ENVIRONMENTAL CHECKLIST

for the proposed

UW Soccer Field Upgrades Project

UNIVERSITY *of* WASHINGTON

March 20, 2025

EA Engineering, Science, and Technology, Inc., PBC
Shannon & Wilson

PREFACE

The purpose of this Environmental Checklist is to identify and evaluate probable environmental impacts that could result from the proposed ***UW Soccer Field Upgrades Project*** and to identify measures to mitigate those impacts. The ***UW Soccer Field Upgrades Project*** would provide several essential updates required to meet FIFA's requirements for World Cup training facilities, including full renovation of the existing soccer field with upgraded subsurface drainage system, irrigation system, and natural grass playing surface. The renovation would also include upgrades to the existing lighting system with LED lighting, new ball control netting, and other maintenance equipment and fixtures to meet FIFA standards.

The State Environmental Policy Act (SEPA)[1] requires that all governmental agencies consider the environmental impacts of a proposal before the proposal is decided upon. This Environmental Checklist has been prepared in compliance with the State Environmental Policy Act; the SEPA Rules, effective April 4, 1984, as amended (Chapter 197-11, Washington Administrative Code), which implements SEPA.

This document is intended to serve as SEPA review for site preparation work, construction, and operation of the proposed ***UW Soccer Field Upgrades Project.*** Analysis associated with the proposed project contained in this Environmental Checklist is based on schematic plans for the project. While not construction-level detail, the schematic plans accurately represent the eventual size, location and configuration of the proposed project and is considered adequate for analysis and disclosure of environmental impacts.

This Environmental Checklist is organized into three major sections. *Section A* of the Checklist (beginning on page 1) provides background information concerning the *Proposed Action* (e.g., purpose, proponent/contact person, project description, project location, etc.). *Section B* (beginning on page 8) contains the analysis of environmental impacts that could result from implementation of the proposed project, based on review of major environmental parameters. This section also identifies possible mitigation measures. *Section C* (page 32) contains the signature of the proponent, confirming the completeness of this Environmental Checklist.

Project-relevant analyses that served as a basis for this Environmental Checklist include the *Geotechnical Engineering Report* (Shannon & Wilson, June 2024) and *Geotechnical Memorandum* (Shannon & Wilson, March 2025).

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[1] Chapter 43.21C. RCW

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PURPOSE

The State Environmental Policy Act (SEPA), Chapter 43.21 RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. The purpose of this checklist is to provide information to help identify impacts from the proposal (and to reduce or avoid impacts, if possible) and to help the University of Washington to make a SEPA threshold determination.

A. BACKGROUND

1. Name of Proposed Project:

University of Washington (UW) Soccer Field Upgrades Project

2. Name of Applicant:

University of Washington

3. Address and Phone Number of Applicant and Contact Person:

Applicant
University of Washington
Facilities, Project Delivery Group
Box 359571
Seattle, WA 98195-9571

Contact
Julie Blakeslee
Environmental and Land Use Planner
University of Washington
Facilities, Asset Management
Box 359571
Seattle, WA 98195-9571
jblakesl@uw.edu

4. Date Checklist Prepared

The Checklist was prepared on March 20, 2024 by the University of Washington as the lead agency under the authority of WAC 478-324

5. Agency Requesting Checklist

University of Washington

6. Proposed Timing or Schedule (including phasing, if applicable):

Construction of the proposed ***UW Soccer Field Upgrades Project*** is anticipated to begin in May 2025, with completion and operation in August 2025.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

No future plans for further development of the project site are proposed.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal:

The following environmental review documents were prepared for the University of Washington 2018 Seattle Campus Master Plan:

- University of Washington 2018 Seattle Campus Master Plan Draft EIS (2016)
- University of Washington 2018 Seattle Campus Master Plan Final EIS (2017)

The following environmental review information was prepared in support of the proposed project:

- *Geotechnical Engineering Report* (Shannon & Wilson, 2024)
- *Geotechnical Memorandum* (Shannon & Wilson, 2025)

These documents are included as an appendix to this Checklist.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain:

There are no known other applications that are pending approval for the ***UW Soccer Field Upgrades Project*** site.

10. List any government approvals or permits that will be needed for your proposal, if known:

University of Washington

- Project approval, design approval, authorization to prepare contract documents, and authorization to Call-for-Bids.

State of Washington

- *Washington State Department of Ecology*
  - Construction Stormwater Permit

King County & Seattle

- *Department of Public Health*
    - Review and approval for work done over the former landfill site

City of Seattle

- *Department of Construction and Inspections*

  Permits/approvals associated with the proposed project, including:
    - Grading Permit
    - Electrical Permit
    - Drainage Permit

11. Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

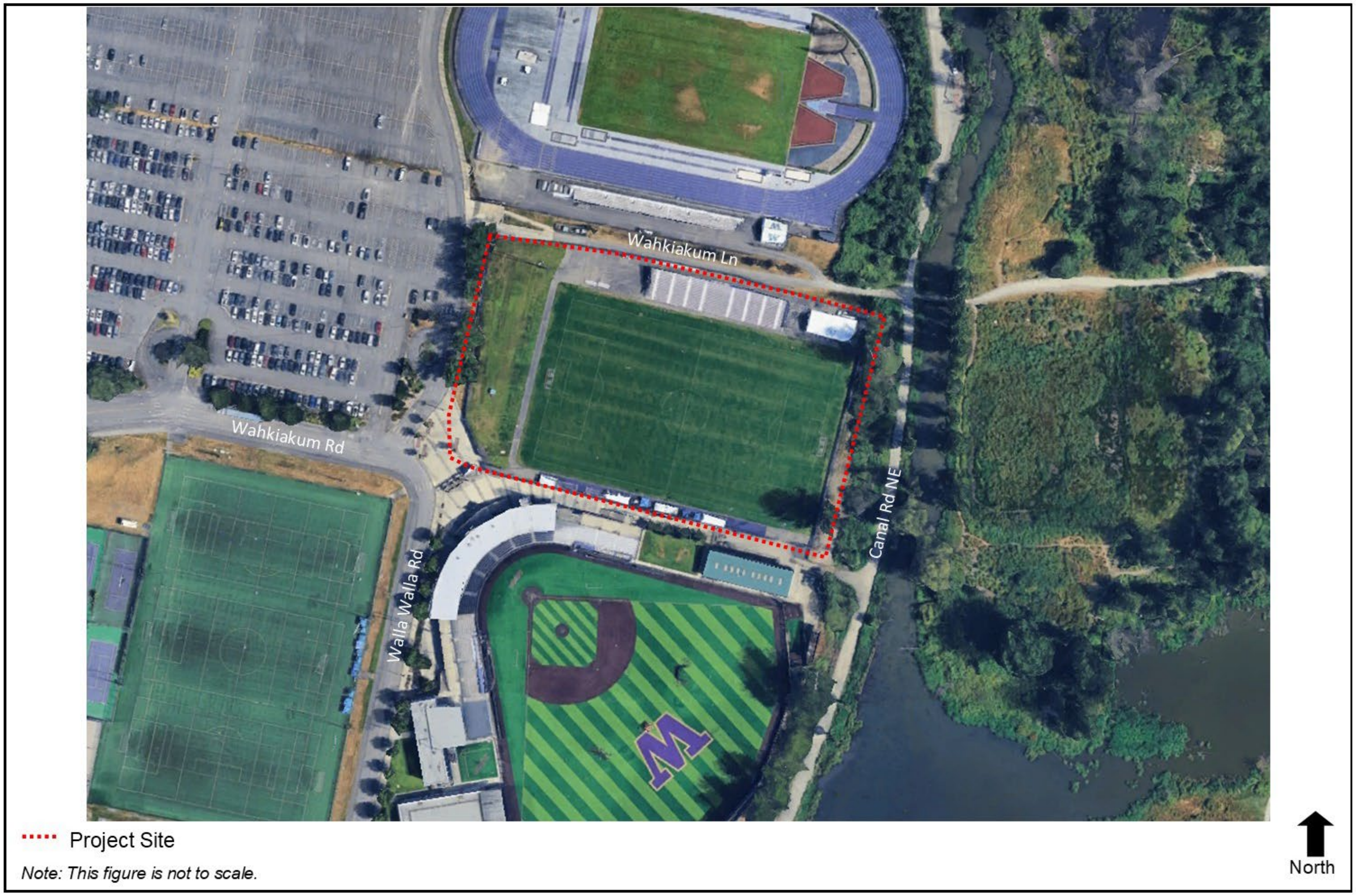
Existing Site Conditions

The proposed ***UW Soccer Field Upgrades Project*** site is located in the East Campus area of the University of Washington Seattle campus and is the athletic center of the campus with substantial area in surface parking lots. The project site, Husky Soccer Stadium, encompasses approximately 77,760 sq.ft. (1.78 acres) consists of the grass playing surface and the paved perimeter of the field, which includes lighting fixtures as well as spectator seating areas. The site is bounded by the E18 parking lot and paved Walla Walla Road to the west, gravel Canal Road NE and University Slough to the east, paved Wahkiakum Lane and Husky Track to the north, and Husky Ballpark to the south. (see **Figure 1** for an aerial map of the site/vicinity and **Figure 2** for a site plan of the project site).

Proposed Project

The primary intent of the ***UW Soccer Field Upgrades Project*** is to improve the existing UW Soccer Facility to meet the standards of FIFA (the sanctioning body of World Cup Soccer) in order to open the facility as a Venue-Specific Training Site ("VSTS") for visiting international teams to use during the 2026 FIFA World Cup soccer tournament being held in 16 North American cities, including Seattle, in June and July of 2026. Competitive Matches will be played at Lumen Field, making UW one of two VSTS facilities in Seattle which are critical components of the World Cup tournament operations.

University of Washington Soccer Field Updates Project
Environmental Checklist



🟥 Project Site

Note: This figure is not to scale.

Source: Google Earth and EA Engineering, 2025.

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Figure 1

Vicinity Map

The proposed project includes renovating the existing 77,760 sq. ft. soccer field including new drainage and irrigation systems, raising the level of the playing surface and adding new concrete stub walls/fencing at grade transitions, upgrading the lighting fixtures, and additional pitch maintenance equipment and other fixtures necessary to meet FIFA standards (see **Figure 2** for the proposed site plan). The improvements fall into several categories as discussed further below.

Improvements to the existing playing surface are the key component of the project. The existing grass playing surface would be removed and replaced with new, sand-based natural grass. Field limits will be slightly expanded to accommodate FIFA Standards for pitch dimensions. Existing sod and some quantity of the existing growing medium will be re-purposed on site and elsewhere on campus as topsoil.

In order to meet FIFA requirements, the soccer field will be regraded to ease slopes to within acceptable FIFA limits prior to planting the new, sand-based natural grass. Approximately seven inches of existing material would be removed either for restoration topsoil or re-blending and re-use onsite or elsewhere on campus. The field area would then be graded to a uniform, crowned condition with a maximum gradient of 0.6%, a cross-slope of 0.5%, and a longitudinal slope of 0.33%. A four inch bridging layer of pea gravel and 10 inch layer of improved root zone sand would also be provided to support the new natural grass field.

Trenching is going to occur one to four feet deep at the perimeter of the field, which may reach the former landfill material. If this happens, regulations will require disposal to a permitted landfill facility, which the contractor will complete. For the field, the first three inches to be removed will be sod and roots, and then up to four inches of additional topsoil, sand, and grave; subbase. Existing sod and some quantity of the existing growing medium will be re-purposed on site and elsewhere on campus as topsoil.

Once at the new designed subgrade slopes and elevations, new subsurface drainage would be provided including HDPE flat drains that would be arranged 15 feet on-center perpendicular to the field. These flat drains would intercept lateral stormwater flows and convey water to new collector piping along the field sidelines. The collectors will discharge to a combination of new and existing catch basins, and all stormwater will pass through a pre-engineered water quality treatment facility, to be located at the southeast corner of the project site. Similar to existing conditions, water will direct discharge via the existing daylighted culvert at Union Bay/Lake Washington immediately to the east. In addition, the existing field irrigation system would be replaced in its entirety and utilize the existing water service connection.

Existing synthetic turf along the south edge of the playing field would be replaced with new synthetic turf which would connect and match new synthetic turf areas on the west and east ends of the field. New ball control fencing would also be provided on the east of the field, including a four-foot high chain link fence that would run the width of the field with 40-foot total height nylon ball control netting centered above.

Improvements to pedestrian access would be provided along the west end of the site, adjacent to the parking lot, and would include new asphalt paving to meet or exceed accessibility standards. Vehicle and pedestrian access would also be improved at the southeast corner of the site, near the shared soccer/baseball maintenance building. The existing pavement elevation would be raised in this area to better match the elevations of the field and maintenance building.

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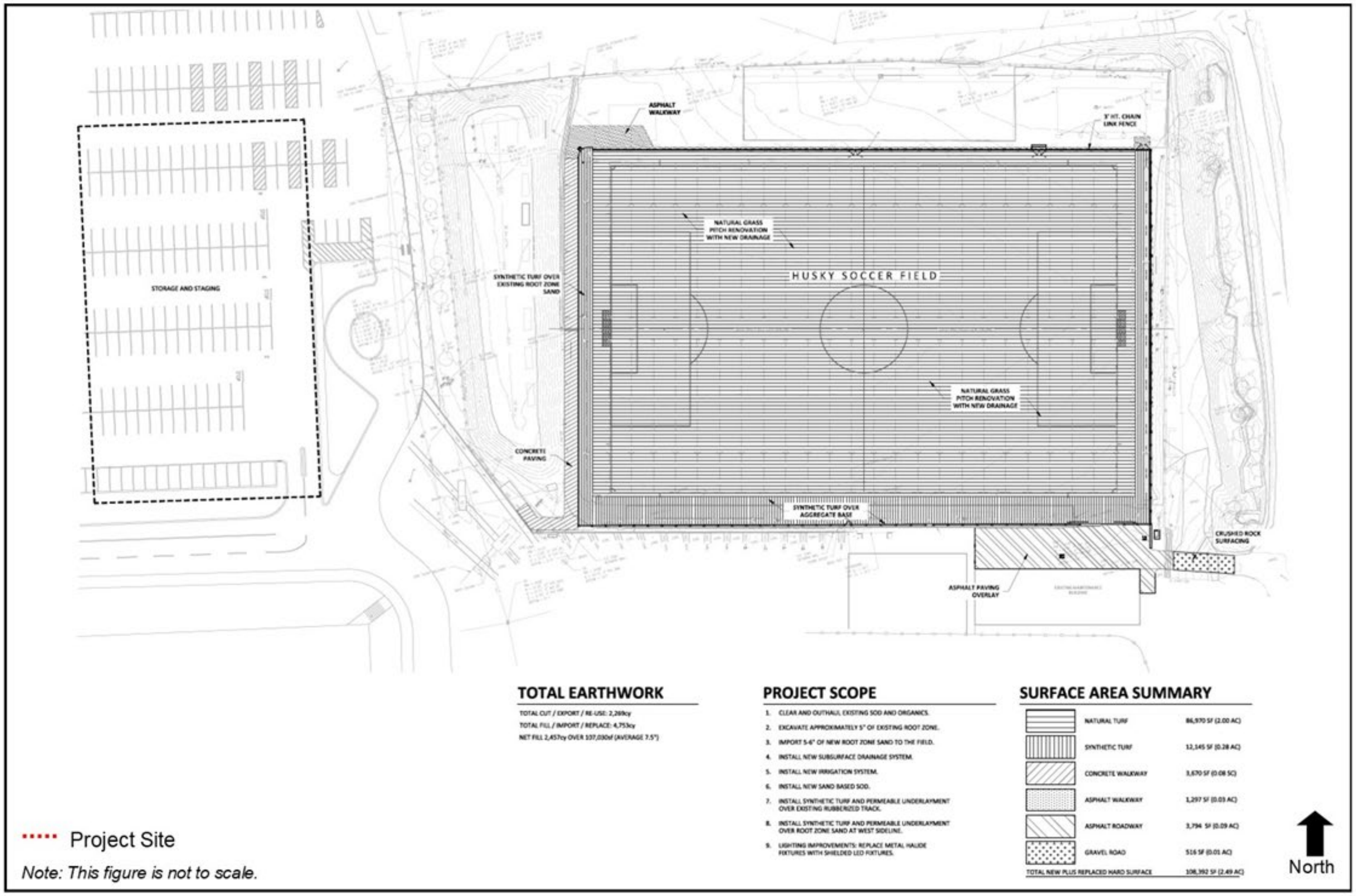

TOTAL EARTHWORK

TOTAL CUT / EXPORT / RE-USE: 2,269cy

TOTAL FILL / IMPORT / REPLACE: 4,753cy

NET FILL 2,457cy OVER 107,030sf (AVERAGE 7.5")

PROJECT SCOPE

1. CLEAR AND OUTHAUL EXISTING SOD AND ORGANICS.
2. EXCAVATE APPROXIMATELY 5" OF EXISTING ROOT ZONE.
3. IMPORT 5-6" OF NEW ROOT ZONE SAND TO THE FIELD.
4. INSTALL NEW SUBSURFACE DRAINAGE SYSTEM.
5. INSTALL NEW IRRIGATION SYSTEM.
6. INSTALL NEW SAND BASED SOD.
7. INSTALL SYNTHETIC TURF AND PERMEABLE UNDERLAYMENT OVER EXISTING RUBBERIZED TRACK.
8. INSTALL SYNTHETIC TURF AND PERMEABLE UNDERLAYMENT OVER ROOT ZONE SAND AT WEST SIDELINE.
9. LIGHTING IMPROVEMENTS: REPLACE METAL HALIDE FIXTURES WITH SHIELDED LED FIXTURES.

SURFACE AREA SUMMARY

☰	NATURAL TURF	86,970 SF (2.00 AC)
▥	SYNTHETIC TURF	12,145 SF (0.28 AC)
▨	CONCRETE WALKWAY	3,670 SF (0.08 SC)
░	ASPHALT WALKWAY	1,297 SF (0.03 AC)
▧	ASPHALT ROADWAY	3,794 SF (0.09 AC)
⁘	GRAVEL ROAD	516 SF (0.01 AC)
TOTAL NEW PLUS REPLACED HARD SURFACE		108,392 SF (2.49 AC)

······ Project Site

Note: This figure is not to scale.

Source:* *DA Hogan, 2025.

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Figure 2

Site Plan

Existing field lighting would also be upgraded with the replacement of the existing metal halide floodlights. New, fully shielded, LED floodlights would be installed on the existing lighting poles which will dramatically reduce off-site glare and spill lighting.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any. If a proposal would occur over a range of area, provide the range or boundaries of the site(s).

The proposed ***UW Soccer Field Upgrades Project*** site is located in the east portion of the University of Washington Seattle campus. The project site consists of Husky Soccer Stadium's 72 x 120 yard natural grass playing field surface and its paved perimeter including lighting fixtures and spectator seating. The project site is bounded by the E18 parking lot and paved Walla Walla Road to the west, gravel Canal Road NE and University Slough to the east, paved Wahkiakum Lane and Husky Track to the north, and Husky Ballpark to the south (see **Figures 1** and **2**).

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site (circle one):
[✓ Flat], rolling, hilly, steep slopes, mountainous,
other:______________________________________

The ***UW Soccer Field Upgrades Project*** site is relatively flat with a gentle slope to the east toward a drainage ditch along Canal Road and currently contains a natural grass soccer field with a paved perimeter.

b. What is the steepest slope on the site (approximate percent slope)?

According to the City of Seattle’s Environmentally Critical Areas (ECA) Maps, there are no steep slope hazard areas located on the site.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The site and immediate vicinity is mapped as advance outwash and pre-Fraser deposits. Advance outwash generally consists of dense to very dense well sorted sand and gravel. In general, soils at the site consist of relatively shallow fill overlaying landfill refuse, peat, soft clay and glacially consolidated soils at depth. See **Appendix A** for the Geotechnical Report and Geotechnical Memo.

According to the publicly available City of Seattle’s Environmentally Critical Areas (ECA) GIS Maps, the project site area is listed as a Peat-Settlement Prone Area, Liquefaction Prone Area, and within the footprint of the abandoned Montlake Landfill. See **Appendix A** for the Geotechnical Report and Geotechnical Memo.

The proposed project site does not contain agricultural land areas of commercial significance.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

According to the publicly available City of Seattle’s Environmentally Critical Areas (ECA) GIS Maps, the project site area is listed as a Peat-Settlement Prone Area, Liquefaction Prone Area, and within the footprint of the abandoned Montlake Landfill. There are no steep slope areas or potential slide areas listed on the City of Seattle ECA GIS map at the project site (see **Appendix A** for details).

e. Describe the purpose, type, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

The existing slopes for the soccer field currently exceed FIFA requirements and will be regraded as part of the project to ease slopes to within acceptable FIFA requirements. Approximately seven inches of existing materials would be removed from the field area for restoration topsoil or re-blending and reuse on site or within the UW campus. Additional grading would also be required for the preparation of the new perimeter synthetic turf areas, and perimeter pedestrian access areas. In total, the proposed ***UW Soccer Field Upgrades Project*** would include approximately 2,300 cubic yards (cy) of cut/excavation for reuse or export and approximately 4,800 cy of fill would be imported to the site.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Temporary erosion is possible in conjunction with any construction activity. Site work would expose soils on the site, but the implementation of a Temporary Erosion Sedimentation Control (TESC) plan that is consistent with City of Seattle standards and the implementation of best management practices (BMPs) during construction would mitigate any potential impacts.

Once the project is operational, no erosion is anticipated.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

With the proposed project, the amount of impervious surface on the site would be the same as under existing conditions.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

The mitigation of erosion impacts are addressed in individual permit reviews under the *Grading and Drainage control codes* (*SMC 22.170*), and in critical area locations by the *Seattle Critical Areas ordinance* (*SMC 25.09*), which prescribed best management practices for excavation and grading on critical areas. The 2018 Seattle Campus Master Plan EIS identifies the site areas as having a high potential for earth-related impacts. General methods to address impacts to earth are identified in Section 3.1.1 and Section 3.1.3 of the Final EIS, including the implementation of TESC measures.

According to the City of Seattle's Environmentally Critical Areas (ECA) GIS Maps, the project site area is listed as a Peat-Settlement Prone Area, Liquefaction Prone Area, and within the footprint of the abandoned Montlake Landfill. (see **Appendix A**).

Because the proposed ***UW Soccer Field Upgrades Project*** does not include confined space (i.e. enclosed building) methane gas accumulation associated with the landfill is not anticipated. Project activities, including grading and excavation, would comply with the University's Montlake Landfill Project Guide and no significant impacts would be anticipated (see **Appendix A** for details).

Pursuant to the Overview Policy at *SMC* *25.05.665*, no further mitigation is warranted.

2. Air

a. What type of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

During construction, the ***UW Soccer Field Upgrades Project*** could result in temporary increases in localized air emissions associated with particulates and construction-related vehicles. It is anticipated that the primary source of temporary, localized increases in air quality emissions would result from particulates associated with on-site excavation and site preparation. While the potential for increased, air quality emissions could occur throughout the construction process, the timeframe of greatest potential impact would be at the outset of the project in conjunction with the site preparation and excavation/grading activities. However, as described above under the Earth discussion, minimal amounts of excavation would be required for the project and air quality emission impacts are not anticipated to be significant.

Temporary, localized emissions associated with carbon monoxide and hydrocarbons would result from diesel and gasoline-powered construction equipment operating on-site, construction traffic accessing the project site, and construction worker traffic. However, emissions from these vehicles and equipment would be small and temporary and are not anticipated to result in a significant impact.

No new air emissions or Greenhouse Gas (GHG) emissions would be anticipated with operation of the ***UW Soccer Field Upgrades Project*** and significant adverse air quality impacts would not be anticipated.

b. **Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.**

The primary off-site source of emissions in the site vicinity is vehicle traffic in the E18 parking lot and on surrounding roadways, including Montlake Boulevard NE which is approximately 300 feet to the west of the site. There are no known offsite sources of air emissions or odors that would affect the proposed project.

c. **Proposed measures to reduce or control emissions or other impacts to air, if any:**

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for air quality impacts.

Short term impacts to air quality arising for construction, (fugitive dust and airborne particulates) are mitigated by adherence to *Puget Sound Clean Air Agency regulations PSCAA - Reg 1 - Section 9.15* (*1-9 Emission Standards*), *PSCAA – Reg 3 – Article 4 (Asbestos Control Standards)*, the *Seattle Stormwater Drainage Code* *22.800*, and *Grading Code* *22.170* and the best management practices for controlling erosion described above from the Seattle Municipal Code.

Pursuant to the Overview Policy at *SMC* *25.05.665*, no further mitigation is warranted.

3. Water

a. **Surface:**

1) **Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.**

University Slough is approximately 100 feet to the east of the soccer field site (beyond Canal Road) and Union Bay is located further to the east as well.

2) **Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.**

The proposed project will occur approximately 100 feet from University Slough (located to the east, beyond Canal Road). The proposed plan set identifies existing environmentally critical areas on and adjacent to the site, including adjacent wetland areas.as identified by City of Seattle GIS mapping. It should be noted that City GIS data identifies a small portion of the northeast corner of the site to contain a wetland area; however, this area appears to be mapped in error as it is currently comprised of existing paved surfaces and fencing.

3) **Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.**

   No fill or dredge material would be placed in or removed from any surface water body as a result of the proposed project.

4) **Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.**

   The proposed project would not require any surface water withdrawals or diversions.

5) **Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

   The proposed project site does not lie within a 100-year floodplain and is not identified as a flood prone area on the City of Seattle Environmentally Critical Areas map (*City of Seattle, 2022)*.

6) **Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

   There would be no discharge of waste materials to surface waters.

b. Ground:

1) **Will ground water be withdrawn, or will water be discharged to ground water? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known.**

   As noted in the Geotechnical Report (**Appendix A**), ground water at the ***UW Soccer Field Upgrades Project*** site is approximately 10 feet in depth and this level is anticipated to vary seasonally with variation consistent with changes in the surface elevation of Lake Washington. Ground water would not be withdrawn as part of the project and water would not be discharged to ground water. The proposed project would include the development of a stormwater drainage system for the soccer field which is discussed in further detail below as part of Section B.3.c.

2) **Describe waste material that will be discharged into the ground from septic tanks or other sources; industrial, containing the following chemicals; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.**

Waste material would not be discharged into the ground from septic tanks or other sources as a result of the proposed project.

c. **Water Runoff (including storm water):**

1) **Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.**

Stormwater and drainage systems for the site would be updated as part of the ***UW Soccer Field Upgrades Project*** to provide a new drainage system for the soccer field and associated site areas. The existing drainage system under the soccer field will be replaced. The proposed drainage system will be designed in accordance with the *City of Seattle Stormwater and Drainage Code, SMC Title 22* and will include perforated HDPE flat drains that will be installed 15 feet on-center and perpendicular to the field directly on the prepared subgrade to intercept lateral stormwater flows and convey water to new collector piping along the field sidelines. The collectors will discharge to a combination of new and existing catch basins, and all stormwater will pass through a pre-engineered water quality treatment facility, located at the southeast corner of the project site.

Stormwater ultimately direct discharge via the existing daylighted culvert at Union Bay/Lake Washington immediately to the east. There is no change in the contributory area of discharge. Drainage discharge from the soccer field is not anticipated to increase and may in fact decrease as runoff from the field due to the clogged surface will now flow vertically into the subgrade and attenuated within the base due to the hydraulic conductivity of the subsurface material prior to being collected in the subsurface drainage system and discharged into Union Bay/Lake Washington.

