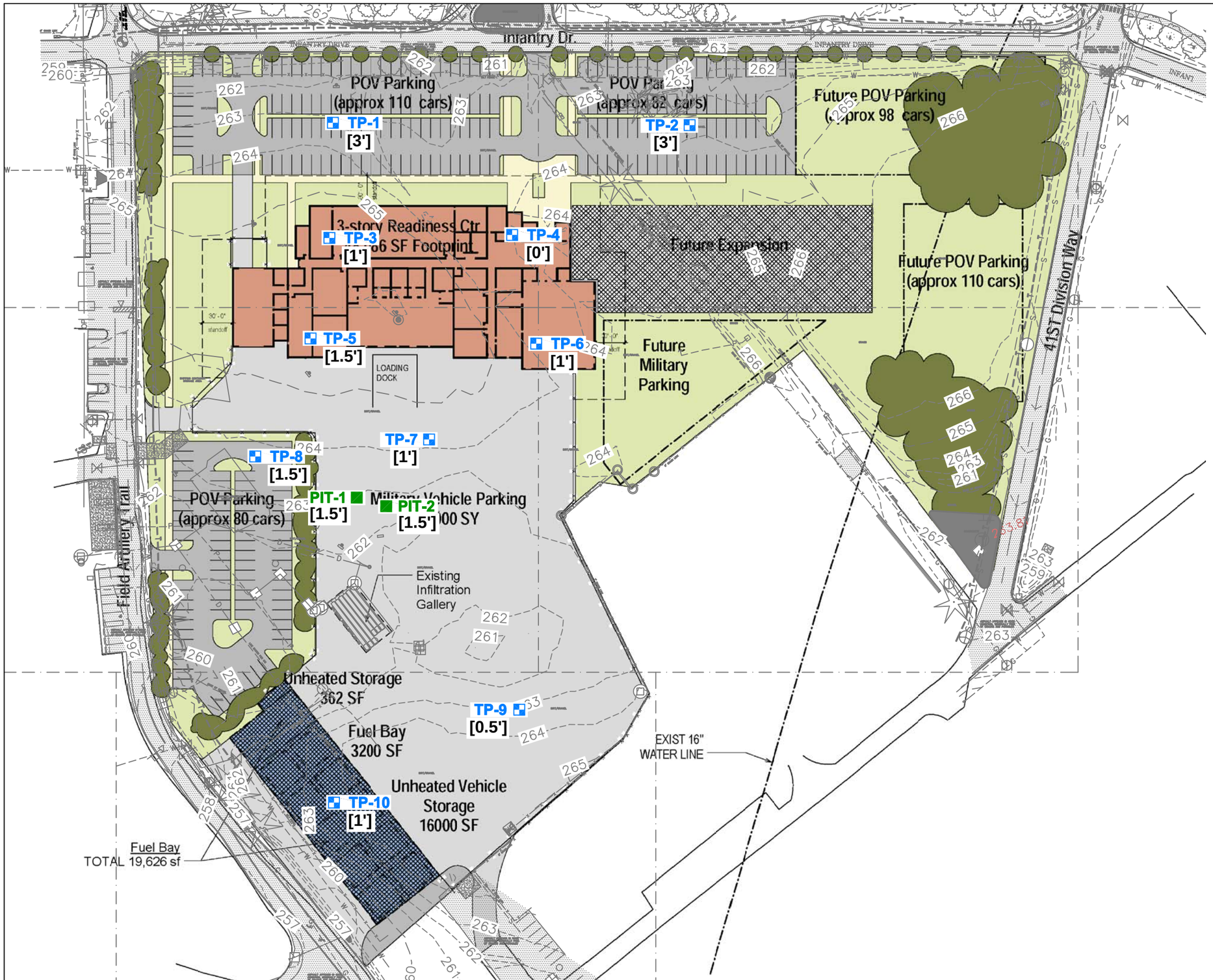

TP-1 Test Pit Location and Number

[3] Fill and Topsoil Thickness in Feet

PIT-1 Pit Test Location

N

0 100 200

Scale in Feet

Pierce County Readiness Center
Camp Murray, Washington

Site and Exploration Plan - Overlay

17981-00 6/14

HARTCROWSER

Figure

2c

EAL 06/13/14 1798100-011.dwg

ATTACHMENT 1
Declaration of Soil Bearing Capacity

DECLARATION

OF

SOIL BEARING CAPACITY

State: Washington Date: May 8, 2014

Site Location: Camp Murray

Address: Camp Murray, Tacoma, WA

Project: Pierce County Readiness Center

On the basis of our surface and subsurface investigation, and on generally accepted practices and procedures of the geotechnical engineering profession, I hereby declare to the best of my professional opinion, that the existing soil conditions at the site for this project are of a nature and classification which determine that the undisturbed soils at elevation 262 feet (elevation of the bottom of the proposed footing) when considered in conjunction with the supporting capability of the underlying soils strata, are rated at an allowable design bearing capacity of not less than 4,000 pounds per square foot for a spread footing type of building foundation.

(Signature of Soils Engineer)

Barry S. Chen, PhD, PE
(Soils Engineer Name)

Senior Principal
(Title)

Hart Crowser
(Firm Name)

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