2) **Could waste materials enter ground or surface waters? If so, generally describe.**

The proposed stormwater management system for the site would continue to ensure that waste materials would not enter ground or surface waters as a result of the proposed project.

3) **Does the proposal alter or otherwise affect drainage patterns in *the vicinity of the site? If so, describe.***

The existing site stormwater currently directly discharges via a daylighted culvert into University Slough/Union Bay to the east. Proposed drainage improvements will maintain this point of discharge only after treatment and will not alter or otherwise affect drainage patterns in the site vicinity.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for stormwater impacts. Stormwater drainage systems for the proposed project site would be designed in accordance with all existing local regulations including the Stormwater and Drainage Code, SMC Title 22. Stormwater drainage would discharge to the University of Washington's storm drainage system which ultimately drains to the Union Bay area of Lake Washington. Pursuant to the Overview Policy *SMC 25.05.665*, no further mitigation is warranted.

4. Plants

a. Check or circle types of vegetation found on the site:

X_deciduous tree:
__evergreen tree:
__shrubs
X_ grass
__ pasture
__ crop or grain
__ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
__ water plants: water lily, eelgrass, milfoil, other
__ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

The ***UW Soccer Field Upgrades Project*** would include the removal and replacement of the existing grass playing surface with new, sand-based natural grass. Field limits will be slightly expanded to accommodate FIFA Standards for pitch dimensions. Removal of existing growing media to an on-site blending area, blending and testing with new root zone sand materials, and replacement to better support vigorous growth, drainage, and air movement, and provide improved stability and footing. Existing sod and some quantity of the existing growing medium will be re-purposed on site and elsewhere on campus as topsoil. Approximately 2,325 sq. ft. of existing natural grass surface behind the east end line would be restored with soil improvements, native woody shrubs, groundcovers, and organic mulch.

c. **List threatened or endangered species known to be on or near the site.**

No known threatened or endangered species are located on or proximate to the project site.

d. **Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:**

Removal and replacement of the existing grass playing surface with new, sand-based natural grass. Field limits would be slightly expanded to accommodate FIFA Standards for pitch dimensions. Approximately 2,325 sq. ft. of existing natural grass surface behind the east end line would be restored with soil improvements, native woody shrubs, groundcovers, and organic mulch.

e. **List all noxious weeds and invasive species known to be on or near the site.**

Noxious weeds or invasive species that could be present in the vicinity of the site include giant hogweed, English Ivy and Himalayan blackberry.

5. Animals

a. **Circle (underlined) any birds and animals that have been observed on or near the site or are known to be on or near the site:**

birds: **<u>songbirds,</u>** hawk, heron, eagle**, other:** **<u>seagulls</u>, <u>pigeons,</u>**
mammals: deer, bear, elk, beaver**, other:** **<u>squirrels</u>,** raccoons, **<u>rats</u>, <u>mice</u>**
fish: bass, salmon, trout, herring, shellfish**, other:** **<u>None</u>.**

Birds and small mammals tolerant of urban conditions may use and may be present on and near the ***UW Soccer Field Upgrades Project*** site. Mammals likely to be present in the site vicinity include: eastern gray squirrel, mouse, and rat.

Birds common to the area include: European starling, house sparrow, rock dove, American crow, seagull, western gull, Canada goose, American robin, and house finch.

In support of a previous project in the site vicinity (UW Basketball Training Facility located approximately 1,200 feet south of the ***UW Soccer Field Upgrades Project*** site), a Nesting Bird Survey was completed in 2022 to identify any active great blue heron or bald eagle nests in the site area (Shannon & Wilson, 2022). As part of that survey, no great blue heron or bald eagle nests were observed at any location within the site vicinity area.

b. List any threatened or endangered species known to be on or near the site.

The following are listed threatened or endangered species by the U.S. Fish and Wildlife Service: Marbled murrelet, Yellow-billed cuckoo, Northwestern pond turtle, Bull trout, Monarch butterfly and Suckley's cuckoo bumble bee[2]. However, it should be noted that none of these species have been observed in the site vicinity and due to the urban location of the site, it is unlikely that these animals are present within the proposed site area.

c. Is the site part of a migration route? If so, explain.

The entire Puget Sound area is within the Pacific Flyway, which is a major north-south flyway for migratory birds in America—extending from Alaska to Patagonia. Every year, migratory birds travel some or all of this distance both in spring and in fall, following food sources, heading to breeding grounds, or travelling to overwintering sites.

d. Proposed measures to preserve or enhance wildlife, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for wildlife impacts. As described under section 3.d, the UW campus has undergone Salmon Safe certification for installing campus-wide improvements and measures to protect water quality in nearby receiving waters. In addition, the 2018 Seattle Campus Master Plan contains an extensive open space element (section 1V, p. 54) which was analyzed in the 2018 Seattle Campus Master Plan Final EIS (Section 3.11). These preserved open space areas provide mitigation for encroachment of development on campus into areas which may provide habitat for native wildlife.

Pursuant to the Overview Policy at *SMC* *25.05.665*, no further mitigation is warranted.

e. List any invasive animal species known to be on or near the site.

Invasive species known to be located in King County and the Seattle area include European starling, house sparrow, nutria, and eastern gray squirrel.

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[2] U.S. Fish and Wildlife Service. IPaC. https://ecos.fws.gov/ipac/location/index. Accessed March 2025.

6. Energy and Natural Resources

a. **What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.**

Operation of the proposed ***UW Soccer Field Upgrades Project*** would not be anticipated to result in increased energy consumption. The soccer field facilities would continue to utilize electricity for the operation of the soccer field lighting fixtures. As part of the project, the existing metal halide floodlights would be replaced with LED floodlights which would reduce the electrical load of the field lighting system from 129.6 kilowatts (KW) to 84.6 KW.

b. **Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.**

The proposed project would not affect the use of solar energy by adjacent properties.

d. **What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:**

As noted above, the proposed project would replace the metal halide floodlights on the existing field lighting system with new LED floodlights. The provision of LED floodlights would reduce the electrical load of the field lighting system from 129.6 kilowatts (KW) to 84.6 KW.

Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

7. Environmental Health

a. **Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? If so, describe.**

As with any construction project, accidental spills of hazardous materials from equipment or vehicles could occur during the construction of the ***UW Soccer Field Upgrades Project***; however, a spill prevention plan would minimize the potential of an accidental release of hazardous materials into the environment.

According to the City of Seattle ECA Maps, the project site is located within the footprint of the abandoned Mountlake landfill (see **Appendix A** for details).

1) Describe any known or possible contamination at the site from present or past uses.

As noted above, the site is located in an area of a former abandoned landfill. It is anticipated that the fill over the former landfill is at a depth where there is a possibility to encounter waste during excavation activities on the site. Debris piling, testing, and appropriate disposal and safety protocols would be followed in accordance with the University's Montlake Landfill Project Guide and no significant impacts would be anticipated.

Because the proposed ***UW Soccer Field Upgrades Project*** does not include confined space (i.e. building space) methane gas accumulation associated with the abandoned landfill is not anticipated.

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

Other than the potential waste associated with the abandoned landfill described for Section B.7.a, no existing hazardous materials are anticipated to be encountered.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

During construction, gasoline and other petroleum-based products would be used for the operation of construction vehicles and equipment.

Once operational, maintenance activities for the soccer field would require gasoline and/or other petroleum-based products for operation of field maintenance equipment. No other hazardous materials would be anticipated with the operation of the project.

4) Describe special emergency services that might be required.

No special emergency services are anticipated to be required as a result of the project.

5) **Proposed measures to reduce or control environmental health hazards, if any:**

Washington State occupational health and safety standards and local fire code requirements ensuring the use of toxic or flammable materials is adequately addressed in the campus setting. Project activities, including grading and excavation, would comply with the University's Montlake Landfill Project Guide and no significant impacts would be anticipated

Pursuant to the Overview Policy at *SMC* 25.05.665, no further mitigation is warranted.

b. Noise

1) **What types of noise exist in the area that may affect your project (for example: traffic, equipment operation, other)?**

Traffic noise associated with adjacent roadways and parking areas (Montlake Boulevard NE, NE Wahkiakum Lane, E18 parking lot, and E1 parking lot), as well as activity associated with surrounding athletic facilities (Husky Track, Chaffey Field (Baseball), Husky Stadium, Alaska Airlines Arena, and the Softball Stadium) are the primary source of noise in the vicinity of the project site. Existing noise in the site vicinity is not anticipated to adversely affect the proposed ***UW Soccer Field Upgrades Project***.

2) **What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from site.**

Short-Term Noise

Temporary construction-related noise would occur as a result of on-site construction activities associated with the project. The proposed project would comply with provisions of Seattle's Noise Code (SMC, Chapter 25.08) as it relates to construction-related noise to reduce noise impacts during construction.

Long-Term Noise

The proposed ***UW Soccer Field Upgrades Project*** would not be anticipated to result in an increase in operational noise. Noise from the operation of the soccer field would continue to be similar to the existing conditions.

3) Proposed measures to reduce or control noise impacts, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a medium potential for noise impacts. Short term noise impacts deriving from construction projects are mitigated primarily through the adoption of construction noise control best practice, typically including limiting hours of construction. Measures such as the following are considered appropriate mitigation for this project:

- In accordance with City of Seattle regulations, construction activities would be limited to applicable noise levels per the City's noise regulations covering construction noise (*Seattle Municipal Code 25.08.425*).

- Given the level of existing environmental noise in the vicinity and the anticipated level of post-construction noise, no measures would be necessary to reduce or control post-construction noise impacts from the proposed project.

Permanent onsite operations at the UW Campus are regulated by *Seattle Municipal Code Chapter* 25.08 regarding maximal noise levels. Pursuant to the Overview Policy at *SMC* 25.05.665, no further mitigation is warranted.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe.

The proposed ***UW Soccer Field Upgrades Project*** site is located in the East Campus area of the University of Washington Seattle campus which is the athletic center of the campus with substantial areas in surface parking lots. The project site, Husky Soccer Stadium, encompasses approximately 77,760 sq. ft. (1.78 acres) and consists of the grass soccer playing surface and the paved perimeter of the field. Field lighting poles are located at each of the four corners of the field and spectator seating bleachers are located on the north end of the field. A grass area is provided adjacent to the west end of the field and separates the site from the E18 parking lot. Existing trees and vegetation are located along the east end of the field and separate the field from Canal Road NE (see **Figure 1** for an aerial map of the site and **Figure 2** for a map of the project site).

The project site is generally bounded by the E18 parking lot and paved Walla Walla Road to the west, gravel Canal Road NE and University Slough to the east, paved Wahkiakum Lane and Husky Track to the north, and Husky Ballpark to the south.

Once operational, the site would continue to be utilized for athletic events and activities as the University's soccer field, as well as a FIFA Venue-Specific Training Site for the 2026 FIFA World Cup. Operation activities would not be anticipated to affect adjacent land uses.

Policies and standards under the 2019 Seattle Campus Master Plan related to minimizing potential impacts would be followed under the proposed project. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

b. Has the site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

The project site has no recent history of use as a working farmland or forest land.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how:

The project site is located in an urban area and would not affect or be affected by working farm or forest land; no working farm or forest land is located in the vicinity of this urban site.

c. Describe any structures on the site.

The ***UW Soccer Field Upgrades Project*** site contains existing spectator seating bleachers along the north end of the soccer field. No other existing structures are located on the site.

d. Will any structures be demolished? If so, what?

No structures would be demolished as a result of the proposed project.

e. What is the current zoning classification of the site?

The site is currently zoned as Major Institution Overlay with a 65-foot height limit (MIO-65).

f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation for the site is Major Institution. (*City of Seattle, 2022*).

g. If applicable, what is the current shoreline master program designation of the site?

The project site is not located within the City's designated shoreline master program boundary.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify.

According to the City of Seattle Environmentally Critical Areas Map, the project site (and surrounding site vicinity) is located within the Peat Settlement-Prone Area, and Liquefaction-Prone Area (refer to Section 1, Earth, for additional information on earth conditions and **Appendix A**).

The City of Seattle ECA map also lists the site as being within the footprint of the former abandoned Montlake Landfill. Because the proposed ***UW Soccer Field Upgrades Project*** does not include confined space (i.e. enclosed building) methane gas accumulation associated with the abandoned landfill is not anticipated. Project activities, including grading and excavation, would comply with the University's Montlake Landfill Project Guide and no significant impacts would be anticipated (see **Appendix A** for details).

It should be noted that City GIS data identifies a small portion of the northeast corner of the site to contain a wetland area; however, this area appears to be mapped in error as it is currently comprised of existing paved surfaces and fencing. Wetland areas associated with University Slough are also located further to the east of the site, beyond Canal Road. As part of the project, new plantings and vegetation would be provided along this eastern edge of the site, including native shrubs and groundcovers.

No other environmentally critical areas are located on or adjacent to the project site (*City of Seattle, 2022*).

i. Approximately how many people would reside or work in the completed project?

The proposed ***UW Soccer Field Upgrades Project*** would not provide any employment or residential opportunities.

j. Approximately how many people would the completed project displace?

The proposed project would not displace any people.

k. Proposed measures to avoid or reduce displacement impacts, if any:

No displacement impacts would occur, and no mitigation measures are necessary.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed ***UW Soccer Field Upgrades Project*** would continue the existing soccer field use on the site and would remain compatible with surrounding uses.

The 2018 Seattle Campus Master Plan EIS identifies the site areas as having a low potential for land use impacts. The site is designated as "Major Institution" under the City of Seattle Comprehensive Plan. Under the *1998 City-University Agreement*, the City of Seattle required the University of Washington to develop a conceptual Master Plan for its Seattle campus. The 2019 Seattle Campus Master Plan, developed pursuant to the Agreement and adopted by the University and the Seattle City Council, governs future development within the Major Institution Overlay zone. Pursuant to the Overview Policy at *SMC* *25.05.665*, no further mitigation is warranted.

m. Proposed measures to ensure the proposal is compatible with nearby agricultural and forest lands of long-term commercial significance, if any:

The project site is not located near agricultural or forest lands and no mitigation measures are necessary.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

No housing units would be provided as part of the ***UW Soccer Field Upgrades Project***.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

No housing presently exists on the site and none would be eliminated.

c. Proposed measures to reduce or control housing impacts, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for housing impacts. As noted above, the site is located with the Major Institution Overlay zone under the 2019 Seattle Campus Master Plan. Adherence to the 2019 Seattle Campus Master Plan is de facto compliance with the Seattle Comprehensive Plan policies and Map. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The proposed ***UW Soccer Field Upgrades Project*** does not include the development of any new structures on the site.

b. What views in the immediate vicinity would be altered or obstructed?

Viewers to the site primarily include motorists utilizing Wahkiakum Road and the E18 and E1 parking lots, as well as people attending events at the Track and Baseball facilities. The existing view of the site primarily consists of a soccer field, spectator seating areas, and field lighting. Views of the site would generally remain the same with the completion of the ***UW Soccer Field Upgrades Project***.

c. Proposed measures to reduce or control aesthetic impacts, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site areas as having a medium potential for aesthetics impacts. The 2019 Seattle Campus Master Plan contains adopted policies and development standards for the whole of the Campus. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Short-Term Light and Glare

At times during the construction process, area lighting of the project site (to meet safety requirements) may be necessary, which would be noticeable proximate to the project site. In general, however, light and glare from construction of the proposed project are not anticipated to adversely affect adjacent land uses.

Long-Term Light and Glare

Existing soccer field lighting for the site is comprised of four 100-foot light poles located at each of the corners of the soccer field. Each pole includes light fixtures that contain approximately 19 spun-aluminum metal halide floodlights.

The proposed project would replace the 76 existing metal halide floodlights with 60 fully shielded LED floodlights on the existing poles. The provision of shielding as part of the new floodlights would dramatically reduce off site glare and spill light adjacent to the field.

The existing connected electrical load will be reduced from 129.6KW down to 84.6 KW with light output restored to 70 fc average, 1.5:1 uniformity.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Light and glare associated with the proposed project would not be expected to cause a safety hazard or interfere with views.

c. What existing off-site sources of light or glare may affect your proposal?

No off-site sources of light or glare are anticipated to affect the proposed project.

d. Proposed measures to reduce or control light and glare impacts, if any:

The proposed replacement floodlights are designed to minimize off site impacts. The floodlights incorporate precise optics that deliver light down to the field and reduce spill light extending beyond the field. Additional exterior shielding is also included to block views of the LED arrays and reflecting surfaces from offsite locations which dramatically reduces off site glare from the lighting system.

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for light and glare impacts. The proposed ***UW Soccer Field Upgrades Project*** is designed to be consistent with the University's existing internal design review process which considers the effect of architectural glazing, lighting, landscape designs to ensure that impacts from light and glare are adequately mitigated. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

There are several University athletic/recreational facilities in the vicinity (approximately 0.5 miles) of the ***UW Soccer Field Upgrades Project*** site, including:

- Husky Track to the immediate north;
- Chaffey Field (Husky Baseball) to the immediate south;
- Golf Driving Range to the north.
- The Intermural Activities (IMA) Building, Tennis Courts, IMA Sports Fields to the south;
- Alaska Airlines Arena (Hec Edmundson Pavilion) to the south;
- Nordstrom Tennis Center to the south;
- Dempsey Indoor Facility to the south; and,
- Husky Stadium to the south

b. Would the proposed project displace any existing recreational uses? If so, describe.

The ***UW Soccer Field Upgrades Project*** would not displace any existing recreational uses.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for park and recreation impacts. The University Campus is open to the public during normal daylight hours and provides an extensive network of public trails and open space. The City of Seattle Comprehensive Plan relies upon the UW campus as an element of the City's public open space inventory. The 2019 Seattle Campus Master Plan identifies and categorizes open space areas on campus.

Pursuant to the Overview Policy at *SMC* 25.05.665, no further mitigation is warranted.

13. Historic and Cultural Preservation

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers located on or near the site? If so, specifically describe.

No buildings or structures eligible for listing are located on or immediately adjacent to the ***UW Soccer Field Upgrades Project*** site.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.

The project site is not located within the designated City of Seattle Government Meander Line Buffer, with properties located within that area required to prepare an archaeological investigation as part of the SEPA and MUP processes. The cultural resources sensitivity analysis conducted for the 2018 Seattle Campus Master Plan EIS indicates that the site area has a low potential to encounter sensitive cultural resource conditions and standard best practices and code compliance would be adequate.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.

The DAHP website, WISAARD, and the City of Seattle Department of Neighborhoods Landmarks Map and List were consulted to identify any potential historic or cultural sites in the surrounding area, as well as the potential for encountering archaeological resources in the area.

Additionally, the cultural resources sensitivity analysis in the 2018 Seattle Campus Master Plan EIS indicates that the site has a low potential for sensitive historic resources and medium for sensitive cultural resource conditions. Given that proposed site disturbance would be generally limited to shallow excavation within disturbed fill material, significant cultural resources impacts are not anticipated.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for historic and medium[3] potential for cultural resources impacts. Mitigation measures were identified in the 2018 Seattle Campus Master Plan Final EIS and would be applicable for this project, including:

- The University of Washington's existing site selection and internal design review processes (architectural, landscape, environmental review, and Board or Regents) would continue to review and authorize major building projects in terms of siting, scale, and the use of compatible materials relative to recognized historic structures.

Pursuant to the Overview Policy at *SMC* 25.05.665, no further mitigation is warranted.

14. Transportation

a. Identify public streets and highways serving the site or affected geographic area and describe the proposed access to the existing street system. Show on site plans, if any.

The ***UW Soccer Field Upgrades Project*** site is located immediately east of Wahkiakum Road which is an internal campus roadway that connects with Montlake Boulevard NE approximately 600 feet to the west. Wahkiakum Lane and Canal Road NE are also located adjacent to the site (to the north and east, respectively) and provide additional internal campus circulation in the site vicinity.

No changes to site access or access to parking are proposed.

b. Is site or affected geographic area currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

The University of Washington Link Light Rail station is located approximately 0.45 mile to the southwest of the ***UW Soccer Field Upgrades Project*** site and provides service to Capitol Hill, Downtown Seattle and SeaTac Airport. King County Metro Transit (Metro) provides bus service in the vicinity of the site. Numerous transit routes

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[3] *Medium potential is primarily assigned to the shoreline and not in the existing field and associated facilities which are located over fill soil and former landfill areas.*

have stops in the vicinity of the site, including Route 43, 44, 48, 65, 73, 167, 255, 271, 542, 556 and 586.

c. **How many additional parking spaces would the completed project have? How many would the project or proposal eliminate?**

The proposed project would not displace any existing parking and no new parking would be provided with the project.

d. **Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private).**

The proposed project would include improvements to pedestrian access adjacent to the soccer field. Pedestrian access along the west end of the field would be upgraded with new asphalt paving to meet or exceed applicable accessibility standards. Access at the southeast corner of the site would also be upgraded to provide more level access between the soccer field and an existing adjacent maintenance building that is utilized by the baseball and soccer fields. The elevation of the existing pavement would be raised to match the existing field and maintenance building elevations.

e. **Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.**

The project would not use or occur in the immediate vicinity of water or air transportation. As noted above, the University of Washington Link Light Rail Station is located to the southwest of the site and is utilized by University students and employees.

f. **How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?**

Construction of the proposed project would temporarily generate some additional vehicle trips associated with construction workers and equipment/vehicles travelling to and from the site during the construction process. Construction activities would be in compliance with applicable University of Washington and City of Seattle regulations, which would include preparation of a Construction Management Plan to minimize potential construction-related transportation issues.

Once operational, the proposed project would not be anticipated to result in an increase in vehicle trips.

g. **Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe.**

There are no agricultural or forest product uses in the immediate site vicinity and the project would not interfere with, affect or be affected by the movement of agricultural or forest products.

h. **Proposed measures to reduce or control transportation impacts, if any.**

Construction activities would occur in compliance with applicable University of Washington and City of Seattle regulations and would include the preparation of a Construction Management Plan to control and minimize potential construction-related transportation issues. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

15. Public Services

a. **Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.**

The ***UW Soccer Field Upgrades Project*** is not anticipated to generate an increase in the need for public services. To the extent that emergency service providers currently serve the soccer field and surrounding area, the level of need for these services would continue.

b. **Proposed measures to reduce or control direct impacts on public services, if any.**

The 2018 Seattle Campus Master Plan EIS identifies the site area as having a low potential for public service impacts. General methods to address impacts to public services are identified in Section 3.14.3 of the EIS, including all development constructed in accordance with applicable Seattle Fire Code requirements; review of development projects for life/safety and security issues; and, UWPD could increase its staff capacity and operations, if necessary, to meet security needs for the campus. Pursuant to the Overview Policy at *SMC 25.05.665*, no further mitigation is warranted.

16. Utilities

a. **Circle utilities currently available at the site: [✓ electricity], natural gas, [✓ water], [✓ refuse service], telephone, sanitary sewer, septic system, other.**

The site is served by electrical and water service utilities. The existing power service will remain unchanged, with the lighting upgrades resulting in a reduced energy demand. The existing water service will remain unchanged, with the replaced irrigation system performing a similar function, if more effectively.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity that might be needed.

The proposed ***UW Soccer Field Upgrades Project*** would utilize the existing water service connection to serve the upgraded field irrigation system. The new system would perform a similar function for irrigating the field but in a more effective and efficient manner. Similarly, existing electrical connections would continue to serve the field lighting facilities on the site; however, the provision of new LED floodlights would reduce the electrical load of the system from 129.6 KW to 84.6 KW.

The proposal would not utilize or affect other utilities in the vicinity.

C. SIGNATURES

The above answers are true and complete to the best of my knowledge. I understand the lead agency is relying on them to make its decision.

Signature:

Julie Blakeslee

Name of Signee:

Julie Blakeslee

Position and Agency/Organization:

SEPA Responsible Official

Date:

March 20, 2025

REFERENCES

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City of Seattle. *City of Seattle Department of Neighborhoods Landmarks Website and Map:* https://www.seattle.gov/neighborhoods/programs-and-services/historic-preservation/landmarks. Accessed March 2025.

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Appendix A

Geotechnical Report and Memorandum

SUBMITTED TO:
University of Washington
4002 E. Stevens Way NE
Seattle, WA 98195

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

GEOTECHNICAL REPORT

UW Soccer Field Technology Updates

SEATTLE, WASHINGTON

June 26, 2024

Shannon & Wilson No: 113263-001

Submitted To: University of Washington, Facilities, Project Delivery Group
4002 E. Stevens Way NE
Seattle, WA 98195
Attn: Carmen Scraper

Subject: GEOTECHNICAL REPORT, UW SOCCER FIELD TECHNOLOGY UPDATES, SEATTLE, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a consultant to the University of Washington. Our services were completed under our On-Call Master Services Agreement for Environmental and Geotechnical Service dated September 20, 2023. Our scope of services was specified in your Professional Services Authorization Letter dated April 25, 2024. This report presents the results of our subsurface exploration and recommendations for project design, and was prepared by the undersigned.

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

Sincerely,

SHANNON & WILSON

NIKOLAS LEIGH ROLLA POLZIN
23027855
6/26/2024

ALI SHAHBAZIAN-AHARI
6/26/2024

Nikolas Polzin, PE
Senior Geotechnical Engineer

Ali Shahbazian, PhD, PE
Associate

NLP:AAS/nlp:aas:mwp

Site-specific seismic hazard analysis and time history calculations were prepared by or under the direct supervision of Ali Shahbazian, PhD, PE

Site geology, subsurface soil, and geotechnical calculations (other than seismic considerations) were prepared by or under the direct supervision of Nikolas Polzin, PE.

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1 INTRODUCTION

This report presents the results of our subsurface explorations and geotechnical engineering recommendation for design and construction of the University of Washington (UW) Soccer Field Technology Updates Project (project). Our evaluations, analyses, conclusions, and recommendations are based on the following:

- The limitations of our approved scope, schedule, and budget described in your Professional Services Authorization Letter dated April 25, 2024.
- Our understanding of the project and conceptual site plan provided by UW on March 25, 2024.
- Site and subsurface conditions we observed during our site reconnaissance and in our cone penetrometer test (CPT) soundings as they existed during May 2024.

We understand this report will be used for design of foundations for a camera platform structure at the UW Husky Soccer Stadium. This report should not be used for other purposes without Shannon & Wilson's review. Our scope of services included:

- A site visit for site reconnaissance and exploration location marking.
- Submitting a public utility locate request through DigSafeWA.
- Completing CPT sounding(s) to approximately 120 feet in depth, with shear wave velocity measurements, and pore pressure dissipation tests.
- Completing geotechnical analysis for:
  - Shallow Foundation Design
  - Deep Foundation Design
  - Seismic Site Response
  - Site Liquefaction Susceptibility
- Preparing a report detailing the results of our explorations, analyses, and recommendations for project design and construction.

If a service is not specifically indicated in this report, do not assume that it was performed.

2 PROJECT AND SITE DESCRIPTION

2.1 Project Description

Our understanding of the project components is based on a conceptual site and foundation plan provided to us via email on March 25, 2024, by Anna Daeuble of UW. The site plan shows two major site improvement features:

- Underground electrical conduit and handhole installation.
- A platform for a television camera located north of the center of the existing grandstands.
  - This platform is shown as consisting of modular components comprising the platform structure, with foundation(s) to be designed based on the site soil conditions.
  - Access to the platform is provided by steps or a ramp from the grandstands.

Through conversation with the project structural designer, KPFF, we understand that the preferred approach for foundation design is to compensate for the added vertical load on the site soil by replacing the surficial soil with expanded polystyrene (EPS) geofoam. Preliminary sketches provided by KPFF show a concrete grade beam foundation at the ground surface bearing on geofoam blocks.

2.2 Site Description

The project site is located on the UW Seattle campus, east of the main campus, and north of Husky Stadium and the Intramural Activities Building. The project site is bordered to the south by the Husky baseball stadium, to the west by the Montlake parking lots, to the north by Husky Track, and to the east by the gravel-surfaced Canal Road NE and Ravenna Creek waterway.

The project area is relatively flat with a gentle slope to the east toward a drainage ditch along Canal Road. The site topography suggests that the area was built up with fill to create the flat surface of the soccer field. The soccer field is surrounded by chain link fence. Prominent features near the soccer field include lighting poles and the stadium grandstands. Underground utilities are present in the project area, including electrical, drainage, and water supply.

3 SITE GEOLOGY AND SUBSURFACE CONDITIONS

3.1 Geology

The project site is located within the Puget Lowland, a physiographic region bounded by the Cascade Mountains to the east and Olympic Mountains to the west that stretches from approximately Vancouver, British Columbia, to Olympia, Washington. The Puget Lowland has been filled in with glacial and interglacial sediments that were deposited during the Pleistocene Epoch (2.6 million to 11,700 years ago) by advancing and retreating glaciers, related meltwater streams, and lakes (Troost and others, 2005). The last glacial advance, the Vashon Stade of the Fraser Glaciation, reached its greatest extent about 15,000 years ago and buried most of the Puget Lowland under ice as thick as 3,000 feet (Booth and others, 2004). The weight of this thick ice served to consolidate the soil under the ice sheet to a generally dense or very dense state. After the Vashon ice receded, the site was submerged under Lake Washington, where fine-grained lacustrine deposits have been forming atop the underlying glacially consolidated soil.

In recent history, human influence has changed the depositional environment in the Union Bay area. The level of Lake Washington was lowered coincident with the construction of the Lake Washington Ship Canal. Lowering of the lake level exposed previously submerged land along the periphery of the lake, including the Union Bay area where the project is located. Portions of the Union Bay area were used as a municipal solid waste landfill from approximately 1926 to 1966 (UW Montlake Landfill Oversight Committee, 2022). Following closure of the landfill, a soil cap was placed atop the refuse fill. This soil cap varies in thickness across the landfill area from 2 to 20 feet or more(Shannon & Wilson, 2012; AGRA Earth & Environmental, 1996). The human-placed refuse fill and soil cap fill overlie compressible lacustrine and peat deposits. Monitoring of surface settlement from 2003 through 2012 indicated that the ground surface in the landfill area continues to settle due to underlying soil compressibility and decomposition of natural and human placed organic matter (Shannon & Wilson, 2012).

3.2 Explorations

We completed two CPT soundings in the vicinity of the proposed camera platform structure. The CPT soundings were completed by In-Situ engineering of Snohomish, Washington, using a truck-mounted CPT rig. The first sounding did not reach the target depth due to an obstruction at approximately 17 feet depth. The CPT rig position was adjusted, and the second sounding was advanced to the target depth. The approximate locations of our CPT soundings are shown in Figure 2 – Site and Exploration Plan. Further discussion of the CPT exploration method, and results of the soundings are presented in Appendix A.

3.3 Subsurface Soil

We developed the site subsurface soil profile based on the results of our CPT soundings and the soil conditions described for nearby historic projects. No soil samples were collected during exploration for this project. The explorations were performed to evaluate geotechnical soil conditions for the proposed camera platform. Our observations are specific to the locations and depths noted on the logs, and may not be applicable outside of the camera platform area. No amount of exploration can precisely predict the characteristics, quality, or distribution of subsurface and site conditions. Potential variation includes, but is not limited to the following:

- The conditions between and below explorations may be different.
- The passage of time or intervening causes (natural and manmade) may result in changes to site and subsurface conditions.
- Groundwater levels and flow directions may fluctuate due to seasonal variations.
- Obstructions such as wood waste, rubble, metal debris, or other bulky waste material may be present in the subsurface.

If conditions different from those described herein are encountered during construction, we should review our description of the subsurface conditions and reconsider our recommendations.

CPT exploration logs, presented in Appendix A, include a calculated Soil Behavior Type, which is indicative of soil layer composition but not a direct observation. Further interpretation of soil types is required based primarily on CPT data and secondarily on historical boring logs. The interpreted subsurface soil profile is presented in the Exhibit 3-1. The subsurface soil profile at the site is consistent with the general conditions presented in nearby historic exploration logs and profiles presented in the following reports:

- Report on Union Bay Reclaimed Land (Shannon & Wilson, 1966)
- Montlake Landfill Long-Term Movement Study (Shannon & Wilson, 2012)
  - Site plan and profile included in Appendix B for reference
- Subsurface Exploration and Preliminary Geotechnical Engineering Report, ICA Soccer and Baseball Field Development (AGRA, 1996)
  - Site plan and selected exploration logs included in Appendix B for reference

Exhibit 3-1: Interpreted Subsurface Soil Profile

Top Depth (feet)	Bottom Depth (feet)	Soil Unit	Interpretive Soil Description
0	17.5	Soil Fill	Loose to medium dense Silty Sand with varying gravel; medium stiff to stiff Sandy Silt; may contain concrete and masonry rubble.
17.5	45	Refuse Fill	Very loose to medium dense, Silty Sand and Sandy Silt with organics, ash, fabric, paper, asphalt, concrete, and brick debris.
45	65	Peat	Soft fibrous peat and Organic Clay.
65	70	Alluvium	Medium dense to dense poorly graded to Silty Sand with interbedded silt.
70	115	Lacustrine	Very soft to soft Silt and Clay.
115	118	Glacially Overridden	Dense to very dense Silty Sand with varying gravel.

3.4 Groundwater

The depth to groundwater was estimated based on pore pressure measurements collected during CPT sounding advancement. No observation wells, piezometers, or other groundwater monitoring devices were installed for this project. Based on interpreted soil behavior and CPT pore pressure measurements, the groundwater level at the time of CPT exploration was approximately 10 feet in depth. The groundwater level at the site is expected to vary seasonally with variation nearly coincident with changes in the surface elevation of Lake Washington.

4 GEOLOGIC HAZARDS AND ENVIRONMENTALLY CRITICAL AREAS

A geologic hazard is a natural phenomenon or event that poses a threat to human life, property, or infrastructure. Geologic hazards include events such as earthquakes, volcanic eruptions, landslides, avalanches, floods, tsunamis, sinkholes, subsidence, and coastal erosion. Geologic hazards can be triggered by natural processes such as plate tectonics, weathering, erosion, sedimentation, glaciation, or hydrology, or by human activities, such as mining, construction, or land use. Geologic hazards can vary in frequency, magnitude, duration, and impact depending on the location, geology, climate, and vulnerability of the affected area. Geologic hazards may also interact with each other or with other natural hazards such as wildfires, storms, or droughts.

Certain hazards are recognized by the City of Seattle to be of particular importance for preservation of the environment and public safety. These hazards are identified as Environmentally Critical Areas (ECAs) in City of Seattle Municipal Code Chapter 25.09. ECAs relevant to geotechnical considerations include steep slope areas, seismic hazard areas, liquefaction prone areas, volcanic hazard areas, and abandoned landfills. Based on maps of ECAs prepared by the City of Seattle, the project site is located partly or completely with the following geologic hazard and abandoned landfill ECAs.

4.1 Seismic Hazard

The project site is located within the seismically active Puget Sound region. Earthquakes in this region are generated from the following three primary sources:

- Subduction zone megathrust, e.g., Cascadia subduction zone earthquake, circa 1700.
- Subduction zone deep intraslab, e.g., 2001 Nisqually earthquake.
- Shallow crustal faults, e.g., Seattle Fault Zone earthquake, about 1,100 years ago.

The closest mapped fault to the project site is the Seattle Fault Zone, which is approximately 5.5 miles south of the project site. Considering this separation distance, the relatively lower slip rate of the Seattle Fault Zone, and the short fundamental period of the structure, the risk of near fault effects and surface fault rupture is low (see Appendix C for additional information on directivity). The design level seismic hazard for the project is defined by the Seattle Building Code, which references the 2021 International Building Code (IBC), and American Society of Civil Engineers (ASCE) 7-16. Recommended acceleration parameters for a deign level seismic event are presented in Section 5.1.

4.2 Liquefaction

Soil liquefaction is a phenomenon caused by earthquake ground motions in which soil shear strains cause porewater pressure increases in loose saturated granular soils. Such porewater pressure increases can cause a substantial reduction in soil shear strength (a quicksand-like condition). Liquefaction susceptibility in sandy soils depends on the density and fines content of the soil deposit, the presence of groundwater, and the nature of the earthquake shaking.

We evaluated liquefaction susceptibility at the project site based on the results of CPT-01A, utilizing the methodology described by Boulanger and Idriss (2014). The results of this analysis are included as Figure 3. The results indicate that for a design level seismic event, portions of the soil profile are expected to liquefy, and that liquefaction-induced settlement will occur on the order of 6 to 8 inches.

4.3 Peat Settlement

Historic explorations throughout the Union Bay area show the presence of peat and wood fill in the subsurface soil (Shannon &Wilson, 2012 and 1966; AGRA, 1996). Peat soils tend to be highly porous with a relatively compressible fabric and can produce significant ground surface settlements with small increases in the vertical effective stress. These increases in vertical effective stress can be caused either by increasing the load atop the soil or decreasing the groundwater pressure within the soil.

Peat is interpreted to be present below the project site at a depth below the phreatic groundwater surface and sufficiently deep, so that seasonal fluctuation in groundwater is not expected to significantly affect the pore pressure in the peat. Dewatering of the peat is not necessary to construct the project foundation elements. Depending on the foundation design method, the new shallow foundation loads will either be fully compensated by lightweight fill replacement or be of small enough magnitude that the additional vertical effective stress on the peat will be near zero.

While peat settlement due to construction of the project is expected to negligible, settlement of the peat due to historic filling and ongoing decomposition will continue to occur. Settlement monitoring completed by Shannon & Wilson for the UW between 2002 and 2012 showed an average rate of settlement of approximately 1.25 to 1.5 inches per year at S-11, the monitoring point nearest the project area (Shannon & Wilson, 2012). It is our opinion that this long-term settlement will occur generally uniformly over the project area and will not contribute significantly to differential settlement of the structure foundation.

4.4 Abandoned Landfill

The project site is located atop the closed and abandoned Montlake Landfill. This landfill served the City of Seattle as a location to dispose of various municipal wastes, including domestic, soil, and construction waste. Decomposition of organic material in the waste and underlying naturally deposited peat soil generates methane gas and other byproducts. If allowed to concentrate in an enclosed space, methane can form a hazardous and potentially explosive atmosphere. The planned project improvements do not include construction of enclosed spaces in contact with the ground meant to be occupied during normal use. The likelihood of a hazardous buildup of methane in project structures is highly unlikely. Project structures will either be completely open to the outside atmosphere or be small utility vaults or boxes not meant for human occupancy. It is our opinion that methane mitigation measures are not necessary for the project.

5 GEOTECHNICAL RECOMMENDATIONS

We have prepared our design recommendations for the camera platform foundations and considering the project as described in Section 2. When the foundation designer develops additional information about final foundation configurations or other factors, the recommendations presented herein may need to be revised. Shannon & Wilson should be made aware of the revision(s) or additional information so that we can evaluate our recommendations for applicability.

For purposes of our analyses and recommendations, it was necessary for us to assume that the results of the explorations and research presented in Section 3 are representative of conditions throughout the project site. However, as stated in Section 3, subsurface conditions should be expected to vary. We may need to revise our recommendations during construction if different conditions are encountered.

5.1 Seismic Design Parameters

Seismic design of the project incorporates requirements of 2021 IBC, which adopts ASCE 7-16 and considers the risk-targeted maximum considered earthquake corresponding to a target risk of 1% in 50 years for structural collapse (note that the actual risk of collapse could be higher than 1% in 50 years for sites designed close to active faults in high seismicity areas). Based on our review of the site conditions and the presence of soft clay/peat, the site is classified as Site Class F, and a site-specific site response analysis is required by ASCE 7-16.

We performed a site-specific site response analysis for the project in accordance with ASCE 7-16 Chapter 21. The ground surface site-specific design spectrum was developed for subsurface soil conditions using a one-dimensional effective stress site response analysis and shear wave velocity profile represented by seismic CPT data and historical borings in the vicinity of the site. Details of our site-specific site response analysis and assumptions and subsurface data used to obtain the design acceleration response spectrum are provided in Appendix C of this report.

Figure C-14 presents the ground surface site-specific design spectrum obtained for the project site, and tabulated values are presented in Exhibit C-5. The design acceleration parameters are provided in Exhibit 5-1.

Exhibit 5-1: Response Spectrum Parameters for IBC 2021 Site Class F

Parameter	Value
Peak Ground Acceleration, PGA (g)	0.56
Short-Period Spectral Acceleration, S_s (g)	1.31
Spectral Acceleration at 1-Second Period, S_1 (g)	0.45
MCE_R Spectral Response Acceleration Coefficient, S_{MS} (g)[a]	1.25
MCE_R Spectral Response Acceleration Coefficient, S_{M1} (g)[a]	1.90
Design Spectral Response Acceleration Coefficient, S_{DS} (g)[a]	0.84
Design Spectral Response Acceleration Coefficient, S_{D1} (g)[a]	1.27
MCE_G Site Modified PGA_M (g)	0.64

NOTES:

a. Based on site-specific site response analysis (see Appendix C for details).

g = acceleration due to gravity; IBC = International Building Code

5.2 Shallow Foundations

5.2.1 Load Compensation

We understand that the camera platform foundations will utilize partial or full load compensation though the use of lightweight fill replacement under the foundations. Preliminary foundation concepts show EPS geofoam used as the lightweight fill. Lightweight fill replacement can be completed to a maximum depth of 30 inches as limited by City of Seattle Municipal Code Section 25.09.110. Replacing the existing surficial soil to this depth with allows for a foundation load of 300 pounds per square foot to be applied at the base of the EPS geofoam. Limiting loading to this value will results in vertical stresses similar to the existing condition. EPS geofoam may extend beyond the lateral extents of the platform foundation to accommodate the full foundation load. The maximum width of the EPS geofoam contributing to foundation support should be the width of the foundation plus twice the thickness of the EPS geofoam.

Fully compensating for the foundation load will result in little or no increase in vertical stress. Short-term settlement of the foundations will be small, less than approximately ½ inch, and dependent on the stiffness of EPS geofoam used. Such settlement is anticipated to occur as structural loads are applied during construction and can be compensated for during construction. Loading more than the compensated soil weight is achievable but will result in additional short-term settlement.

5.2.2 Allowable Bearing Capacity

For camera platform shallow foundations or EPS geofoam bearing at a depth of 30 inches in the surficial soil fill, we recommend an allowable bearing pressure of 2,500 pounds per square foot for static conditions. This capacity considers that structural loads will be transferred though the EPS geofoam, if present, to the underlying subgrade soil, such that the full bearing pressure is present at the base of the EPS geofoam. Foundation subgrade preparation should be completed in accordance with the recommendations of Section 6.1. This allowable capacity includes a factor of safety of approximately 2.5. For load combinations including wind and/or earthquake loading, this allowable bearing capacity may be increased by 33%.

For shallow foundations designed and constructed as recommended above, we estimate isolated settlements up to ½ inch and differential settlement (between adjacent footings or over a 20-foot-long span of continuous footing) up to ¼ inch. These settlements are expected to occur as the structural loads are applied due to the relatively granular nature of the subgrade soil.

5.2.3 Lateral Resistance

Lateral loads may be resisted by passive pressures against the buried portions of the camera platform foundation or EPS geofoam. Passive pressures should be estimated using a triangular pressure distribution varying with embedment of the foundation element. The slope of this distribution is an equivalent fluid weight (EFW) that depends on the subsurface soil and loading conditions. We recommend using an EFW of 120 pounds per cubic foot to calculate passive resistance. This value includes a factor of safety to account for the lateral deformation required to develop passive resistance. For load combinations including wind and/or earthquake loading, this allowable lateral capacity may be increased by 33%. Lateral resistance from passive pressure should be ignored for any portion of the platform foundation where soil removal is likely to occur in the future.

5.3 Helical Piles/Anchors

Vertical foundation capacity, both downward and uplift, may be provided by helical piles or anchors as dictated by load direction. Our CPT soundings near the camera platform indicate suitable soil for helical pile/anchor bearing is present at a depth of approximately 15 feet below the ground surface. At this depth, assuming at least one 6-inch-diameter helix plate is used, we recommend an allowable pile/anchor capacity for 5 kips be used for foundation design. Helical piles/anchors should be spaced horizontally no closer than three times the largest helix diameter.

Actual pile/anchor capacity should be verified during construction by load test using the "Quick Test" procedure described in ASTM D1143 (ASTM, 2020) and loading the pile/anchor to 200% of the design load. If the design capacity is not achieved, additional piles/anchors should be installed or larger helix plates used.

For helical pile foundations designed and constructed as recommended above, we estimate isolated settlements less than ½ inch and differential settlement (between adjacent footings or over a 20-foot-long span of continuous footing) less than ¼ inch. These settlements are expected to occur as the structural loads are applied, due to the granular nature of the subgrade soil.

5.4 Deep Foundations

The UW Montlake Landfill Project Guide (UW, 2022) states that structures built atop the landfill shall be pile supported, and that alternative foundations are considered on a case-by-case basis. It is our opinion that the camera platform can be adequately supported by shallow foundations or helical pile elements as described above. Use of piles bearing in the underlying glacially consolidated soil could cause the camera platform to remain stationary as the surrounding ground subsides. Such differential subsidence will require periodic adjustment or reconstruction of the platform access elements as the grandstands settle separately form the platform. For this reason, we recommend that deep pile foundations not be used to support the camera platform.

5.5 Fill, Placement, and Compaction

5.5.1 Placement and Compaction

Fill placed beneath or against structures, such as footings, retaining walls, or hardscape surfaces, should be structural fill. Structural fill should be placed in horizontal lifts, compacted to at least 95% of its Modified Proctor maximum dry density as determined by ASTM D 1557 (ASTM, 2021), and be deemed to be in a dense and unyielding condition by a qualified geotechnical engineer. The moisture content for structural fill should be within 2% of the optimum moisture content at the time of installation. The thickness of loose lifts should not exceed 12 inches for heavy equipment compactors or 6 inches for hand-operated compaction equipment. Fill placed in areas where structural fill is not required and settlement is acceptable should be compacted to 90% of its Modified Proctor maximum dry density. All compacted surfaces should be sloped to promote drainage and mitigate ponding.

Compaction of backfill adjacent to retaining walls or existing footings can result in higher lateral earth pressures against the wall or settlement of foundations. Heavy equipment should stay behind a line extending upward from the base of the walls at 0.5 Horizontal to 1 Vertical (0.5H:1V), or 3 feet from the wall, whichever is greater. The backfill within this zone should be compacted with hand-operated equipment or smaller machine-operated equipment. In such areas, the maximum lift thickness of fill should be reduced to 4 inches. We recommend that the backfill around the structure be brought up in uniform horizontal layers on all sides of the structure being backfilled.

5.5.2 Reuse of On-Site Soil

On-site soil may be used as structural backfill, provided the soil is free of organics and other deleterious materials. Where on site soil is used to backfill against structures or utilities, particles larger than 3 inches should be removed from the soil prior to placement. If on-site soil is not able to be compacted as required or not available in sufficient quantity, imported backfill soil should be used. On-site soil not suitable for structural backfill could be used as backfill within landscaped areas where potential settlement is tolerable.

5.5.3 Imported Backfill

Imported structural backfill should meet the gradation requirements of Mineral Aggregate Type 17, as described in the City of Seattle Standard Specifications for Road Bridge and Municipal Construction Section 9-3.10 (Seattle Public Utilities, 2023), or similar free-draining material as approved by the project engineer. Materials used as pipe bedding and cover should be consistent with the material recommended by the pipe manufacturer.

If fill is to be placed during periods of wet weather or under wet conditions, it should have the added requirement that the percentage of fines (material passing the No. 200 sieve based on wet-sieving the minus ¾-inch fraction) be limited to 5%. All fines should be nonplastic.

6 CONSTRUCTION CONSIDERATIONS

We have identified considerations for foundation construction, earthwork, and site erosion control for the project to assist you in developing geotechnical-related plans, and specifications, but not to dictate methods or sequences used by contractors. Prospective contractors should undertake their own independent review and evaluation of all information, data, and recommendations to arrive at decisions concerning the planning of the work; the selection of equipment, means and methods, techniques, and sequences of construction; establishment of safety precautions; and evaluation of the influence of construction on adjacent sites.

6.1 Subgrade Preparation

Subgrade preparation should generally conform to the requirements of the Washington State Department of Transportation (WSDOT) Standard Specifications Section 2.09.3(3)C (WSDOT, 2023). Below the camera platform foundations and areas to receive structural fill, subgrade surfaces should be clear of debris and loose soil. Existing site fill soil should be compacted to 95% of its maximum dry density, as determined by ASTM D1557 (ASTM, 2021). All bearing subgrade surfaces should be evaluated by a qualified geotechnical engineer prior to placing reinforcing steel and concrete.

6.2 Temporary Erosion and Sediment Control

Project drawings should include provisions for temporary erosion and sediment control along with site stormwater management. The plans should incorporate Best Management Practices (BMPs), as identified in the 2021 City of Seattle Stormwater Manual (Seattle public Utilities, 2021). At a minimum, these BMPs should include protection from sediment transport at the boundaries of the site and detention of site stormwater. These BMPs could include installation of a temporary silt fence, straw wattles, and stabilized site access. On-site soil stockpiles should be covered when not actively being worked. Areas of disturbed soil should be stabilized using mulching, planting, or paving as soon as practical from the time of soil disturbance. Stormwater detention could be accomplished in temporary ponds, or in aboveground tanks designed for such purpose. Site erosion and sediment control measures actually implemented by the Contractor should be documented in the project Stormwater Pollution Prevention Plan.

6.3 Wet Weather Earthwork Considerations

In western Washington, wet weather generally begins in October and continues through May, although rainy periods could occur at any time of the year. Earthwork performed during wet weather months could cost more and take longer to complete. While most stormwater is expected to infiltrate into the soil, surface water runoff due to heavy rain may need to be controlled using drainage ditches, sumps, and pumps. Standing water on the ground surface, along with construction activity, could result in disturbance and an unstable surface that could require overexcavation and replacement with clean crushed rock.

The following recommendations are applicable for footings, general excavation, floor slabs, or pavements:

- If there is to be traffic over the exposed subgrade, the subgrade should be protected from disturbance. A lean concrete or gravel pad, about 2 to 3 inches thick, could be placed immediately following excavation on the undisturbed subgrade soil. This could be done, as needed, to protect the exposed soil and act as a working surface. Overexcavation could be needed to accommodate the lean concrete pad.

- The ground surface in the construction area should be sloped and sealed with a smooth-drum roller to promote runoff of precipitation. This will also help promote surface water flow and prevent the ponding of water.
- Work areas should be covered with plastic and/or sloping, ditching, and dewatering methods as needed.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soil and placement and compaction of structural fill can be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. Native soil or fill soil that becomes wet and unstable, and/or too wet to suitably compact, should be removed and replaced with structural fill as described in Section 5.5.
- Excavation and backfill should not occur during periods of heavy, continuous rainfall.

The recommendations above apply for all weather conditions but are most important for wet weather earthwork. They should be incorporated into the contract specifications for excavations, foundations, and pavement construction.

6.4 Temporary and Permanent Soil Slopes

For safe working conditions and prevention of ground loss, excavation slopes and/or shoring should be the responsibility of the Contractor. The Contractor is able to observe the nature and conditions of the subsurface materials encountered and should evaluate the stability of temporary slopes as they are constructed. If instability is observed, slopes should be flattened or shored. All current and applicable safety regulations regarding excavation slopes and shoring should be followed.

For cost estimating and planning purposes only, temporary excavation slopes will likely require slopes of 1.5H:1V, consistent with Occupational Safety and Health Administration (OSHA) Type C soils (OSHA, 2015). Flatter slopes may be required based on the actual conditions encountered, particularly where groundwater is encountered. Materials and equipment should be kept back from the top of site slopes a distance of at least half the slope height. Steeper slopes could be achieved by using temporary and/or permanent retaining walls.

For planning purposes, we recommend permanent slopes consisting of engineered fill be no steeper than 3H:1V. Slopes constructed of uncontrolled fill or cut into existing surficial fill should be no steeper than 4H:1V. Materials and equipment should be kept back from the top of site slopes a distance of at least half the slope height. Steeper slopes could be achieved by using permanent retaining walls or soil reinforcement. If needed, we can provide additional recommendations for design of temporary and permanent retaining walls.

7 CLOSURE

This geotechnical report was prepared for the exclusive use of the University of Washington and their project design team for design of a camera platform an associated utility improvements for the Husky Soccer Stadium in Seattle, Washington. We have prepared the document "Important Information About Your Geotechnical/Environmental Report" to assist you and others in understanding the use and limitations of this geotechnical report. Please read this document to learn how you can lower your risks for this project.

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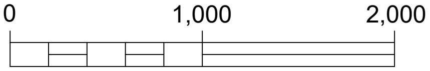

Approximate Scale in Feet

UW Soccer Field Technology Updates
Seattle, Washington

VICINITY MAP

May 2024
113263-001.1

SHANNON & WILSON, INC.

FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\113263\001.1\113263-001.1 Vicinity Map.dwg Date: 05-29-2024 Login: JRS

© 2024 Microsoft Corporation © 2024 Maxar ©CNES (2024) Distribution Airbus DS © 2024 TMAP MOBILITY Earthstar Geographics SIO

LEGEND

CPT-1 ⊕ Boring Designation and Approximate Location

0 80 160

Scale in Feet

UW Soccer Field Technology Updates
Seattle, Washington

SITE AND EXPLORATION PLAN

May 2024 113263-001.1

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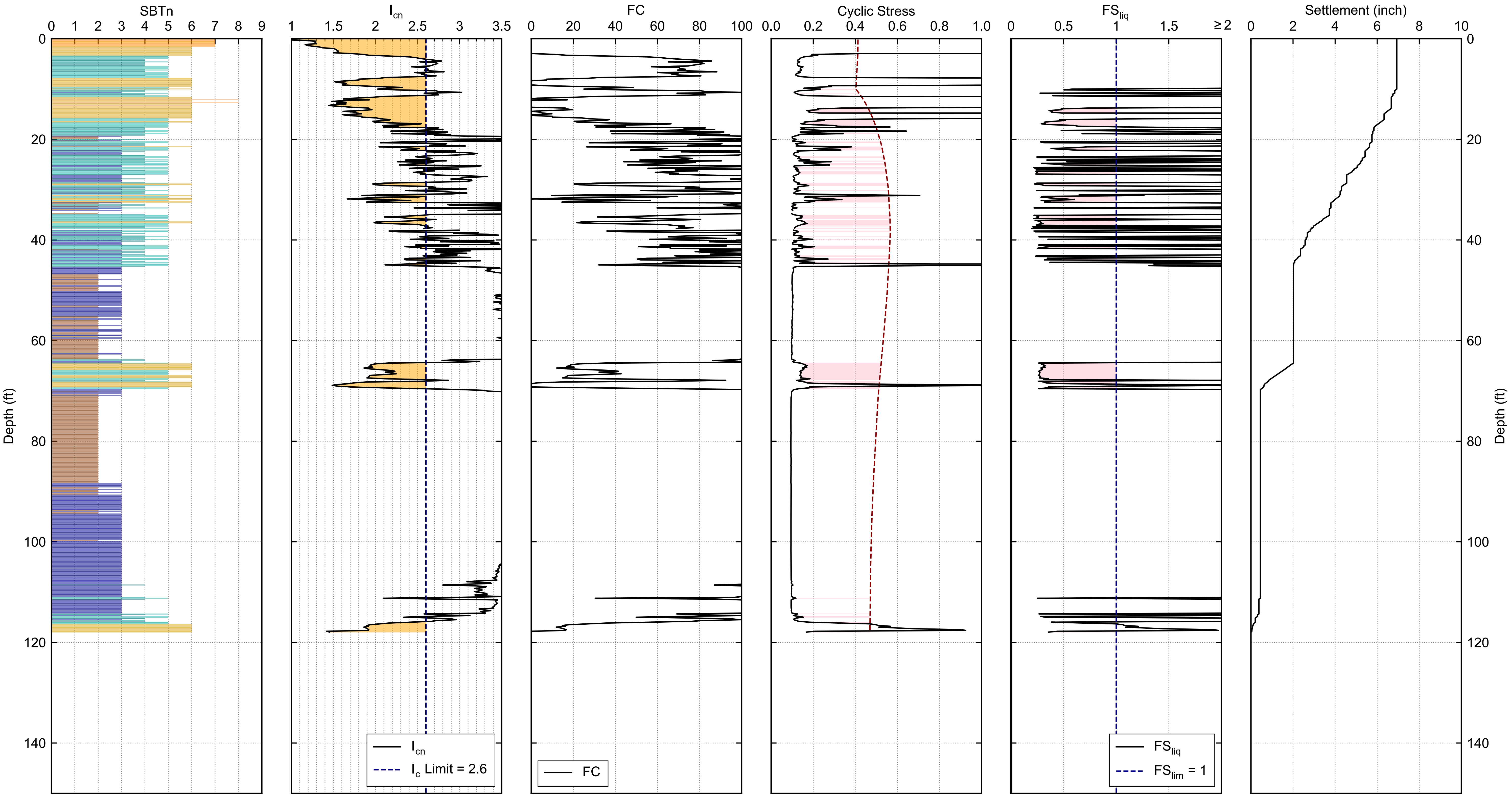
FIG. 2

FIG. 2

ver:0.18.1, by:NLP



Notes:
1. We performed the analyses based on the procedures of Boulanger and Idriss (2014), Idriss and Boulanger (2008), Idriss and Boulanger (2015).
2. SBTn = Normalized soil behavior type; I_{cn} = Soil behavior index; FC = Fines content; CSR = Cyclic stress ratio; CRR = Corrected cyclic resistance ratio; FS_{liq} = Factor of safety against liquefaction; Settlement = Settlement; FC_{lim} = Maximum fines content for liquefaction; FS_{lim} = Maximum FS to consider liquefaction effects
3. Soil behavior types: 1 = Sensitive, fine grained; 2 = Organic soils – clay; 3 = Clays – silty clay to clay; 4 = Silt mixtures – clayey silt to silty clay; 5 = Sand mixtures – silty sand to sandy silt; 6 = Sands – clean sand to silty sand; 7 = Gravelly sand to dense sand; 8 = Very stiff sand to clayey sand; 9 = Very stiff, fine grained
4. ft = feet

c:\Users\NLP\Desktop\UW CPT Plotting\Python

UW Soccer Field
Technology Updates

CPT LIQUEFACTION ANALYSIS
CPT-01A
M=7.12, PGA= 0.635

June 2024 113263-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3

APPENDIX A: SUBSURFACE EXPLORATIONS

Appendix A

Subsurface Explorations

CONTENTS

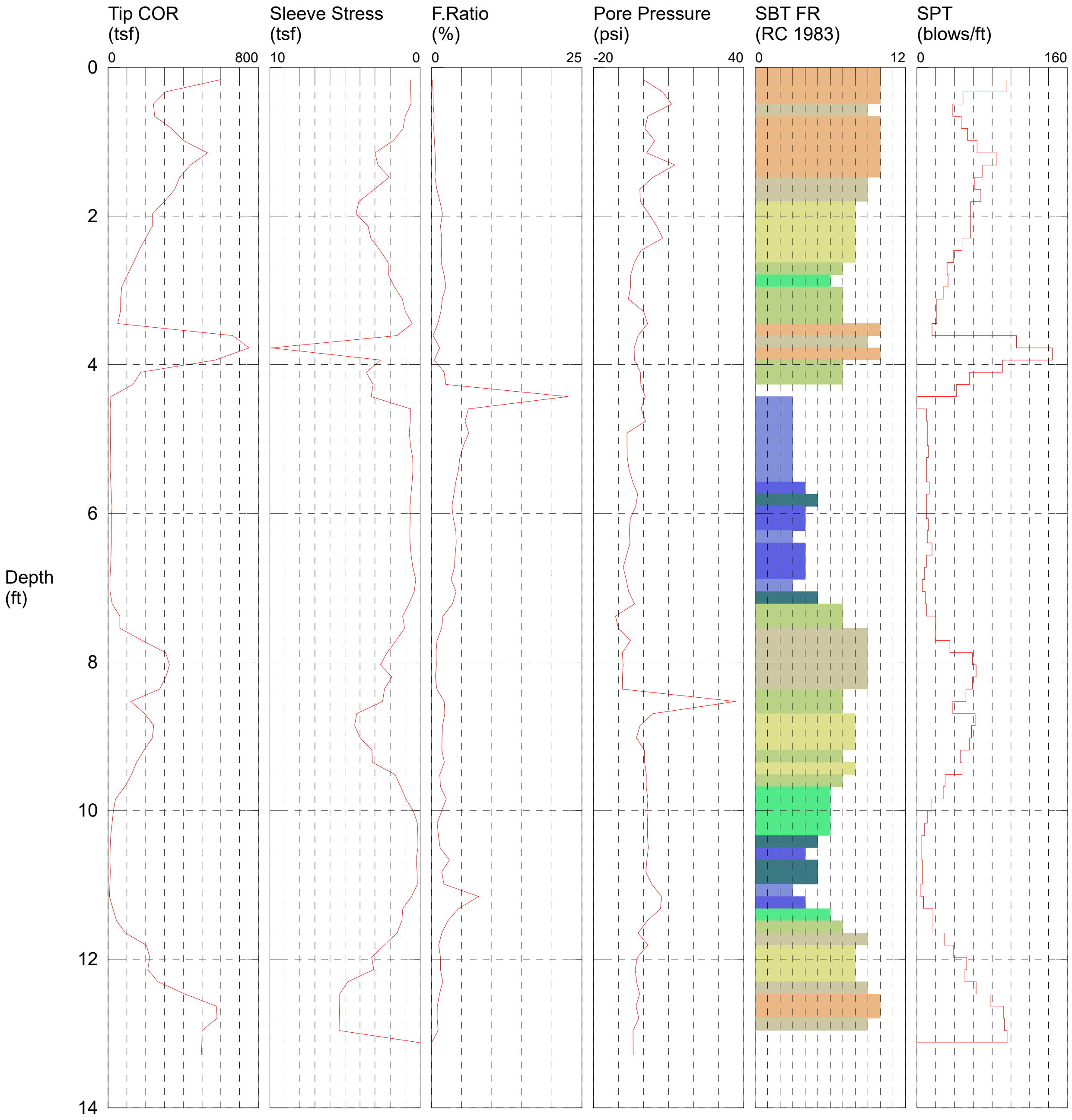
CONE PENETROMETER TESTS

Two cone penetrometer test (CPT) soundings were performed to characterize subsurface conditions near the proposed camera platform. The CPT method consists of pushing an instrumented cone into the ground at a constant rate to obtain measurements of tip resistance, side friction resistance, and pore water pressure. Additional measurements of shear wave velocity were performed at 1-meter intervals over the depth of the soundings. Pore pressure dissipation tests were performed in cohesive soil layers to characterize groundwater conditions where pore pressure increases due to soil behavior. The data can be used to estimate soil properties for use in engineering studies. The CPT locations are shown in Figure 2, after the main text of the report. The CPTs were performed by In-Situ Engineering (In-Situ), of Snohomish, Washington, using a truck-mounted CPT rig. Figures A-1 and A-2, prepared by In-Situ, present the results of the CPT soundings.

CPT-01

CPT Contractor: In SItu Engineering
CUSTOMER: Shanon & Wilson
LOCATION: Seattle
JOB NUMBER: 113263-001
NOTE: Refused due to inclination

OPERATOR: Forinash/Okbay
CONE ID: DDG1351
TEST DATE: 5/7/2024 9:32:45 AM
PREDRILL: 0 ft
BACKFILL: 20% Bentonite slurry & Chips
SURFACE PATCH: Cold Patch



TOTAL DEPTH: 13.287 ft

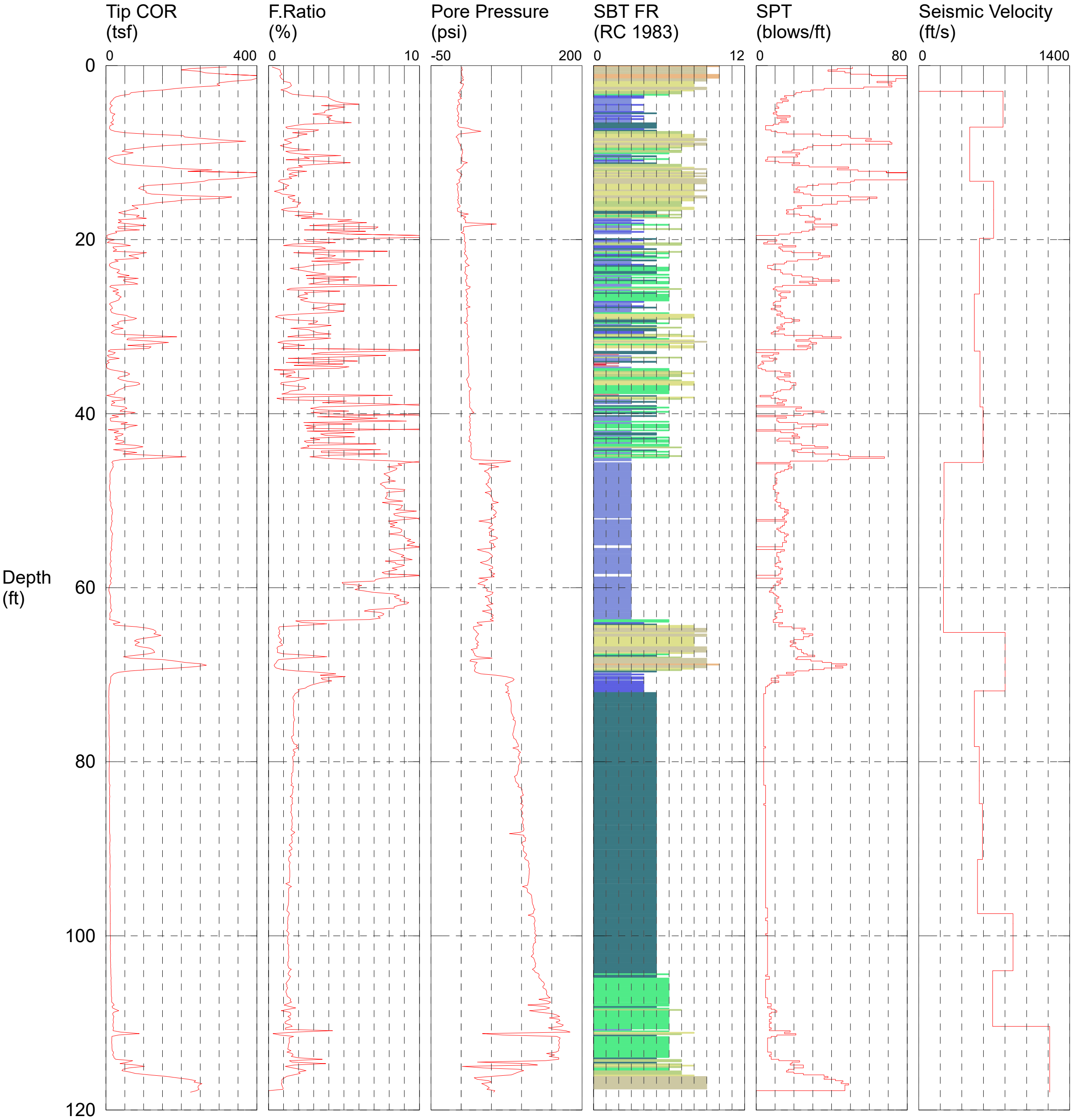
■ 1 sensitive fine grained
■ 2 organic material
■ 3 clay
■ 4 silty clay to clay
■ 5 clayey silt to silty clay
■ 6 sandy silt to clayey silt
■ 7 silty sand to sandy silt
■ 8 sand to silty sand
■ 9 sand
■ 10 gravelly sand to sand
■ 11 very stiff fine grained (*)
■ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT-01A

CPT Contractor: In SItu Engineering
CUSTOMER: Shanon & Wilson
LOCATION: Seattle
JOB NUMBER: 113263-001

OPERATOR: Forinash/Okbay
CONE ID: DDG1351
TEST DATE: 5/7/2024 10:07:11 AM
PREDRILL: 0 ft
BACKFILL: 20% Bentonite slurry & Chips
SURFACE PATCH: Cold Patch



TOTAL DEPTH: 117.946 ft

🟥 1 sensitive fine grained
🟥 2 organic material
🟦 3 clay
🟦 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
🟫 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Appendix B

Historic Subsurface Explorations

CONTENTS

LEGEND

S-1 ● Settlement Point Designation and Location

B+ A+ 8.00" I-4 Inclinometer Designation and Approximate Location

A+ A-Axis Direction

B+ B-Axis Direction

Direction & Magnitude of Resultant Cumulative Movement

A A' Generalized Subsurface Profile (See Figure 2)

NOTE

Results for inclinometers are cumulative through June 2010 due to cessation of monitoring.

Montlake Landfill Long-Term
Movement Study - University of Washington
Seattle, Washington

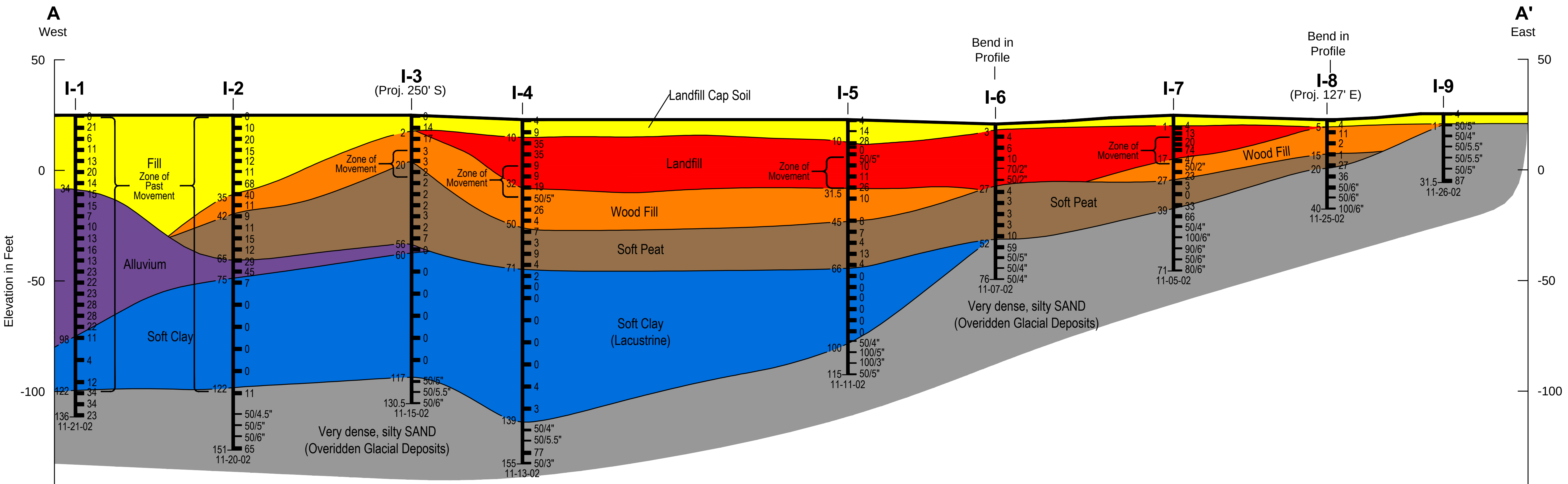
SITE AND EXPLORATION PLAN

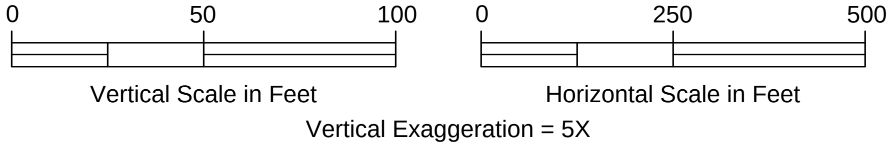
December 2012
21-1-09694-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1

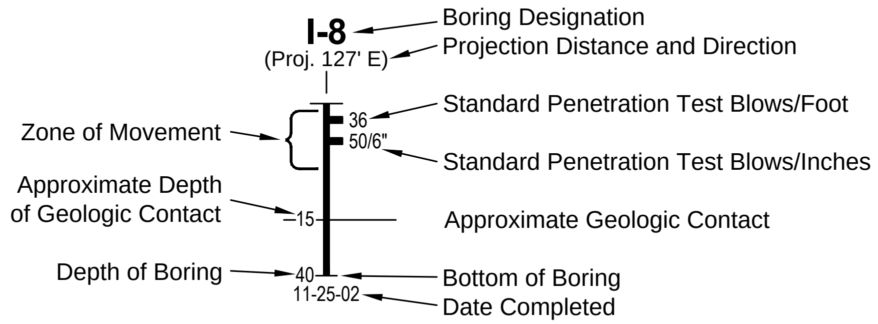
File: J:\211\09694-005\21-1-09694-005 Fig 1.dwg Date: 12-13-2012 Author: bac





Vertical Exaggeration = 5X

LEGEND



GEOLOGIC LEGEND

🟨 Landfill Soil Cap / or Fill

🟥 Landfill

🟧 Wood Fill

🟫 Peat

🟪 Alluvium

🟦 Soft Clay

⬜ Glacial Deposits

NOTE

This subsurface profile is generalized from materials observed in soil borings. Variations may exist between profile and actual conditions.

Montlake Landfill Long-Term
Movement Study - University of Washington
Seattle, Washington

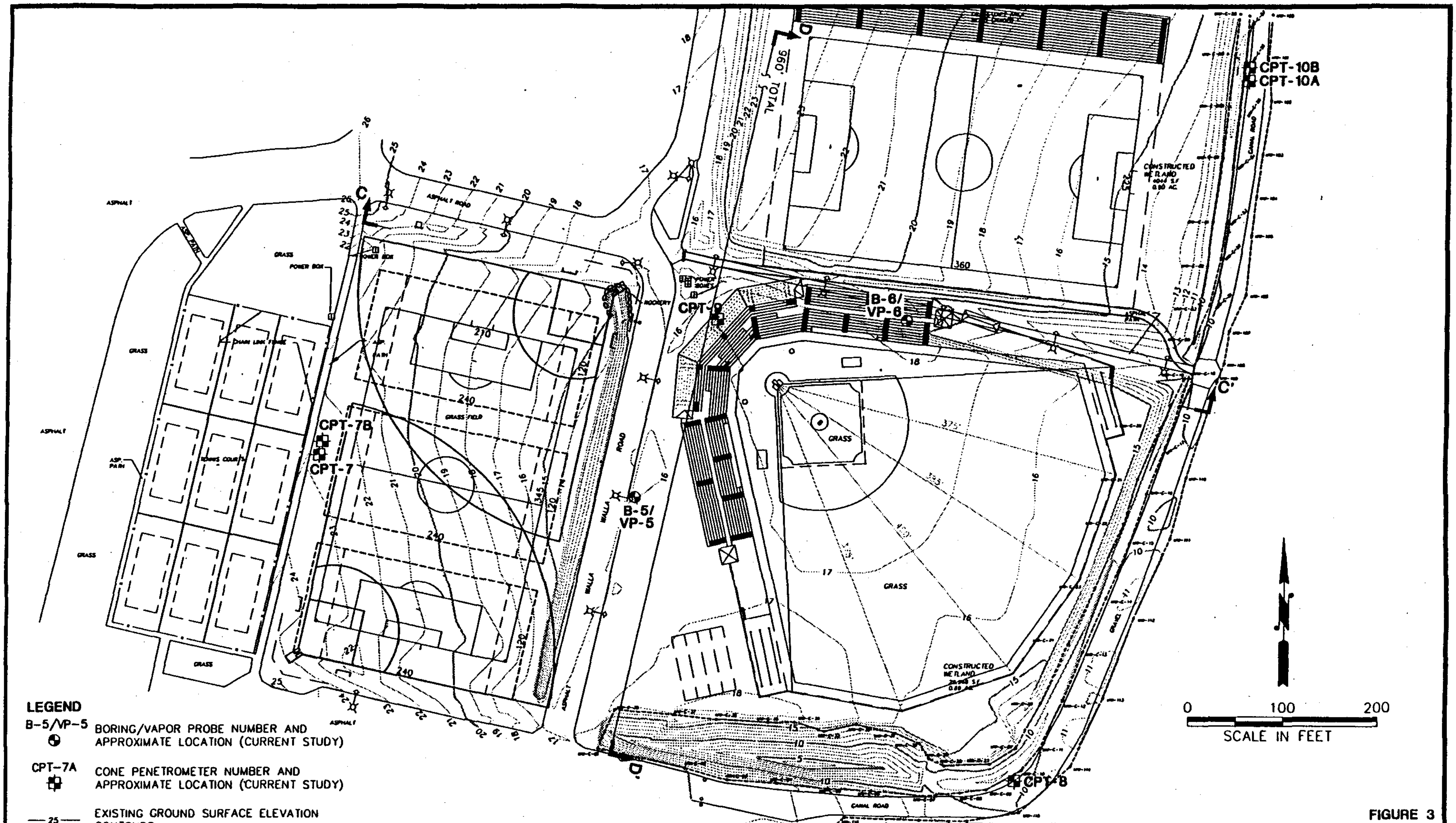
GENERALIZED SUBSURFACE PROFILE A-A'

December 2012
21-1-09694-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2

File: J:\211\09694-005\21-1-09694-005 Fig 2.dwg Date: 12-13-2012 Author: bac



LEGEND

B-5/VP-5 ● BORING/VAPOR PROBE NUMBER AND APPROXIMATE LOCATION (CURRENT STUDY)

CPT-7A ⊞ CONE PENETROMETER NUMBER AND APPROXIMATE LOCATION (CURRENT STUDY)

—25— EXISTING GROUND SURFACE ELEVATION CONTOURS

D D' DESIGNATION AND APPROXIMATE LIMITS OF GEOLOGIC CROSS SECTION

FIGURE 3

AGRA
Earth & Environmental
11335 N.E. 122nd Way, Suite 100
Kirkland, WA, U.S.A. 98034-6918

W.O.	6-914-10758
DESIGN	KSS
DRAWN	BDT
DATE	APR 1996
SCALE	1"=100'

ICA SOCCER & BASEBALL FIELD DEVELOPMENT (SOUTH SITE)
UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON

SITE & EXPLORATION PLAN

AGRA EARTH & ENVIRONMENTAL, INC. DRAWING NO. \01\10758\S SITE DWG

University of Washington

PROJECT: ICA Soccer & Baseball Field Development W.O. 6-914-107580 BORING NO. B-6

Page 1 of 5

DEPTH (feet) | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | GROUND WATER

Location: Third base grandstands

Approximate ground surface elevation: 18 feet

0

Medium dense, moist, gray/brown, gravelly SAND (Fill)

S-1

5

3/1/96

S-2

G-1

Medium dense, wet, gray, gravelly, silty SAND with trace gravel (Fill)

S-3

10

Becomes loose

ATD

S-4

15

Soft, moist, blue/gray, fine sandy SILT (Fill)

S-5

S-6

Loose, wet, gray, gravelly SAND

20

Becomes medium dense, some brick fragments (Fill)

S-7

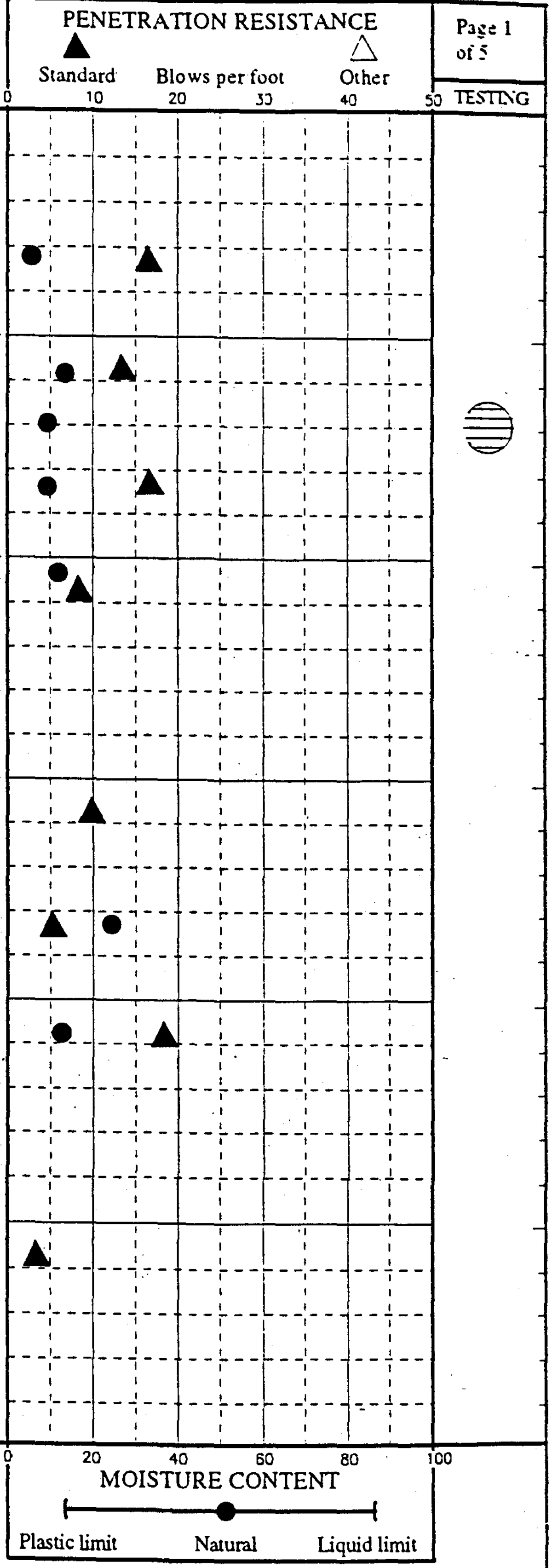
Loose, saturated, gray/black, silty SAND with glass and wood debris (Refuse) (150% LEL at top of auger)

25

S-8

30

(continued)



LEGEND

- 2.00-inch OD split-spoon sample
- 3.00-inch OD split-spoon sample
- 3.00-inch OD Shelby tube sample
- Sample not recovered
- Grab sample
- Groundwater level at time of drilling (ATD)
- 3.00-inch OD split-spoon sample with 140 lbs hammer
- Grain size analysis
- Unconfined Compresive Strength test

AGRA
Earth & Environmental
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

AGRA Earth and Environmental, Inc.

Drilling method: HSA/ Casing Advancer Hammer type: Automatic Date drilled: 01 March 1996 Logged by: KSS

University of Washington

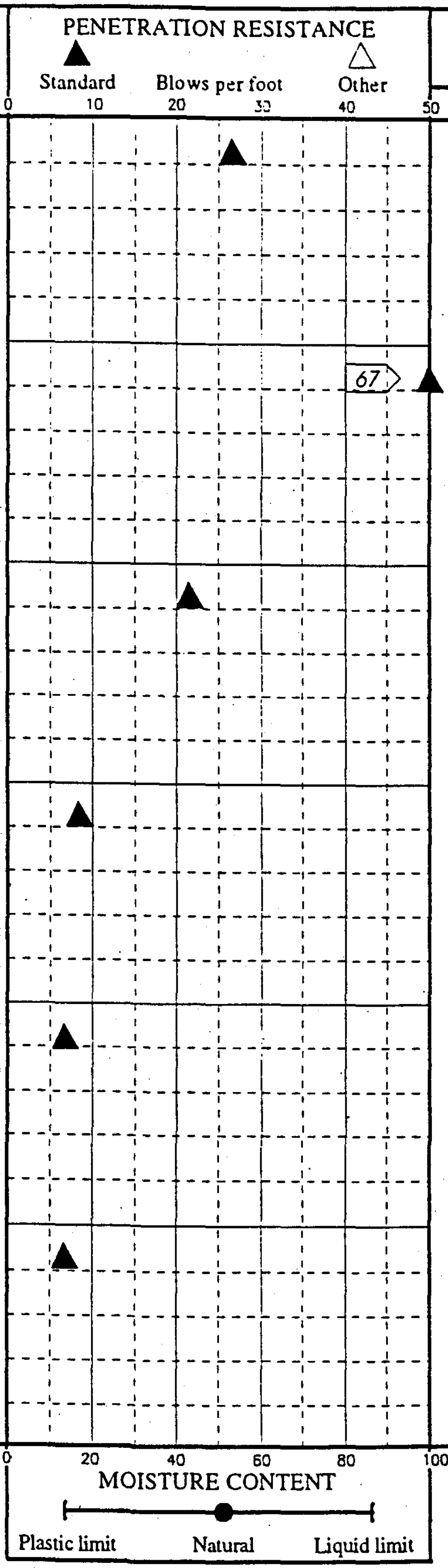
PROJECT: ICA Soccer & Baseball Field Development W.O. 6-914-107580 BORING NO. B-6

Page 2 of 5

Location: Third base grandstands -

Approximate ground surface elevation: 18 feet

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER
30	Becomes dense, gravelly, asphalt fragments (Refuse) (26% LEL at top of auger)	I	S-9	
35	Wood (sampled piece of timber/lumber)	I	S-10	
40	Medium dense, saturated, gray, silty, fine SAND	I	S-11	
45	(80 % LEL at top of auger)	X	S-12	
	Very loose, saturated, black, silty SAND with wood, metal and fabric debris (Refuse)			
50	(79% LEL at top of auger)	I	S-13	
55	Includes paper, very little soil (Refuse) (95% LEL at top of auger)	I	S-14	
60	(continued)			



TESTING

LEGEND

- I 2.00-inch OD split-spoon sample
- II 3.00-inch OD split-spoon sample
- II 3.00-inch OD Shelby tube sample
- X Sample not recovered
- Grab sample
- ATD Groundwater level at time of drilling
- △ 3.00-inch OD split-spoon sample with 140 lbs hammer
- Grain size analysis
- Unconfined Compresive Strength test

AGRA
Earth & Environmental
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling method: HSA/ Casing Advancer Hammer type: Automatic Date drilled: 01 March 1996 Logged by: KSS

University of Washington

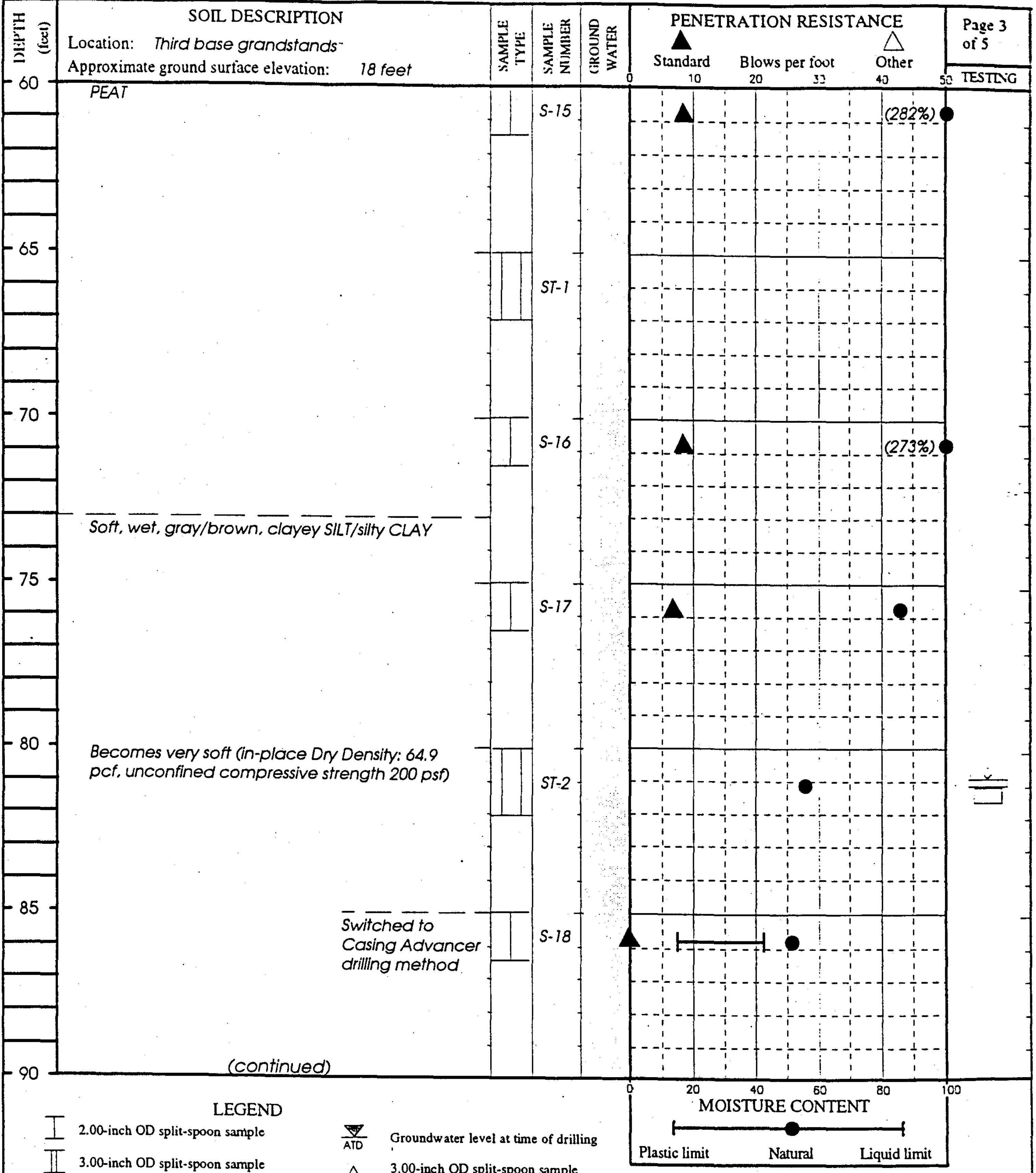
PROJECT: ICA Soccer & Baseball Field Development W.O. 6-914-107580 BORING NO. B-6

Page 3 of 5

SOIL DESCRIPTION

Location: Third base grandstands

Approximate ground surface elevation: 18 feet



PEAT

Soft, wet, gray/brown, clayey SILT/silty CLAY

Becomes very soft (in-place Dry Density: 64.9 pcf, unconfined compressive strength 200 psf)

Switched to Casing Advancer drilling method

(continued)

LEGEND

- 2.00-inch OD split-spoon sample
- 3.00-inch OD split-spoon sample
- 3.00-inch OD Shelby tube sample
- × Sample not recovered
- Grab sample
- ▽ ATD Groundwater level at time of drilling
- △ 3.00-inch OD split-spoon sample with 140 lbs hammer
- Grain size analysis
- Unconfined Compresive Strength test

AGRA Earth & Environmental

11335 NE 122nd Way, Suite 100

Kirkland, Washington 98034-6918

Drilling method: HSA/ Casing Advancer

Hammer type: Automatic

Date drilled: 01 March 1996

Logged by: KSS

AGRA Earth and Environmental, Inc.

University of Washington

PROJECT: ICA Soccer & Baseball Field Development W.O. 6-914-107580 BORING NO. B-6

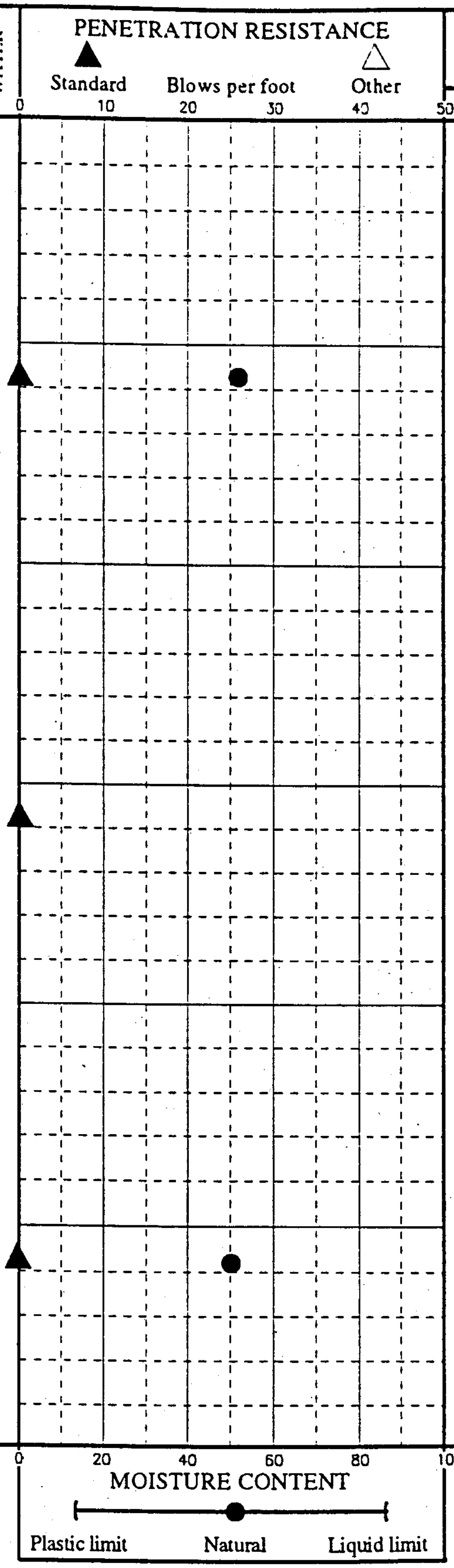
Page 4 of 5

SOIL DESCRIPTION

Location: Third base grandstands

Approximate ground surface elevation: 18 feet

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	TESTING
90	Clayey SILT/silty CLAY (as above)				
95		I	S-19		
100					
105		I	S-20		
110					
115		I	S-21		
120	(continued)				



LEGEND

- I 2.00-inch OD split-spoon sample
- II 3.00-inch OD split-spoon sample
- II 3.00-inch OD Shelby tube sample
- X Sample not recovered
- Grab sample
- ▽ ATD Groundwater level at time of drilling
- △ 3.00-inch OD split-spoon sample with 140 lbs hammer
- Grain size analysis
- Unconfined Compresive Strength test

AGRA
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11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

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Drilling method: HSA/ Casing Advancer Hammer type: Automatic Date drilled: 01 March 1996 Logged by: KSS

University of Washington

PROJECT: ICA Soccer & Baseball Field Development W.O. 6-914-107580 BORING NO. B-6

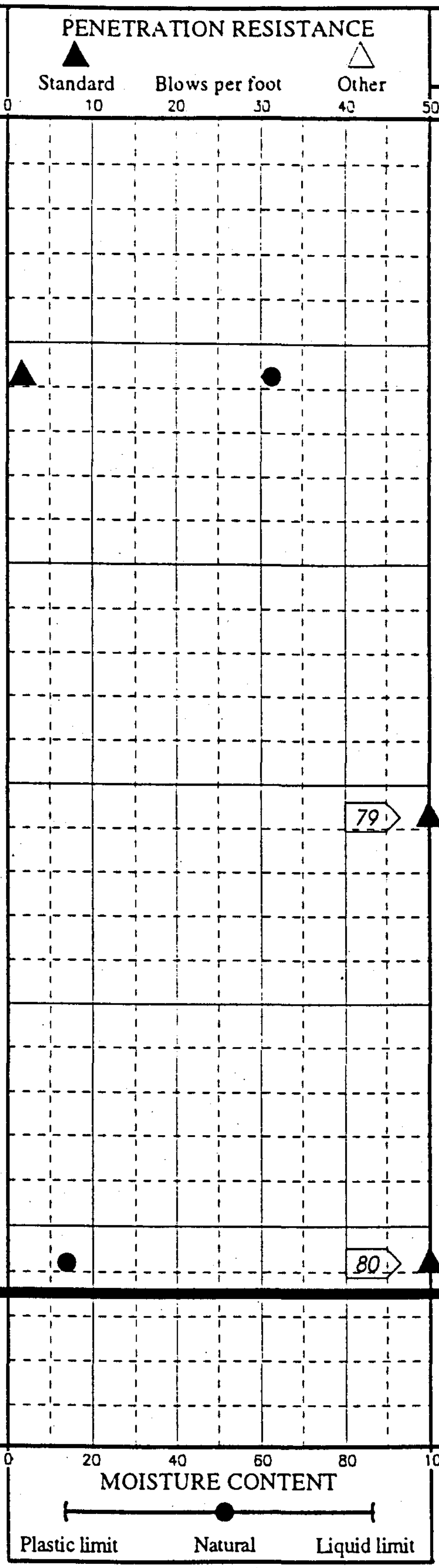
Page 5 of 5

SOIL DESCRIPTION

Location: Third base grandstands

Approximate ground surface elevation: 18 feet

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	TESTING
120	Clayey SILT/silty CLAY (as above)				
125	Thin sand layer at 125.5 feet		S-22		
130					
135	Very dense, saturated, gray SAND with trace to some silt		S-23		
140					
145			S-24		
	Boring terminated at approximately 146.5 feet				
150					



LEGEND

2.00-inch OD split-spoon sample

3.00-inch OD split-spoon sample

3.00-inch OD Shelby tube sample

✕ Sample not recovered

Grab sample

ATD Groundwater level at time of drilling

△ 3.00-inch OD split-spoon sample with 140 lbs hammer

Grain size analysis

Unconfined Compresive Strength test

AGRA
Earth & Environmental
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

AGRA Earth and Environmental, Inc.

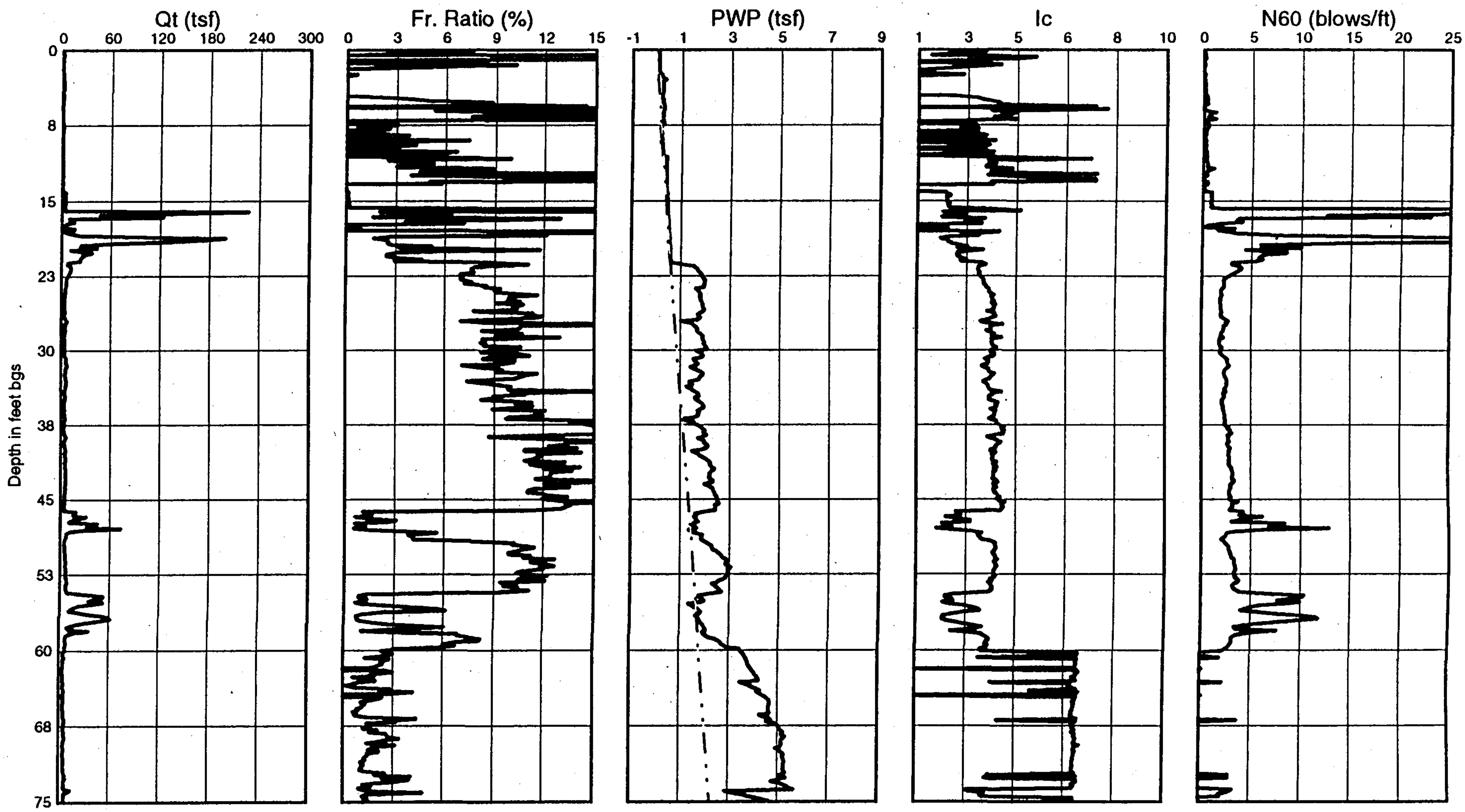
Drilling method: HSA/-Casing Advancer Hammer type: Automatic Date drilled: 01 March 1996 Logged by: KSS

Cone Penetration Test - CPT-10B

Test Date : Mar 02, 1996
Location : ICA Soccer & Baseball Field Development

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 2.50



Qt normalized for
unequal end area effects

Fr Ratio = 100*F/(Qt-Sigmav)
Gamma = 120.3 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silty clay
2.82 <Ic < 3.22 - Clays

After Jefferies and Davies (1993)

PROJECT NO. 6-914-10758-0 DATE: March 5, 1996 DRAWN BY: Keith Brown

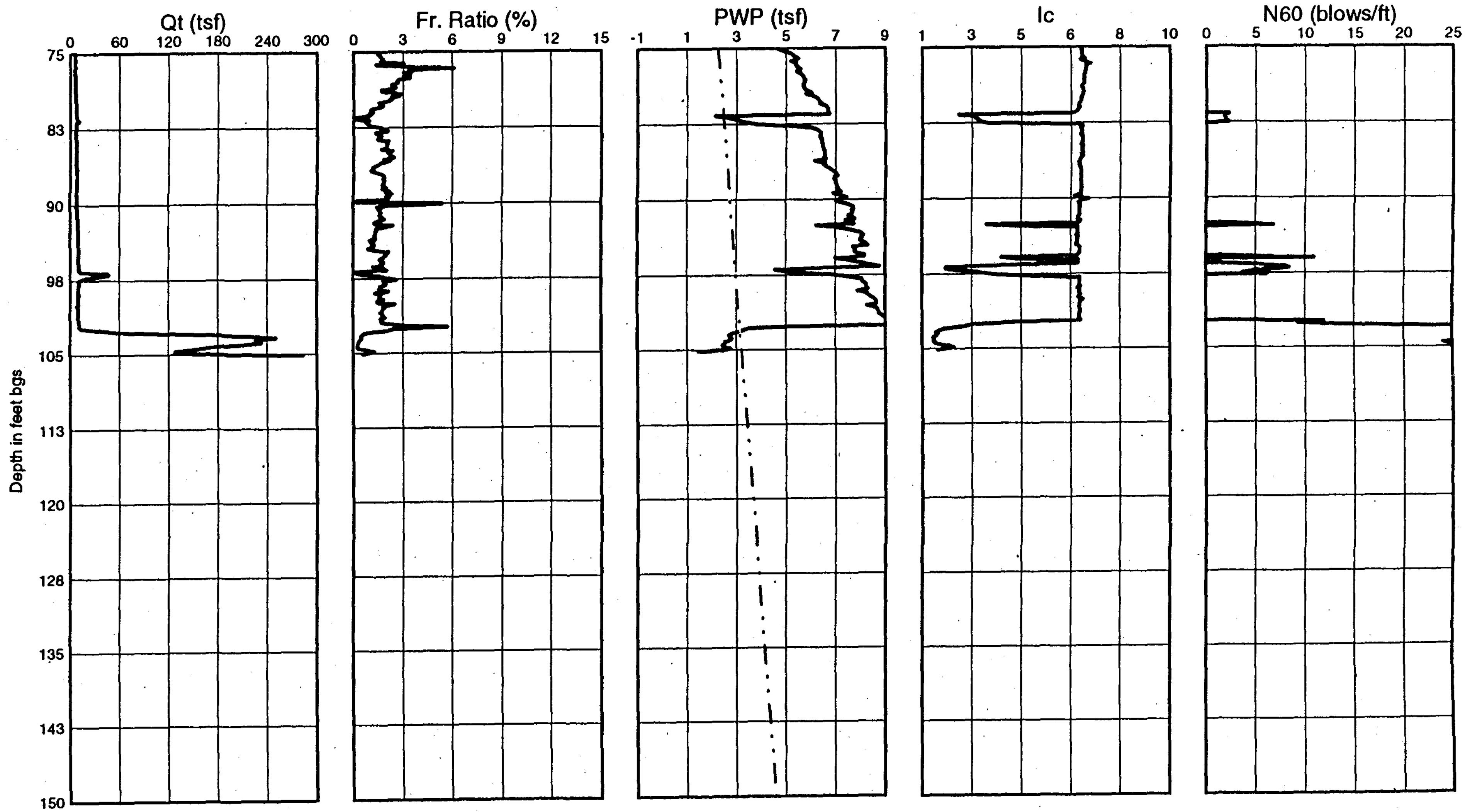
AGRA E & E, Inc.

Cone Penetration Test - CPT-10B

Test Date : Mar 02, 1996
Location : ICA Soccer & Baseball Field Development

Operator : Northwest Cone Exploration

Ground Surf. Elev. : 0.00
Water Table Depth : 2.50



Qt normalized for
unequal end area effects

Fr Ratio = 100*F/(Qt-Sigmav)
Gamma = 120.3 pcf

After Jefferies and Davies (1991)
Ic < 1.25 - Gravelly sands
1.25 <Ic < 1.90 - Clean to silty sand
1.90 <Ic < 2.54 - Silty sand to sandy silt
2.54 <Ic < 2.82 - Clayey silt to silty clay
2.82 <Ic < 3.22 - Clays

After Jefferies and Davies (1993)

PROJECT NO. 6-914-10758-0 DATE: March 5, 1996 DRAWN BY: Keith Brown **AGRA E & E, Inc.**

Appendix C

Site-Specific Site Response Analysis

UW Soccer Field Technology Updates

CONTENTS

Exhibits

Figures

C.1 INTRODUCTION

This appendix details the procedure we used to perform the site-specific site response analysis for the University of Washington (UW) Soccer Field Technology Updates Project (project). Our analyses followed the procedures provided in the 2021 International Building Code (IBC) (International Code Council, Inc., 2020) that serves as the design basis for the project. For the seismic design ground motions, the 2021 IBC has adopted American Society of Civil Engineers (ASCE) 7-16, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures" (ASCE, 2017).

Based on available subsurface exploration and laboratory testing data and the results of our cone penetration test (CPT)-based liquefaction hazard analyses, the shallow subsurface conditions at the site include liquefiable soils. Also, the presence of the soft/organic clay for more than 10 feet in the available borings characterizes the soil conditions as Site Class F per ASCE 7-16; therefore, a site-specific site response analysis is required by ASCE 7-16. Appendices A and B present the available CPT log and historic boring logs for the project, respectively.

Our site-specific site response analysis was performed in accordance with ASCE 7-16, Chapter 21. We performed one-dimensional (1D) site response analysis to evaluate the seismic hazard and calculate the design ground motions at the site. 1D site response analysis models a horizontally layered column of soil. An input motion is applied at the base of the column and the vertical wave propagation is computed based on models that approximate the soil's response to cyclic loading. As such, the inputs for our site-specific site response analysis include the input base motions and the soil model types and input parameters.

The following sections describe the development of the input base motions, the input parameters, and results of our site-specific site response analysis.

C.2 INPUT BASE MOTIONS

We developed our input base motion time histories based on the guidance provided in ASCE 7-16, Section 21.1.1. To develop the input base motions for our site-specific site response analysis we:

- Evaluated the site conditions at the base of the model.
- Developed a risk-targeted maximum considered earthquake (MCE_R) response spectrum that is consistent with the site conditions at the base of our model.

- Selected time histories that were consistent with the seismic hazard at our site and scaled them so that the response spectrum of our selected motion suite was, on average, consistent with the MCE$_R$ spectrum.

Each of these tasks are described in the following subsections.

C.2.1 Base Site Conditions

Shear wave velocity (V_S) measurement was performed at one CPT location at the project site. The measured V_S profile at CPT-01A is shown in Appendix A. The measurement was performed for approximately 118 feet below ground surface. Based on our evaluation of the available V_S data, the site conditions at the base of the profile corresponds to Site Class C and D boundary. Per ASCE 7-16, Chapter 20, Site Class C/D boundary conditions corresponds to a time-averaged V_S for the upper 100 feet below base of the soil profile (i.e., V_{S30}) of 1,200 feet per second (fps). We calculated the base motion MCE$_R$ response spectrum using the average V_{S30} for Site Class C/D boundary conditions (i.e., 1,200 fps).

C.2.2 Risk-Targeted Maximum Considered Earthquake (MCE$_R$) for Base of Soil Profile

Following ASCE 7-16, Section 21.1, the base MCE$_R$ spectrum was used as a target spectrum to develop input time histories needed for site-specific site response analysis. The base MCE$_R$ spectrum was developed for the soil base profile as a lesser of probabilistic MCE$_R$ and deterministic MCE$_R$ per ASCE 7-16, Section 21.2. We obtained the probabilistic MCE$_R$ spectral acceleration values as the mean uniform hazard spectrum consistent with 5% damping, a 2,475-year return period (2% probability of exceedance in 50 years), and V_{S30}=1,200 fps conditions using the 2018 U.S. Geological Survey (USGS) National Seismic Hazard Model (NSHM) (Petersen and others, 2020) for site location at 47.656°N and 122.298°W. We applied risk coefficients consistent with 1% probability of collapse in 50 years (in correspondence with ASCE 7-16, Section 21.2.1.1) and maximum direction (directionality) adjustments obtained from Shahi and Baker (2014). The MCE$_R$ deterministic was calculated as maximum direction 84th percentile deterministic spectrum at the project site considering minimum deterministic spectrum specified in ASCE 7-16, Supplement 3, Section 21.2.2.

Based on our discussions with the structural design team, we understand that the fundamental period of the proposed structure was estimated 0.29 sec (seconds), and the period range of interest for the structure was determined between 0.05 and 0.58 sec per ASCE 7-16, Section 16.2.3.1. The near-fault effects are insignificant for this period range of interest (periods less than 0.75 sec structures [Abrahamson, 2000]); therefore, no adjustment was made for directivity effects on target spectrum.

The project site is within Puget Lowland (PL) basin area and basin effects would be significant for target spectrum. The PL basin effects are incorporated in the 2018 USGS NSHM; therefore, no further adjustment was made for basin effects on target spectrum.

The probabilistic MCE_R, deterministic MCE_R, and target MCE_R spectra are plotted in Figure C-1 and tabulated in Exhibit C-1. As observed from Figure C-1 and Exhibit C-1, the deterministic MCE_R is controlling MCE_R (i.e., is lower than the probabilistic MCE_R) for periods less than 0.25 sec. Above 0.25 sec, the selected MCE_R is controlled by the probabilistic MCE_R.

Exhibit C-1: Probabilistic MCE_R, Deterministic MCE_R, and Target MCE_R Spectra

Period (sec)	Probabilistic MCE_R	Deterministic MCE_R	Target MCE_R
0.01	0.76	0.73	0.73
0.02	0.78	0.73	0.73
0.03	0.83	0.79	0.79
0.05	0.97	0.90	0.90
0.075	1.23	1.11	1.11
0.1	1.53	1.36	1.36
0.15	1.80	1.62	1.62
0.2	1.88	1.73	1.73
0.25	1.80	1.80	1.80
0.3	1.71	1.80	1.71
0.4	1.51	1.68	1.51
0.5	1.30	1.52	1.30
0.75	1.14	1.30	1.14
1	1.04	1.20	1.04
1.5	0.71	0.84	0.71
2	0.53	0.67	0.53
3	0.34	0.46	0.34
4	0.25	0.38	0.25
5	0.20	0.31	0.20
7.5	0.13	0.23	0.13
10	0.096	0.18	0.096

NOTE:
Spectra in this table are acceleration response values in standard acceleration gravity.

C.2.3 Development of Time Histories

We developed a suite of five input time histories at the base of the soil profile that were representative of the seismic hazards and source characteristics of the site and, when scaled, produced an average response spectrum that was consistent with the target MCE_R spectrum described previously. The following subsections describe our time history development procedure, including the seismic source characteristics of the site, time history selection, and time history scaling.

C.2.3.1 Distribution of Time Histories in Suite of Ground Motions

We used the deaggregation data that were obtained from the 2018 USGS NSHM to evaluate the number of the time histories from each seismic source to include in the base input time history suite. The deaggregation results indicate that multiple earthquake sources are significant contributors to the ground motion hazards. The three primary earthquake hazard sources include the following: (1) shallow crustal earthquakes such as the Seattle Fault Zone that occur within the upper 0 to 20 miles of the continental crust, (2) the Cascadia Subduction Zone (CSZ) interface near the top of the diving oceanic slab, located approximately 20 to 40 miles deep, and (3) earthquakes that occur deeper than 40 miles within the subducting oceanic plate, also called CSZ intraslab earthquakes (Petersen and others, 2020).

The seismic hazard contributions from these three seismic sources within the period range of interest for the base MCE_R is tabulated in Exhibit C-2. The mean magnitude and source-to-site distance for each source type needed for time history development are also provided in this exhibit.

Exhibit C-2: Mean M_W, Mean R_{rup}, Mean ε_o, and Hazard Contributions

Period (sec)	Source	Crustal	CSZ Interface	CSZ Intraslab	Source Types Together
0 (i.e., PGA)	M_W	6.5	9.0	7.0	7.1
	R_{rup} (km)	10.4	105.8	65.6	53.1
	ε_o	1.23	1.57	1.58	1.46
	Contribution	0.33	0.14	0.53	1.00
0.05	M_W	6.4	9.0	7.0	7.0
	R_{rup} (km)	10.8	104.5	65.8	50.9
	ε_o	1.29	1.73	1.58	1.50
	Contribution	0.33	0.08	0.59	1.00

Period (sec)	Source	Crustal	CSZ Interface	CSZ Intraslab	Source Types Together
0.075	M_W	6.4	9.0	7.0	6.9
	R_{rup} (km)	11.1	104.9	66.0	51.6
	ε_0	1.35	1.73	1.60	1.53
	Contribution	0.32	0.08	0.60	1.00
0.1	M_W	6.4	9.0	7.0	7.0
	R_{rup} (km)	11.0	105.7	66.3	55.0
	ε_0	1.42	1.71	1.60	1.56
	Contribution	0.27	0.09	0.65	1.00
0.15	M_W	6.4	9.0	7.0	7.0
	R_{rup} (km)	11.1	106.4	66.1	55.3
	ε_0	1.41	1.61	1.58	1.54
	Contribution	0.27	0.11	0.62	1.00
0.2	M_W	6.5	9.0	7.0	7.1
	R_{rup} (km)	11.3	106.2	66.2	53.7
	ε_0	1.33	1.59	1.58	1.50
	Contribution	0.31	0.11	0.58	1.00
0.25	M_W	6.5	9.0	7.0	7.1
	R_{rup} (km)	11.6	105.7	66.0	50.1
	ε_0	1.24	1.55	1.61	1.46
	Contribution	0.38	0.13	0.49	1.00
0.3	M_W	6.6	9.0	7.0	7.1
	R_{rup} (km)	11.8	105.6	65.6	47.2
	ε_0	1.18	1.54	1.64	1.42
	Contribution	0.44	0.14	0.42	1.00
0.4	M_W	6.7	9.0	7.1	7.2
	R_{rup} (km)	12.2	105.6	65.5	44.6
	ε_0	1.11	1.56	1.68	1.37
	Contribution	0.51	0.15	0.34	1.00
0.5	M_W	6.7	9.0	7.1	7.2
	R_{rup} (km)	12.6	105.6	65.2	42.2
	ε_0	1.06	1.54	1.73	1.31
	Contribution	0.57	0.17	0.26	1.00

Period (sec)	Source	Crustal	CSZ Interface	CSZ Intraslab	Source Types Together
0.75	M_W	6.8	9.0	7.1	7.6
	R_{rup} (km)	12.6	107.0	65.4	54.3
	ε_o	1.09	1.35	1.75	1.32
	Contribution	0.46	0.32	0.22	1.00

NOTES:

1 Crustal sources hazard contribution is a total contribution from individual faults and crustal background sources.

2 Sum of the hazard contributions at each period from three seismic source types may not be exactly 1.00 due to rounding off the numbers.

ε_o = number of standard deviations below (negative) or above (positive) median ground motion
km = kilometers; M_W = moment magnitude; PGA = peak ground acceleration; R_{rup} = source-to-site rupture distance

Note that the hazard contribution, mean magnitude, and source-to-site distance vary with the period. Based on the hazard contributions provided in Exhibit C-2, the five time histories in the suite were distributed among the seismic sources as shown in Exhibit C-3.

Exhibit C-3: Number of Time Histories Selected for Seismic Sources

Period Range of Interest (sec)	Crustal	CSZ Interface	CSZ Intraslab
0.05 - 0.58	2	1	2

C.2.3.2 Selection of Time Histories

Candidate reference time histories (i.e., seed motions) were selected to be consistent with the magnitude, distance, site conditions, acceleration response spectrum shape, and tectonic regime of the seismic sources that were identified by the deaggregation data in the period range of interest. The mean magnitude, distance, and epsilon values are period-dependent and obtained from the 2018 USGS NSHM and are provided in Exhibit C-2.

We reviewed the NGA-West2 project web portal for candidate crustal earthquake time histories (https://ngawest2.berkeley.edu) and the NHR3 project web portal for subduction time histories (https://www.risksciences.ucla.edu/nhr3/nga-subduction/gmportal). These datasets include a significant number of previously processed (filtered and/or baseline corrected) records from the past events. In our selection process, the shape of the response spectrum and its relative closeness to the target spectrum, mainly in the period range of interest was given a priority. The time history selection process for the CSZ interface was limited to only two large-magnitude events, magnitude (M_W) 9.0 Tohoku (2011) and M_W 8.8 Maule (2010), due to unavailability of data for similar types of events. Selected time histories are tabulated in C-4.

Exhibit C-4: Selected Time Histories for Site Response Analysis

Mechanism	Crustal Reverse	Crustal Reverse	Subduction Interface	Subduction Intraslab	Subduction Intraslab
Earthquake	Chuetsu-oki, Japan	Northridge, California	Tohoku, Japan	Geiyo, Japan	Pingtung Doublet, Taiwan
Date	2007	1994	2011	2001	2006
Station	Kawanishi Izumozaki	LA - Sepulveda VA Hospital	GN4	MATSUYAMA	KAU080
M_W	6.8	6.7	9.1	6.8	6.9
R_{rup} (km)	11	8	53	41	35
R_{epi} (km)	-	-	175	35	32
R_{hyp} (km)	-	-	176	57	46
R_{jb} (km)	0	0	23	9	23
V_{S30} (m/sec)	338	380	363	312	399
I_a (m/sec)	1.83	6.99	1.68	0.79	0.84
CAV (m/sec)	12.30	19.79	28.54	8.73	8.58
D_{5-75} (sec)	5.8	4.3	61.0	6.8	7.0
D_{5-95} (sec)	13.9	8.5	85.8	13.7	10.2
PGV (cm/sec)	38.61	76.27	16.81	15.09	34.02
Shortest Usable Period (sec)	0	0	0	0	0.02
Longest Usable Period (sec)	8.9	5.5	47.4	22.4	10.5
Scale Factor	2.119	0.779	3.442	2.816	2.994
Time History	RSN4866_CHUETSU_65039NS	RSN1004_NORTHR_SPV360	NGAsubRSN4040369_GN4-EW	NGAsubRSN4027321_EHM008-NS	NGAsubRSN7006531_KAU080--E

NOTES:

CAV = cumulative absolute velocity; D5-75 = Significant duration from 5%-75% of normalized cumulative Arias Intensity; D5-95 = Significant duration from 5%-95% of normalized cumulative Arias Intensity; I_a = Arias Intensity; m/sec = meters per second; PGV = peak ground velocity; R_{epi} = distance to epicenter; R_{hyp} = hypocentral distance; R_{jb} = Joyner-Boore distance

C.2.3.3 Scaling of Time Histories

The selected time histories in Exhibit C-4 were scaled to provide a reasonable match to the target MCE$_R$ response acceleration spectrum. We used a procedure that minimized the difference between the time history acceleration response spectrum and target acceleration spectrum in equally spaced (in log scale) period intervals to calculate a scale factor for each time history.

Figure C-2 shows the response spectra of the selected time histories scaled to the target MCE$_R$ spectrum. As observed from this figure, the geometric mean of the five scaled response spectra of the selected time histories approximately matches the target MCE_R spectrum. When evaluating the scale factors, a higher weight was given to periods within the period range of interest. The scale factor used for each time history is provided in Exhibit C-4.

In selection and scaling of the crustal time histories, we considered secondary parameters, including peak ground velocity (PGV), Arias Intensity (I_a), cumulative absolute velocity (CAV), significant duration for 5% to 75% of I_a (D [5-75%]), significant duration for 5% to 95% of I_a (D [5-95%]), and fraction of the records with strong velocity pulses. The target values for these parameters were estimated using empirical conditional ground motion models developed for each of these parameters, except significant duration (significant duration has low negative correlation with spectral acceleration values). For subduction time histories, we only used I_a and CAV for this study.

Figures C-3 through C-7 provide plots of the scaled acceleration, velocity, and displacement of the selected time histories for MCE_R ground motion level. The scaled time history response spectra and Arias Intensity (i.e., the normalized sum of squared ground acceleration values over time) variations are also plotted in these figures. In each plot, the response spectrum of the scaled time history is compared to corresponding target spectrum.

C.3 SITE RESPONSE ANALYSIS

This section details the procedure we used to perform the site response analysis. We performed a site-specific site response analysis for the project because:

- Soft/organic clay of more than 10 feet is presented in the soil profile (Site Class F per ASCE 7-16), so the site-specific site response analysis is required.
- A site-specific site response analysis can provide a more detailed evaluation of the elevated pore pressure effects considering the variation in subsurface conditions and extensive depth of the potentially liquefiable soils.
- A site-specific site response analysis provides an improved evaluation of the design ground motions.

C.3.1 Numerical Simulation

We performed 1D effective stress site response analyses to propagate the selected input motions from the referenced outcrop to the ground surface. We utilized nonlinear analyses implemented in the finite difference program Fast Lagrangian Analysis of Continua (FLAC) (Itasca, 2018).

The nonlinear effective stress analyses site response models consider pore pressure development and provide estimates of soil strength reduction in soils susceptible to liquefaction during seismic loading based on the PM4SAND constitutive model. The nonlinear effective stress site response analyses consider the development of the excess pore pressure based on the PM4SAND constitutive model. The PM4SAND constitutive model is a stress-ratio controlled, critical state compatible, bounding surface plasticity model for sand and other purely non-plastic granular soils that has been implemented for use with the FLAC.

We assigned the soil model inputs for the site response analyses based on the available site-specific shear wave velocity and soil parameter measurements, including CPT. Using single-element tests with constant amplitude harmonic loading, we calibrated the PM4SAND input parameters, so that the model response matches the correlated Standard Penetration Test (SPT) liquefaction triggering charts in Boulanger and Idriss (2014). The calibration process was repeated over a range of corrected and normalized SPT $(N_1)_{60,cs}$ values, overburden confining stresses, and static shear stresses to capture the range of in situ soil conditions encountered in our subsurface exploration program.

Soil layers that are not considered susceptible to liquefaction for the nonlinear effective stress analysis were modeled using the hysteretic Mohr-Coulomb model provided in FLAC. We selected hysteretic shear modulus reduction and damping ratio relationships from models available in literature based on the available subsurface and laboratory test data, and our experience with dynamic analyses in similar soil types.

C.3.1.1 Initial Shear Modulus Profiles

The PM4SAND and hysteretic Mohr-Coulomb constitutive models implemented in our FLAC analyses require an estimate of the initial shear modulus, G_{max}. We evaluated the initial shear modulus, G_{max}, for each soil layer using an estimate of the shear wave velocity, V_S. The V_S was evaluated based on the available shear wave velocity measurements performed at the project site. To extrapolate the measured V_S values throughout the soil profile, we developed site-specific relationships for V_S for each dynamic soil unit as a function of vertical effective stress using an equation of the form:

$$V_S = V_{S1} (\sigma'_V / P_a)^{\alpha}$$

where V_{S1} is the vertical effective stress normalized V_S, σ'_V is the effective vertical stress, P_a is atmospheric pressure (in the same units as σ'_V), and α is a curve fitting exponent. Note that setting the exponent α equal to zero represents a constant V_S. The site-specific V_S relationship parameters V_{S1} and α were evaluated for each soil layer with regression analyses using the measured V_S data and an estimate of the vertical effective stress profiles at the measured V_S locations. To evaluate G_{max} for input into FLAC, the vertical effective stress was estimated at each FLAC zone location (i.e., soil layer), and the corresponding V_S was computed based on the site-specific V_S relationship parameters for the given dynamic soil layer. With an estimate of V_S at each zone, G_{max} was computed as:

$$G_{max} = \rho \, V_S^2$$

where ρ is the soil density. Additional modulus input parameters (such as bulk and elastic modulus), as required for the hysteretic Mohr-Coulomb model, were computed based on an estimate of Poisson's ratio and elasticity equations.

For the nonlinear effective stress site response analysis, soils that were considered susceptible to liquefaction and/or pore pressure-induced cyclic strength degradation were evaluated using the PM4SAND constitutive model. Based on the available subsurface information, the soil profile included stratified deposits consisting of primarily sands, low plasticity silts, and clay of variable composition, consistency, and density. Among these, saturated sands and low to non-plastic silts were considered susceptible to liquefaction and pore pressure-induced cyclic degradation. Our effective stress analyses considered saturated sands and low to non-plastic silts susceptible to pore pressure generation and potential liquefaction during cyclic loading, and they were modeled using the PM4SAND constitutive model.

The PM4SAND model follows the basic framework of the bounding surface plasticity model presented by Manzari and Dafalias (1997) and Dafalias and Manzari (2004), with modifications to provide better approximations of the cyclic behavior of sands as observed in the field and during laboratory testing. The PM4SAND model consists of three primary input parameters:

- **Relative density, Dr,** controls the stress-strain response characteristics of the soil. Per Boulanger and Ziotopoulou (2017), the corrected SPT blow count $(N_1)_{60,cs}$ can be related to relative density using the expression $Dr = [(N_1)_{60,cs} / 46]^{1/2}$.
- **Shear modulus coefficient, Go,** is used to compute the small strain shear modulus, G_{max}.
- **Contraction rate parameter, hpo,** adjusts the rate at which excess pore pressure is developed when liquefaction is triggered for a given cyclic loading history.

Using single element tests with constant amplitude harmonic loading, we calibrated the PM4SAND input parameter hpo so the model response matched the SPT liquefaction triggering charts in Boulanger and Idriss (2014) for a given value of Dr, Go, and vertical effective stress. The parameter for Go was determined so that the G_{max} value computed internally by PM4SAND matched the G_{max} value computed with the overburden stress-dependent V_S model described previously. All secondary input parameters for PM4SAND were left at their default values.

The input parameter for Dr was determined using the observed blow counts from our subsurface investigation program and the Dr-$(N_1)_{60,cs}$ relationship provided previously. We evaluated the values for $(N_1)_{60,cs}$ based on the available subsurface explorations and the SPT correction procedures of Boulanger and Idriss (2014). We grouped soils within a layer with similar corrected blow counts and smoothed the transitions between the layers. The input parameter for hpo was evaluated based on our calibrations as a function of the initial overburden stress and the assigned $(N_1)_{60,cs}$ value at each soil element modeled using PM4SAND.

Our calibrations also considered the modulus reduction and damping behavior of similar granular soils based on the relationships provided by the Electrical Power Research Institute (EPRI) (1993). We evaluated the modulus reduction and damping behavior of the calibrated PM4SAND model by performing strain-controlled, single-element direct simple shear tests where the shear strain amplitudes were varied, and the modulus reduction and damping behavior was evaluated and summarized as function of shear strain.

Soil layers that are not considered susceptible to liquefaction for the nonlinear effective stress analysis were modeled using the hysteretic Mohr-Coulomb model provided in FLAC. The Mohr-Coulomb model treats the soil as a purely-elastic-purely-plastic material. The model behaves as a linear elastic material at shear stresses less than the shear strength of the soil; if the shear strength of the soil is reached or exceeded, the model behaves as a purely plastic material.

The input properties for the Mohr-Coulomb model, as implemented by FLAC, include mass density, cohesion, friction angle, tension limit, dilation angle, bulk modulus, and shear modulus. The mass density accounts for the mass of the soil; the cohesion, friction angle, tension limit, and dilation angle describe the shear strength of the soil; and the bulk and shear modulus describe the elastic behavior of the soil.

The elastic behavior of the Mohr-Coulomb (when the shear stress is below the strength limit) alone does not account for the strain-dependent modulus reduction and damping behavior that is observed in actual soils (e.g., Vucetic and Dobry, 1991; EPRI, 1993). We used FLAC's hysteretic model in conjunction with the Mohr-Coulomb model to provide a more accurate representation of the dynamic soil response. The hysteretic model allows the user to provide a modulus reduction curve, expressed as a closed-form equation, which is used by FLAC to modify the elastic response to be consistent with the cyclic behavior of soils as observed in cyclic laboratory experiments. The damping ratio is not specified in

FLAC and is obtained based on the results of single-element simulations. We calibrated the hysteretic input parameters to obtain a reasonable match to the target modulus reduction and damping ratio relationships for each soil type.

We selected the target modulus reduction and damping ratio relationships from models available in literature based on interpreted subsurface soil profile (provided in Exhibit 3-1 of the main text), available laboratory test data, and our experience with dynamic analyses in similar soil types. We modeled peat (45 to 65 feet deep), and clay layers (70 to 115 feet deep) using Vucetic and Dobry (1991) equations which are provided as a function of plastic index (PI). We assigned PI = 50 for the peat layer and PI=30 to the clay layer based on our previous local experiences (e.g., State Route 520, Interstate 5 to Medina project [Shannon & Wilson, 2012]) and the available lab test data, respectively. Besides this base case, we also performed sensitivity analyses by assigning different PIs for these layers (i.e., including two alternative models with PI=22 and PI=30 for both peat and clay layers).

C.3.1.2 Model Implementation

The boundary conditions were set to approximate free-field conditions along the model sides and a non-reflecting (i.e., compliant) boundary at the base. The bottom boundary was modeled as a compliant boundary in the horizontal direction and rigid boundary in the vertical direction. Because the primary earthquake loading is in the form of horizontal shear waves, and the impedance contrast between the outcrop rocks and soil deposits are high, p-wave reflections from a rigid vertical boundary were assumed to be relatively small.

The soil constitutive model parameters used in the site response analyses were described previously. The model simulations were conducted in the following stages:

1. Set initial soil stresses based on the assumed soil densities and assuming a horizontal stress coefficient of 0.5.
2. Set initial pore pressures based on the available data for water elevation.
3. Assign elastic properties based on the V_S profile.
4. Solve for static equilibrium assuming elastic conditions for soil layers in the model.
5. Assign the Mohr-Coulomb constitutive model to the appropriate soil layers and solve for equilibrium.
6. Assign the hysteretic constitutive model to the soil layers modeled using the Mohr-Coulomb soil models. Assign PM4SAND constitutive model parameters in the liquefiable soil layers.
7. Solve for equilibrium to initialize the hysteretic and PM4SAND material models.

8. Assign the input ground motion at the base of the model as an upward propagating shear stress history.
9. Solve for the time dependent response of the model due to loading by the input earthquake ground motions.

C.3.2 Results

The correlated blow counts, shear wave velocities, horizontal acceleration, peak shear strain, and elevated pore pressure ratio as a function of depth are provided in Figures C-8 through C-10 for the base case and two alternative parametric study cases with PI= 22 and PI=30, respectively. The profile plots include the response for each individual input ground motion as well as the average response for the five applied ground motions.

We calculated the average response spectral ratio (i.e., surface response spectrum to the base input response spectrum) as the geometric mean of the spectral ratios from the five applied ground motions at each period individually. Plots of the ground surface response spectra of five MCE$_R$ motions and the average of five motions are provided in Figure C-11 through C-13 for the base case and two alternative parameter study cases with PI= 22 and PI=30, respectively. As observed from these figures, the thick, soft clay/peat soils amplify the acceleration ground motions for long periods (above ~2 sec), but the ground motions are mainly filtered for the low period structures. This is an important finding, considering that the fundamental period of the project structure is ~0.29 sec with a period range of interest between 0.05 and 0.58 sec.

C.4 RECOMMENDED DESIGN RESPONSE SPECTRUM

We calculated our recommended design response spectrum based on ASCE 7-16, Section 21.3. We computed the surface response spectrum as well as the response spectral ratio, defined as the ratio of the surface response spectrum to the base input response spectrum. The response spectral ratios adopted to estimate the recommended site-specific spectra are provided in Figure C-11 (the amplification factor is at the bottom of this figure).

Per ASCE 7-16, Section 21.1.3, the surface MCE$_R$ response spectrum is estimated as the target MCE$_R$ response spectrum of the base input motions multiplied by the average response spectral ratio in Figure C-11. A plot of the base motion MCE$_R$ response spectrum and the surface MCE$_R$ spectrum calculated using our average response spectral ratio is provided in Figure C-14.

We calculated our recommended design response spectrum based on the surface MCE$_R$ response spectrum described above and the procedures presented in ASCE 7-16, Section 21.3. ASCE 7-16 defines the design response spectrum as two-thirds of the surface MCE_R spectrum and imposes a limitation that the recommended design response spectrum cannot be less than 80% of the design response spectrum calculated using the standard procedures outlined in ASCE 7-16, Section 11.4.5, and site factors provided in ASCE 7-16, Section 21.3. Per ASCE 7-16, Section 21.3, we calculated the minimum response spectral values assuming Site Class E conditions.

Figure C-14 shows the acceleration spectral response for our recommended site-specific MCE_R response spectrum as well as for two-thirds of the spectrum, which is the recommended site-specific design response spectrum. The MCE_R ground surface response spectrum and the MCE_R base target spectrum are also compared with 80% of Site Class E code-based MCE_R response spectrum in this figure. As observed from this figure, the recommended site-specific MCE_R response spectrum is following the code-based minimum spectrum for periods less than about 1.5 sec, but the soft clay/peat response is more than the code-based minimum spectra for periods >1.5 sec. We calculated the recommended MCE_R response spectrum by smoothing the ground surface MCE_R response spectrum to provide a reasonable acceleration response while also adhering to the minimum requirements described above. The recommended site-specific spectra are tabulated in Exhibit C-5.

Exhibit C-5: Recommended Site-Specific Spectra

Period (seconds)	Site-Specific MCE_R Spectrum	Site-Specific Design Spectrum
0	0.42	0.28
0.01	0.44	0.29
0.02	0.46	0.31
0.03	0.49	0.32
0.05	0.53	0.35
0.075	0.59	0.39
0.1	0.64	0.43
0.15	0.76	0.50
0.2	0.87	0.58
0.25	0.98	0.66
0.28	1.05	0.70
0.4	1.05	0.70
0.5	1.05	0.70
0.75	1.05	0.70
1	1.05	0.70
1.5	1.05	0.70

Period (seconds)	Site-Specific MCE_R Spectrum	Site-Specific Design Spectrum
2	0.82	0.55
3	0.58	0.39
4	0.46	0.31
5	0.38	0.25
7.5	0.22	0.15
10	0.14	0.091

The site-specific design acceleration parameters to be used in structural design were calculated by a method provided in ASCE 7-16, Section 21.4, which are provided in Exhibit C-6.

Exhibit C-6: Design Acceleration Parameters

Seismic Parameter	S_{DS}	S_{D1}	S_{MS}	S_{M1}
0	0.84	1.27	1.25	1.90

NOTES:
S_{DS} = site-specific design, 5% damping, spectral response acceleration at short periods
S_{D1} = site-specific design, 5% damping, spectral response acceleration at a period of 1 second
S_{MS} = site-specific MCE_R, 5% damping, spectral response acceleration at short periods
S_{M1} = site-specific MCE_R, 5% damping, spectral response acceleration at a period of 1 second

C.5 REFERENCES

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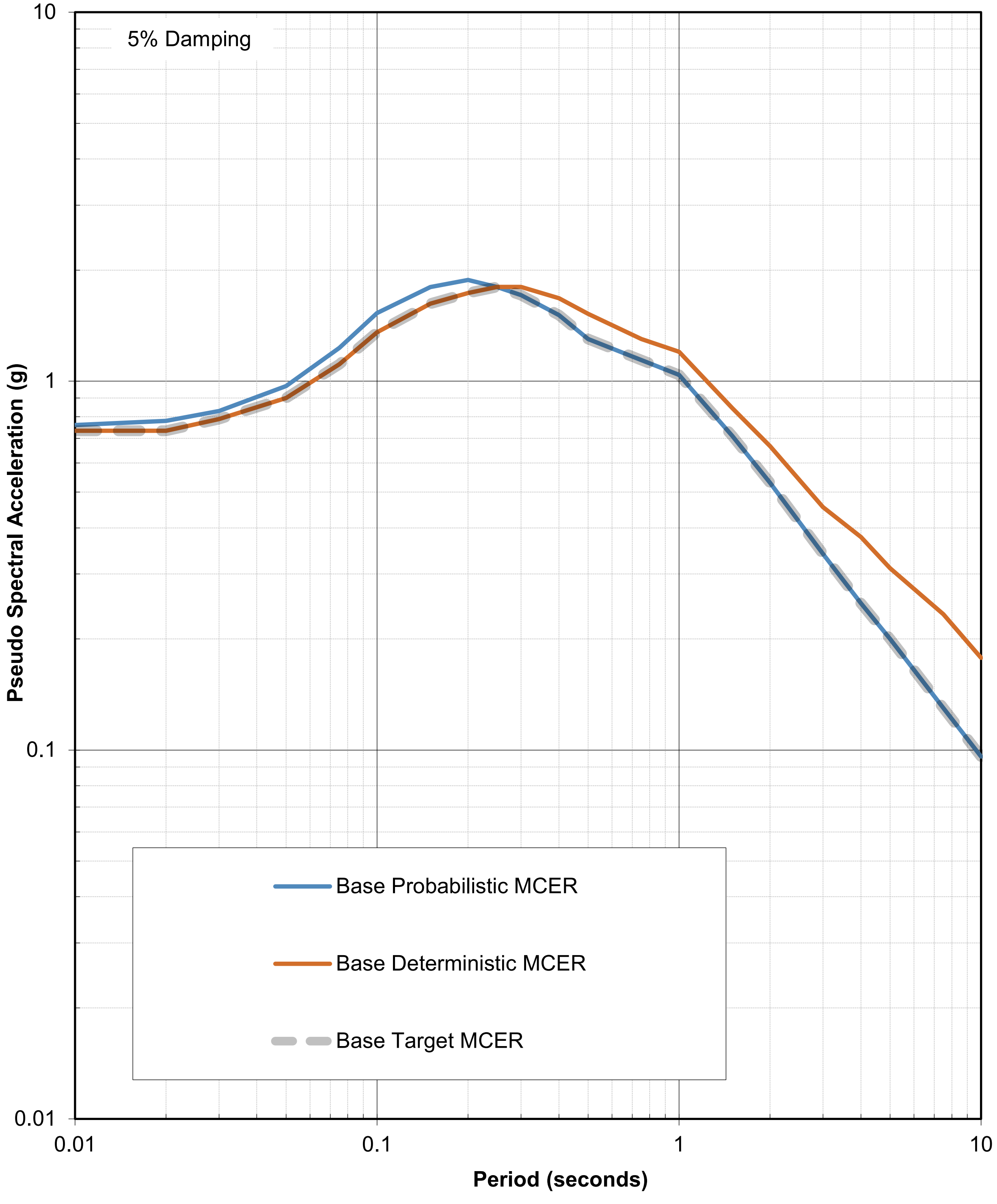

NOTES

1. The Base Target Spectrum was obtained per ASCE 7-16 Section 21.2 from a probabilistic MCE_R (2,475-year return period mean uniform hazard spectrum using 2018 USGS NSHM for V_{S30}=1,200 fps and including maximum direction and risk coefficients) and deterministic 84th percentile MCE_R.
2. ASCE = American Society of Civil Engineers; fps = feet per second; g = standard gravitational acceleration; MCE_R = risk-targeted maximum considered earthquake; NSHM = National Seismic Hazard Model; USGS = U.S. Geological Survey

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BASE MCER SPECTRUM

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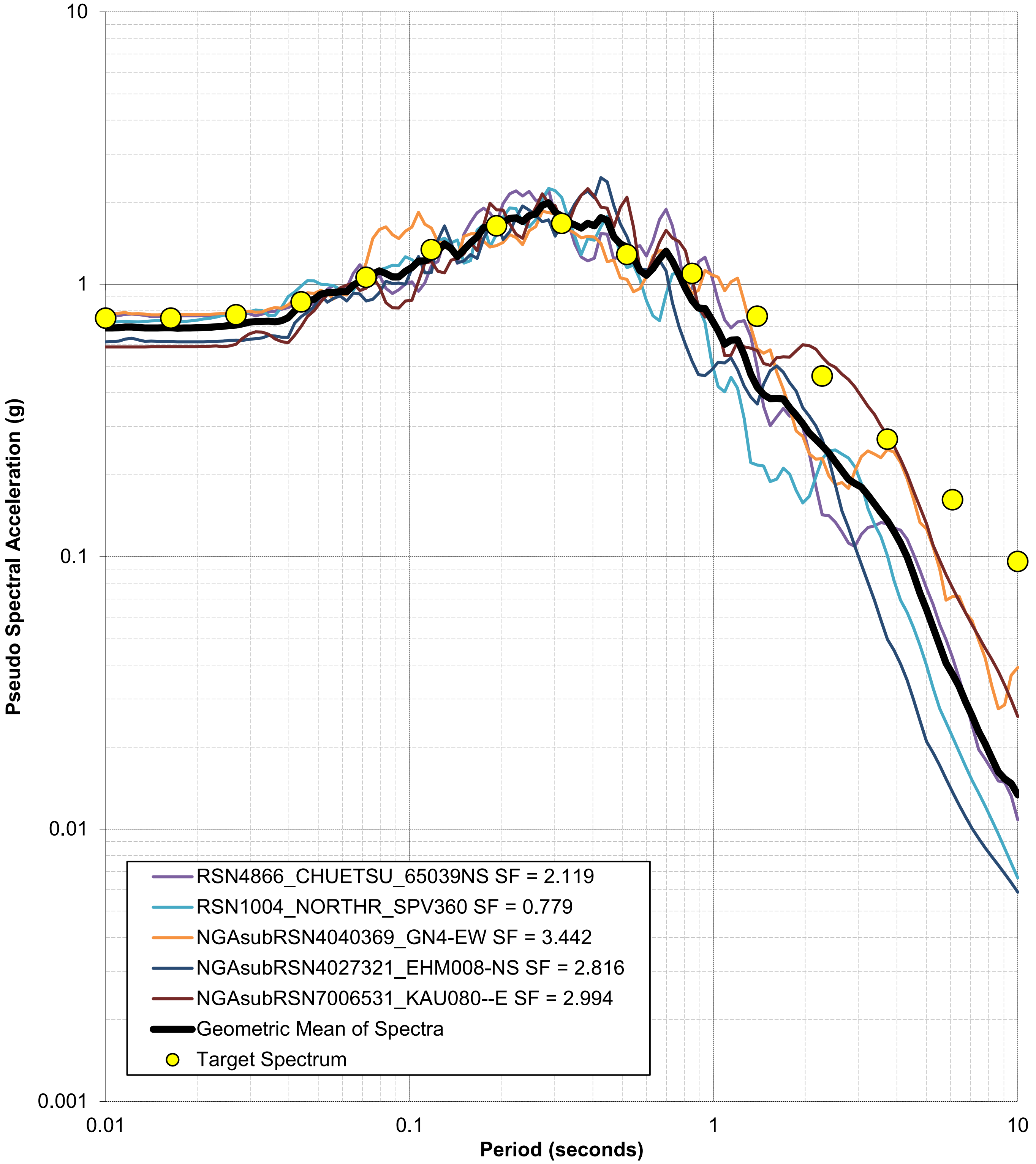
FIG. C-1



NOTES

1. Period range of interest was estimated between 0.05 and 0.6 second.

2. g = standard gravitational acceleration; SF = scale factor

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SCALED ACCELERATION RESPONSE SPECTRA

June 2024 113263-001

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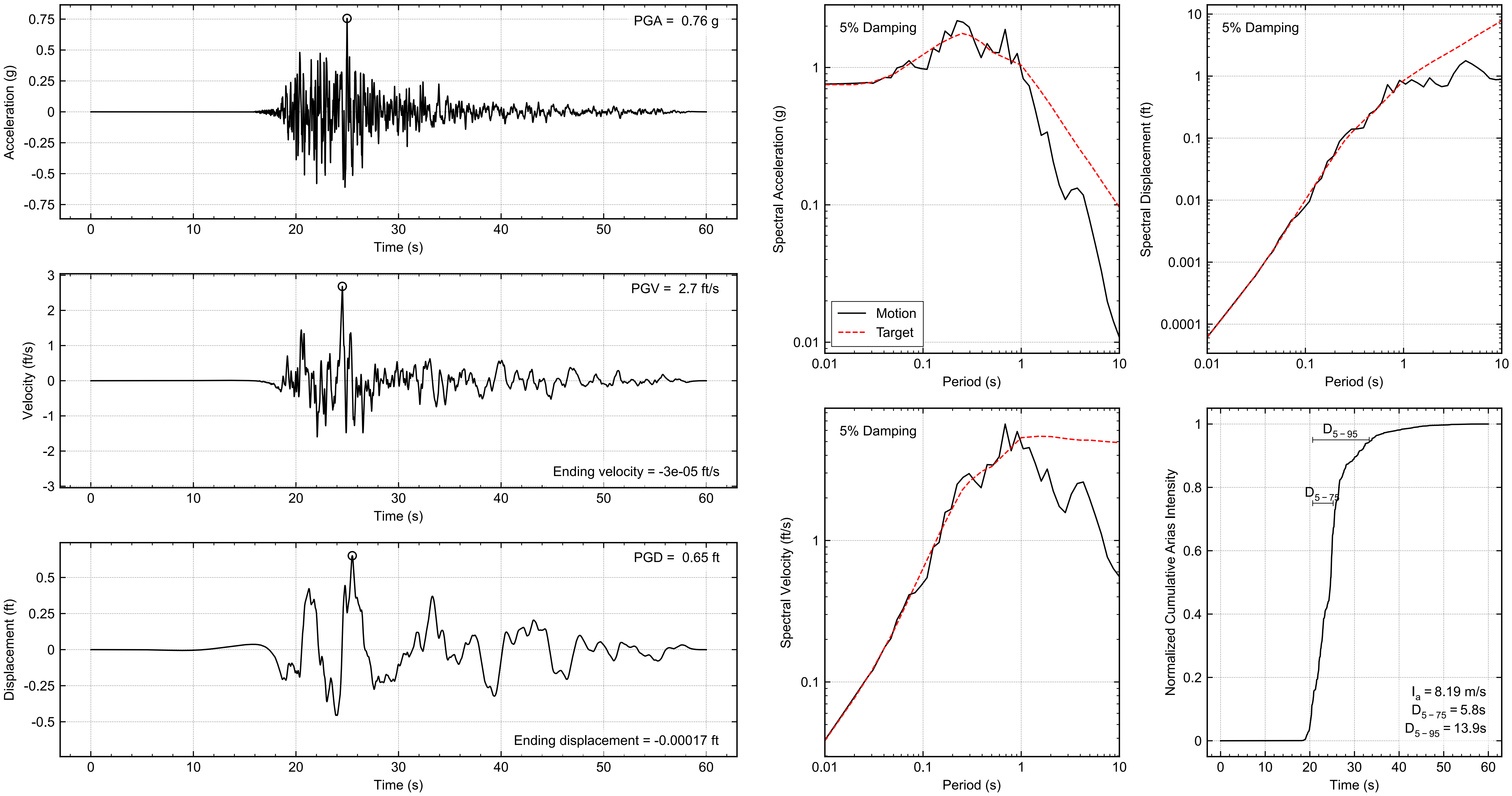
FIG. C-2



Notes:

1. I_a = Arias Intensity; D_{5-75} = Significant Duration from 5%-75% of normalized cumulative Arias intensity; D_{5-95} = Significant Duration from 5%-95% of normalized cumulative Arias intensity; PGA = Peak Ground Acceleration; PGV = Peak Ground Velocity; PGD = Peak Ground Displacement
2. s = second; m = meter; gravity = standard gravity; ft = feet

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CHUETSU-OKI, JAPAN 2007
KAWANISHI IZUMOZAKI, NS
SCALED MCER TIME HISTORY

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FIG. C-3

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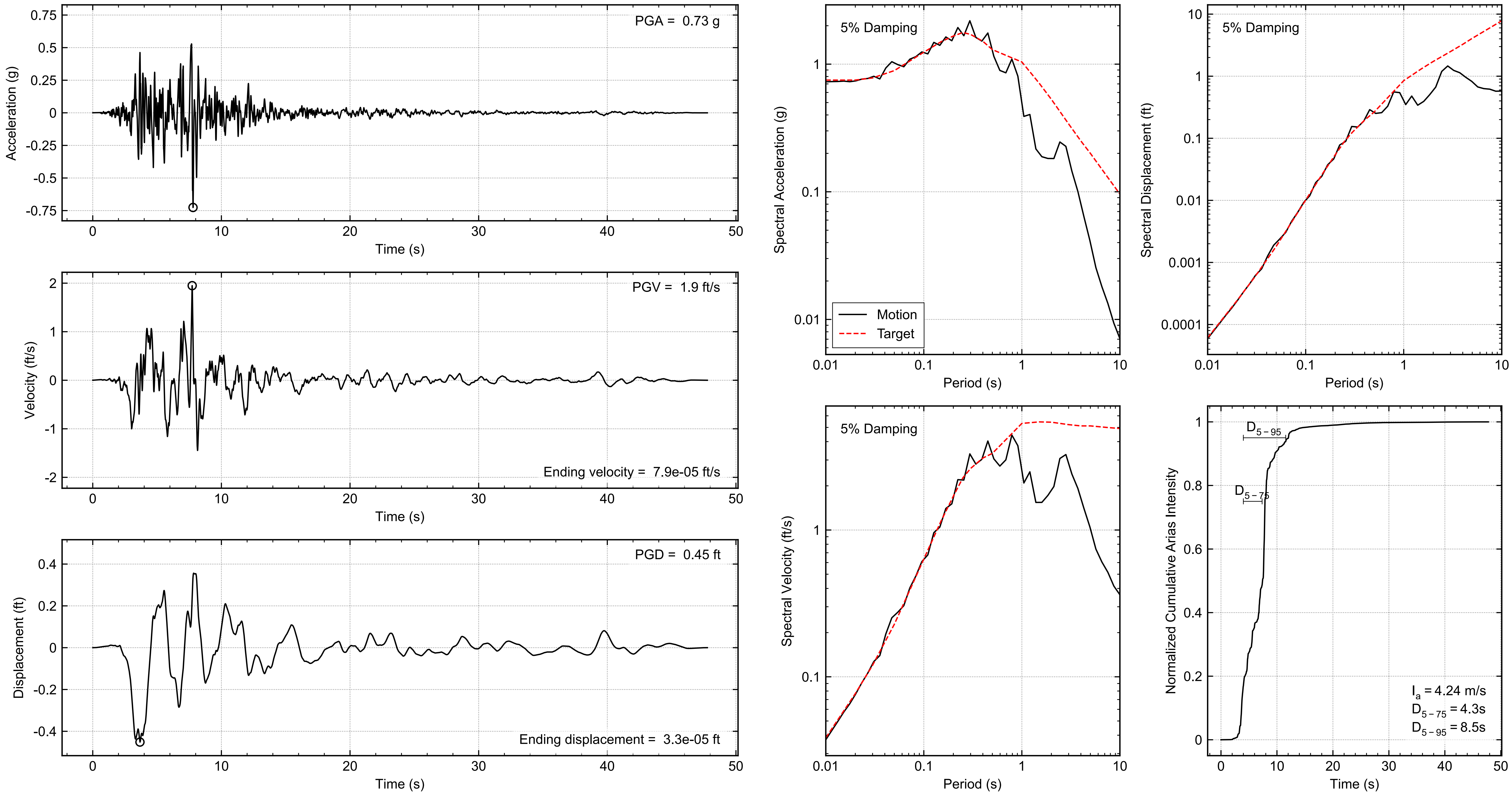

Notes:
1. I_a = Arias Intensity; D_{5-75} = Significant Duration from 5%-75% of normalized cumulative Arias intensity; D_{5-95} = Significant Duration from 5%-95% of normalized cumulative Arias intensity; PGA = Peak Ground Acceleration; PGV = Peak Ground Velocity; PGD = Peak Ground Displacement
2. s = second; m = meter; gravity = standard gravity; ft = feet

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NORTHRIDGE, CALIFORNIA 1994
LA - SEPULVEDA VA HOSP, 360°
SCALED MCER TIME HISTORY

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FIG. C-4

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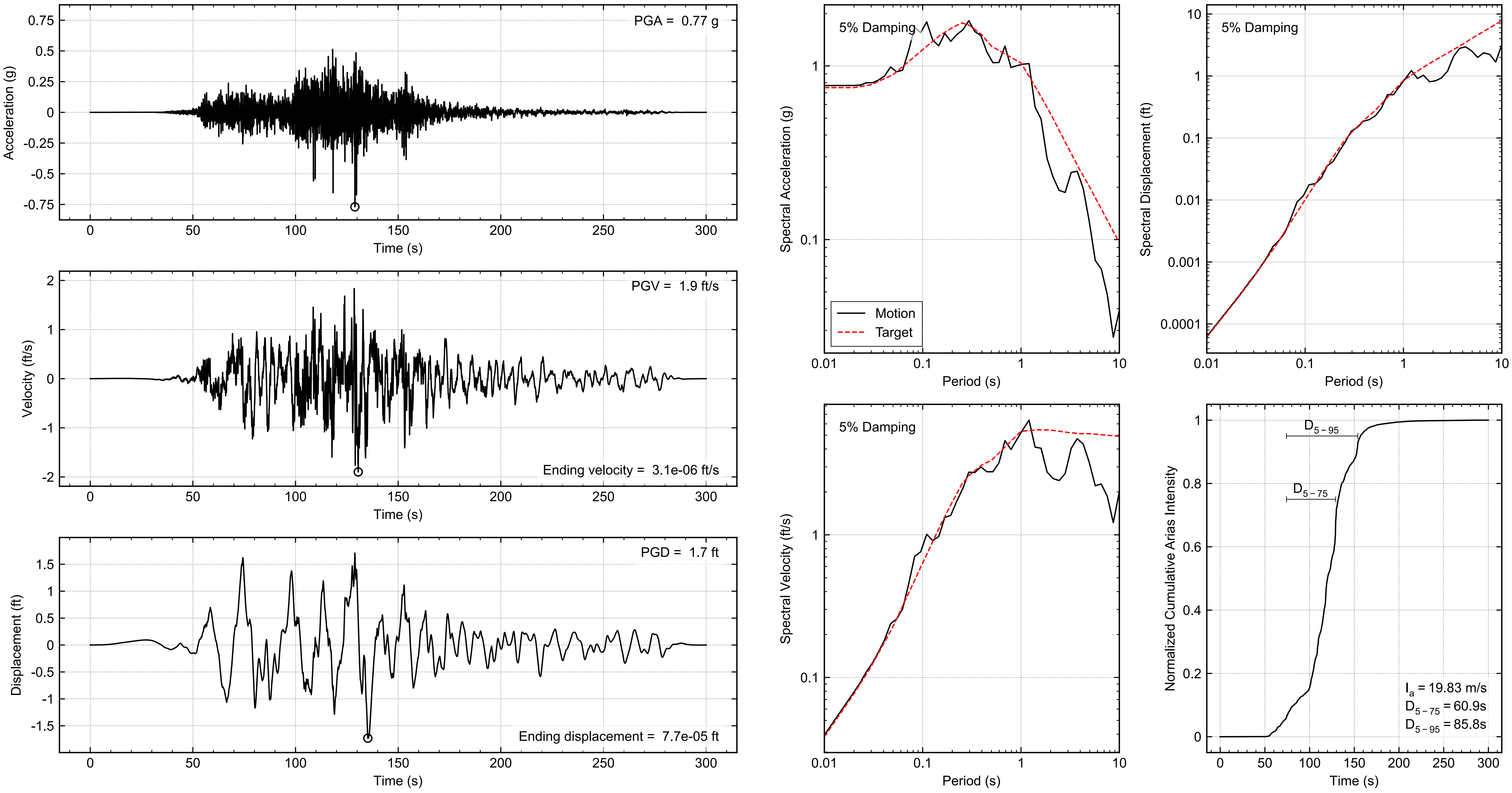

Notes:

1. I_a = Arias Intensity; D_{5-75} = Significant Duration from 5%-75% of normalized cumulative Arias intensity; D_{5-95} = Significant Duration from 5%-95% of normalized cumulative Arias intensity; PGA = Peak Ground Acceleration; PGV = Peak Ground Velocity; PGD = Peak Ground Displacement
2. s = second; m = meter; gravity = standard gravity; ft = feet

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TOHOKU, JAPAN 2011
GN4, EW
SCALED MCER TIME HISTORY

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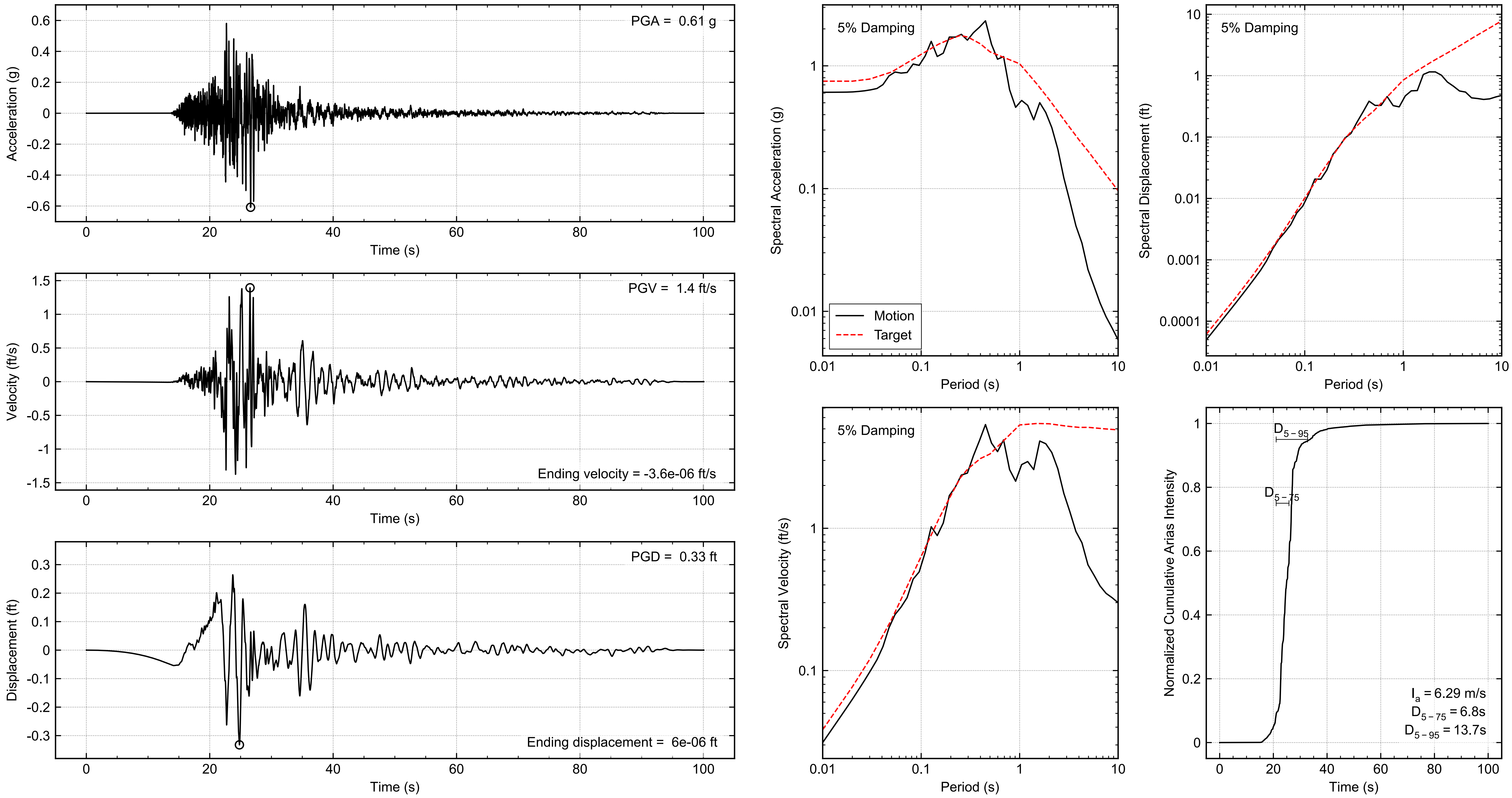
FIG. C-5



Notes:
1. I_a = Arias Intensity; D_{5-75} = Significant Duration from 5%-75% of normalized cumulative Arias intensity; D_{5-95} = Significant Duration from 5%-95% of normalized cumulative Arias intensity; PGA = Peak Ground Acceleration; PGV = Peak Ground Velocity; PGD = Peak Ground Displacement
2. s = second; m = meter; gravity = standard gravity; ft = feet

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GEIYO, JAPAN 2001
MATSUYAMA, NS
SCALED MCER TIME HISTORY

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FIG. C-6

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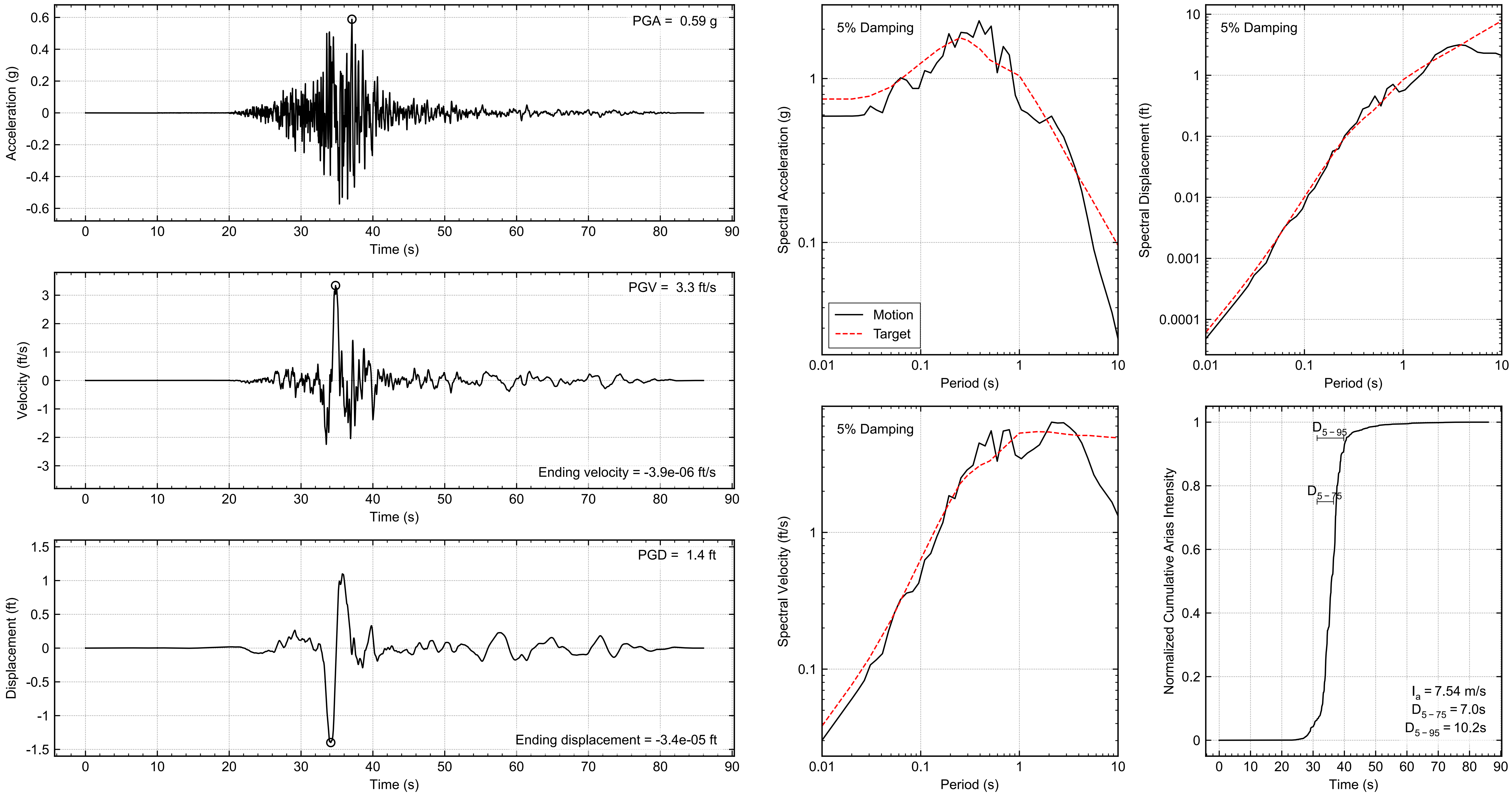

Notes:

1. I_a = Arias Intensity; D_{5-75} = Significant Duration from 5%-75% of normalized cumulative Arias intensity; D_{5-95} = Significant Duration from 5%-95% of normalized cumulative Arias intensity; PGA = Peak Ground Acceleration; PGV = Peak Ground Velocity; PGD = Peak Ground Displacement
2. s = second; m = meter; gravity = standard gravity; ft = feet

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PINGTUNG DOUB, TAIWAN 2006
KAU080, E
SCALED MCER TIME HISTORY

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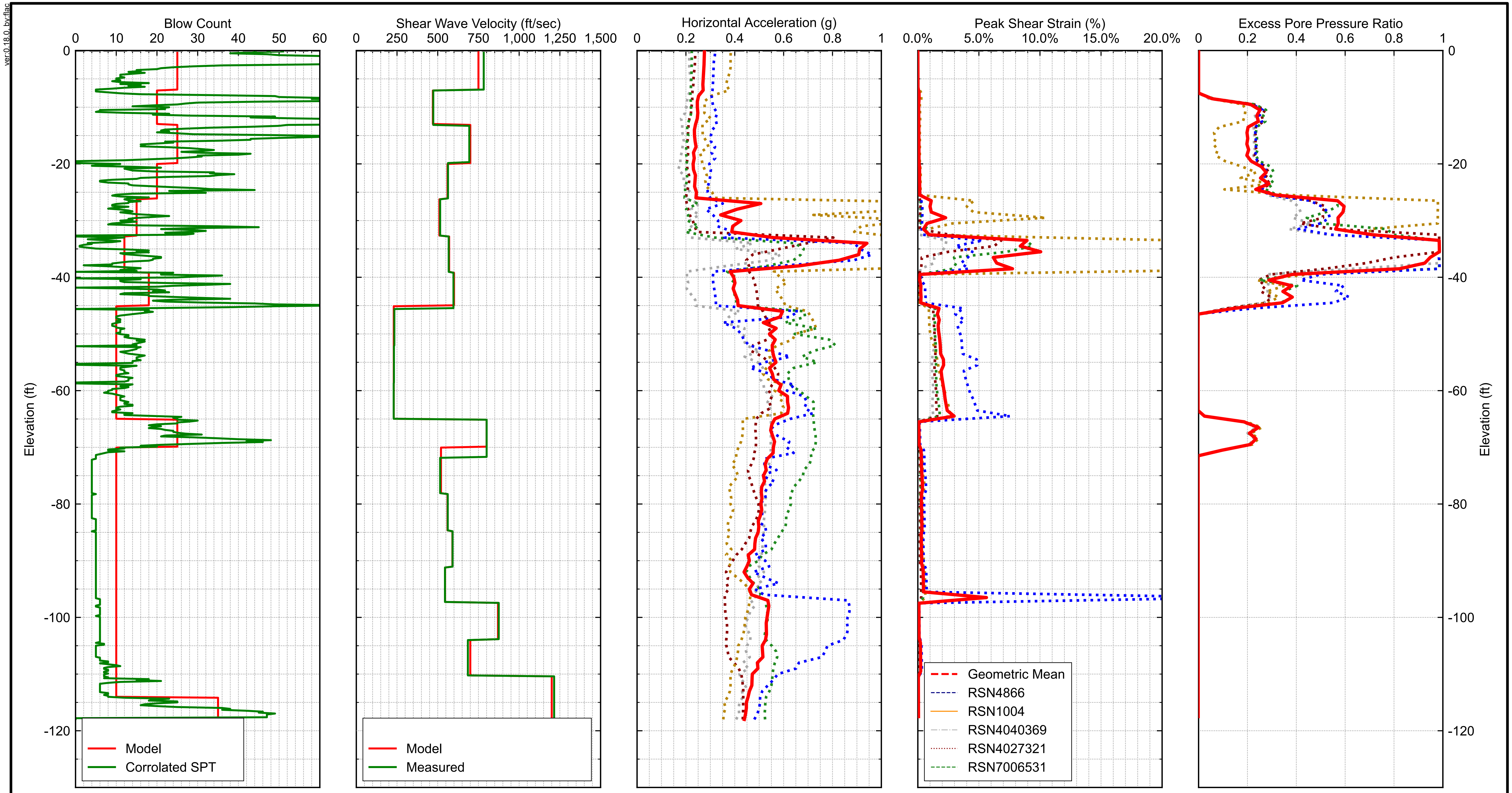
FIG. C-7



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1D SITE RESPONSE ANALYSIS
MCER GROUND MOTION LEVEL
(BASE CASE)

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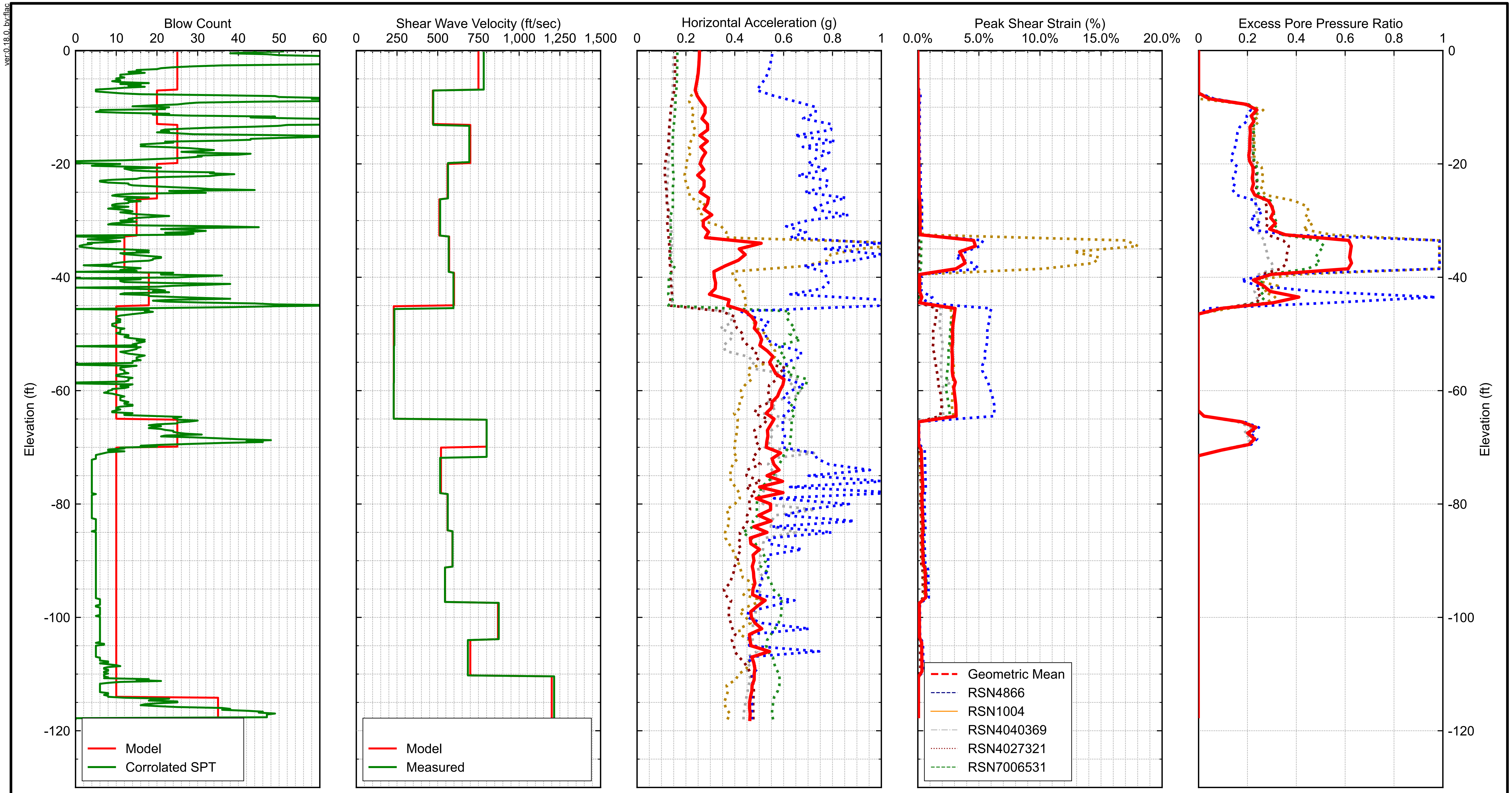
FIG. C-8



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1D SITE RESPONSE ANALYSIS
MCER GROUND MOTION LEVEL
(PI=22)

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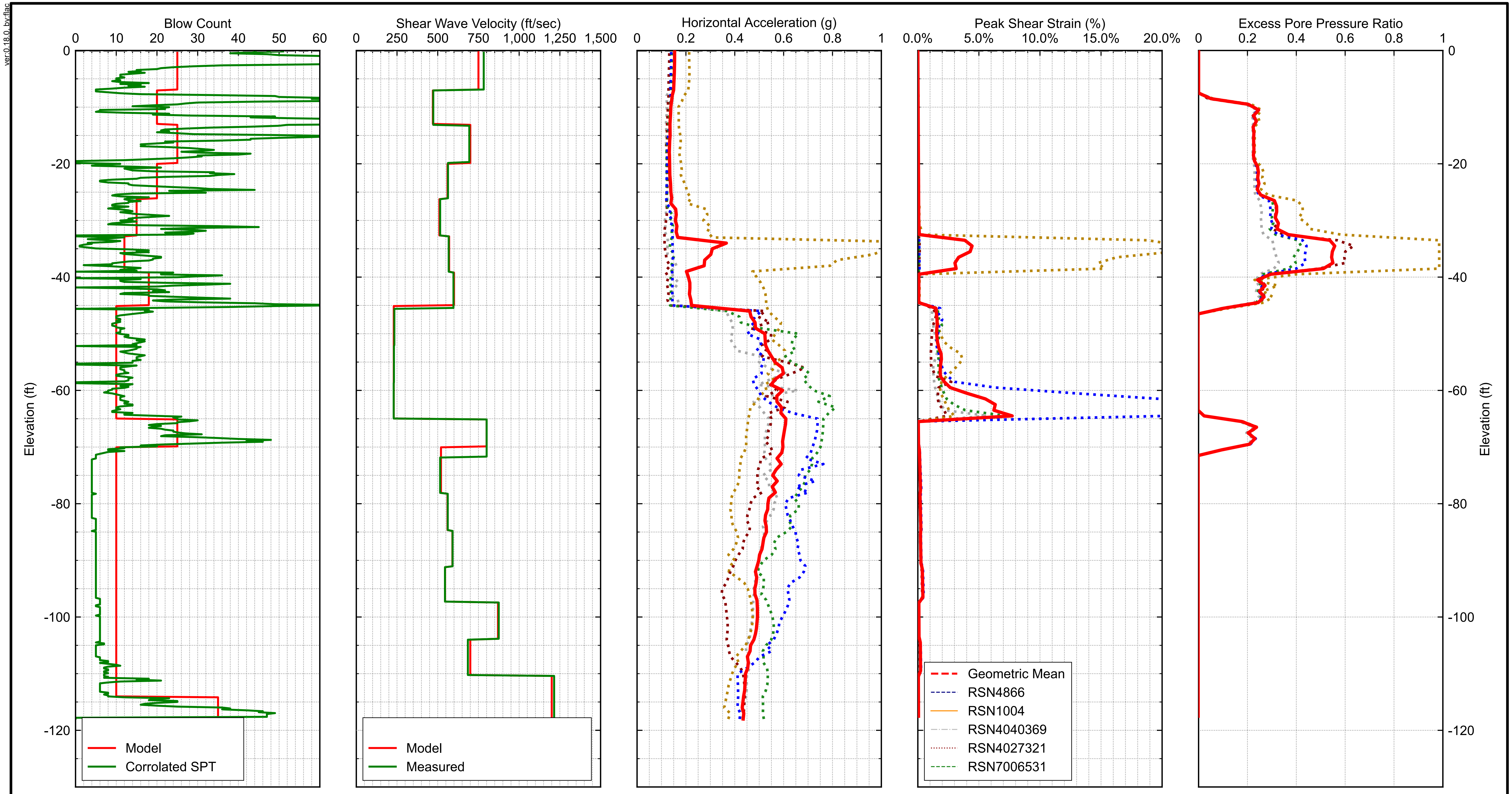
FIG. C-9



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1D SITE RESPONSE ANALYSIS
MCER GROUND MOTION LEVEL
(PI=30)

June 2024 113263-001

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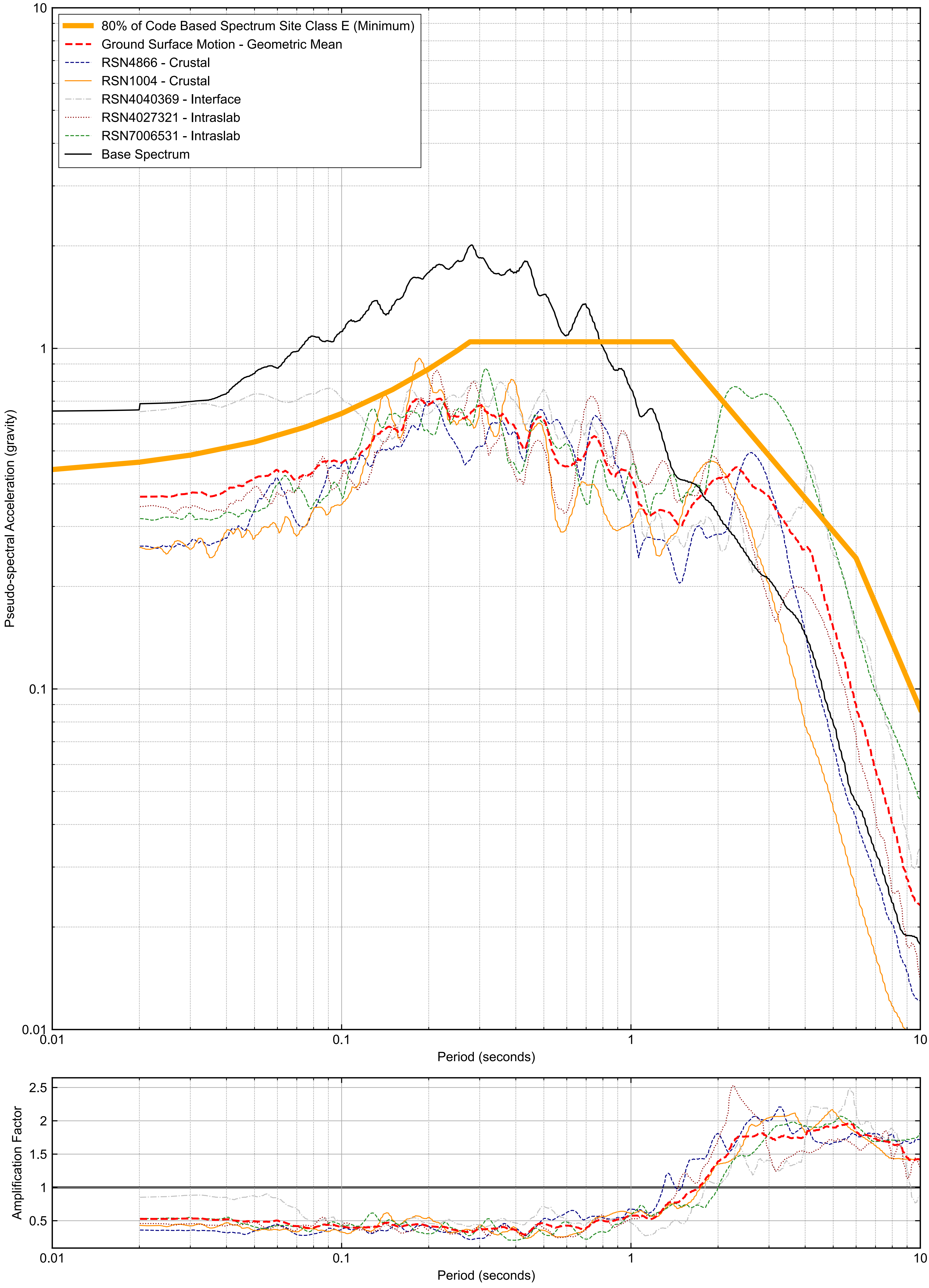
FIG. C-10



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1D SITE RESPONSE SPECTRA
MCER GROUND MOTION LEVEL
(BASE CASE)

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FIG. C-11

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1D SITE RESPONSE SPECTRA
MCER GROUND MOTION LEVEL
(PI=22)

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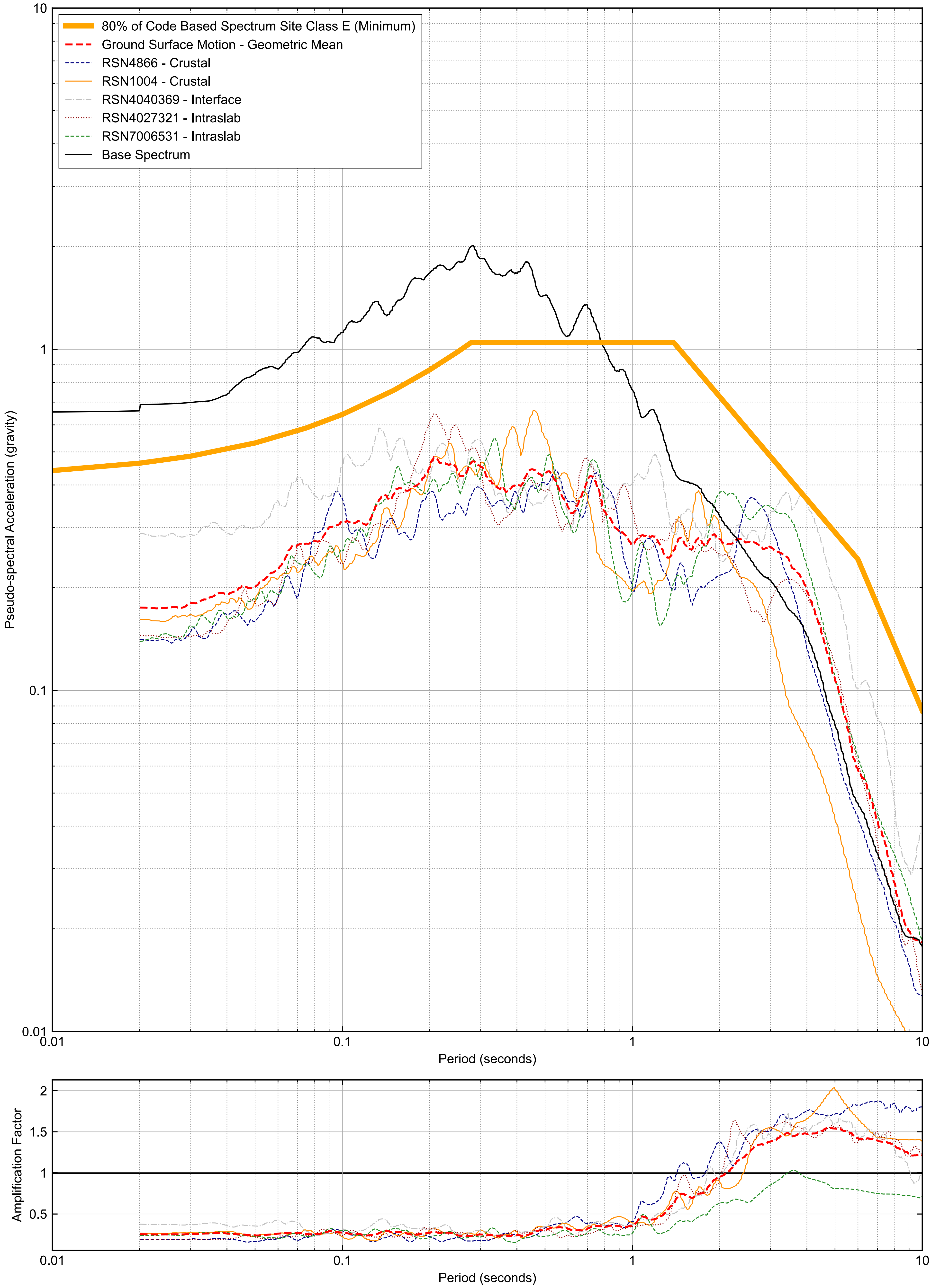
FIG. C-12



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1D SITE RESPONSE SPECTRA MCER GROUND MOTION LEVEL (PI=30)

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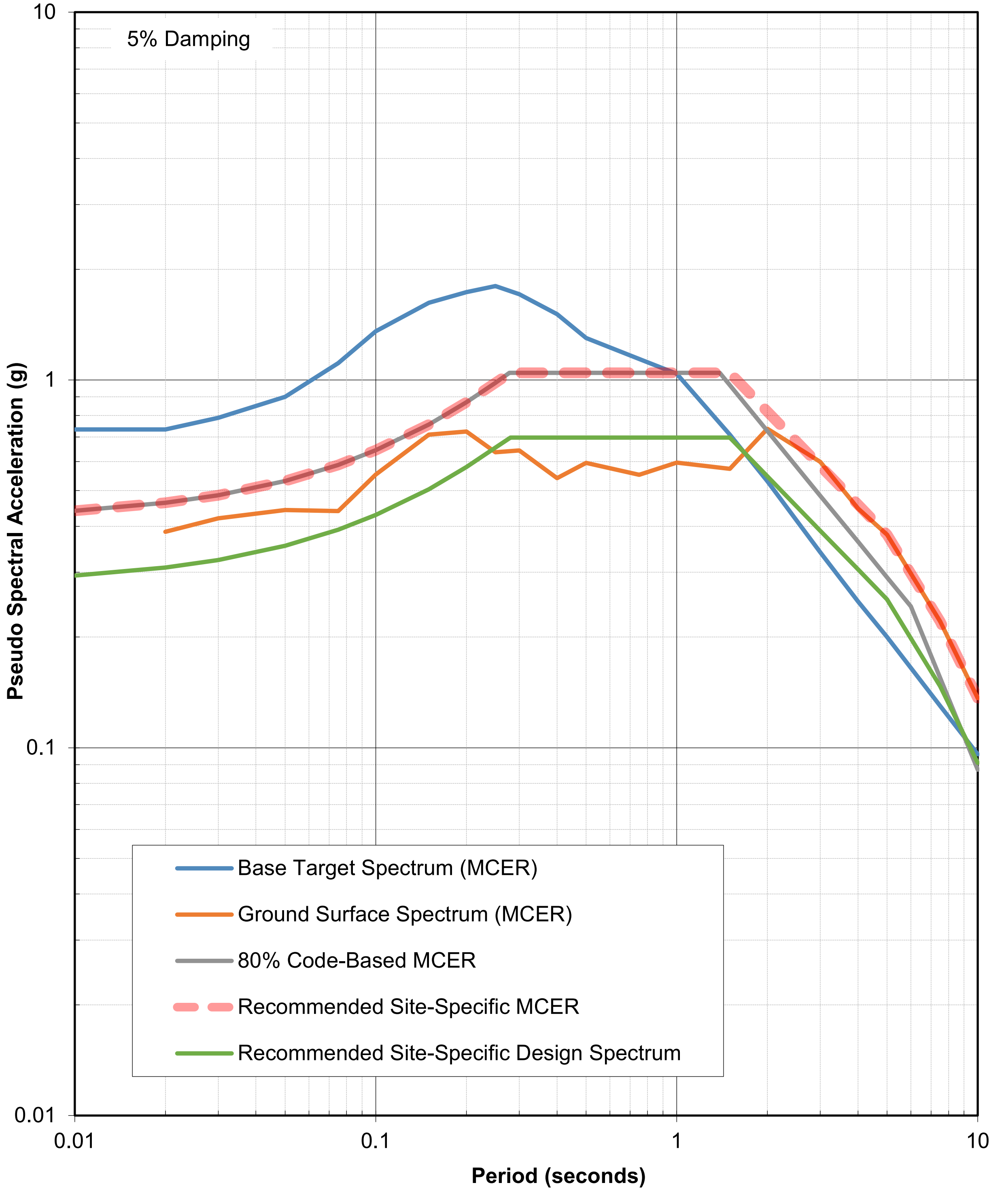
FIG. C-13



NOTES

1. The ASCE standard 7-16 Chapter 21 was followed to calculate the recommended site-specific design acceleration spectrum.

2. ASCE = American Society of Civil Engineers; g = standard gravitational acceleration; MCER = risk-targeted maximum considered earthquake

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RECOMMENDED SITE-SPECIFIC DESIGN SPECTRUM

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FIG. C-14

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland.