SECTION 02401

SHEETING, SHORING AND BRACING

This section should be edited to reflect soil conditions specific to the project site and the recommendations of a Geotechnical Engineer licensed in the State of Washington.

PART 1 GENERAL

1.01 SCOPE

Describe the work that will require sheeting, shoring and bracing.

EXAMPLE:
The work includes installation and removal of shoring for the Wet Well shaft and the installation of the 24-inch sanitary line between an existing manhole and the Wet Well as indicated in the Plans. Shaft details shown in the Plans are for conceptual purposes. Where shoring, sheeting, bracing, or other supports are necessary, they shall be furnished, placed, maintained and, except as shown or specified otherwise, removed by the Contractor.

Delineate acceptable and unacceptable methods of sheeting, shoring and bracing for the project based on the recommendations of the Geotechnical Engineer.

EXAMPLE:
Contractor shall select the means and methods for providing support of the excavations in accordance with safety requirements, Plans and these Specifications. Methods that utilize dewatering, such as soldier pile and lagging may be considered. Specifications for Dewatering are in Section 02405. Other methods that do not require dewatering such as: jet grouting, secant piles, ground freezing and installing a steel casing, all with a shaft bottom seal, may also be considered. Use of sheet piling and sinking caisson methods are discouraged due to the soil conditions. Due to noise and vibration considerations, impact hammers will not be allowed on the site. Vibratory hammers are acceptable.

1.02 REFERENCES

This section references the latest revision of the following documents. They are a part of this section as specified and modified. In case of conflicts between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.
1.03 DESIGN REQUIREMENTS

The design, planning, installation, and removal of all sheeting, shoring, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.

The Contractor shall provide the design, prepared by a professional engineer licensed in the State of Washington, for sheeting, shoring, and bracing in accordance with WAC 296-155.

Horizontal struts below the barrel of a new pipe and the use of the pipe as trench support are not acceptable.

When the construction sequence of structures requires the transfer of bracing loads or forces to the completed portions of any new structure or to any existing structure, the Contractor shall provide the Engineer with a complete design analysis of the expected impact of that bracing on the structure. This action shall in no way absolve the Contractor of responsibility of damage resulting from said bracing.

Steel shoring, bracing and sheeting shall meet the following design requirements:

1. Allowable stresses shall not exceed those allowed by AISC Steel Construction Manual.
2. Steel struts shall have a slenderness ratio of less than 120 and a maximum axial stress of 14,000 pounds per square inch.
3. Connections between struts, walers and wall system shall be designed for a tensile and shearing load equal to at least 10 percent of the design compressive strut load.

*Delete references to ground freezing if it is not an acceptable means of sheeting and shoring.*

Ground freezing shall meet the following requirements:

1. Provide a multi-unit refrigeration plant that can be easily reconfigured to provide back-up cooling in case of breakdowns. Size the refrigeration plant with a cooling capacity capable of maintaining brine temperature of at least –20 degrees Fahrenheit. Refrigeration plant must have an acoustic enclosure to minimize noise disturbance.
2. Pressure test each freezing pipe before and after installation to ensure that coolant does not leak into the ground.

3. Install sufficient electrical temperature sensors (thermisters) in the ground around the shaft to verify extent of ground freezing. Thermister strings shall have thermisters spaced at not more than 5-feet. Provide a minimum of six thermister strings located symmetrically around the excavation and equidistant from adjacent freeze pipes. Provide at least four more thermister strings away from the circulation pipes centerline to determine the thickness of the frozen annulus.

4. Monitor thermister and brine temperatures as required during the freezing process and at least daily thereafter.

5. Monitor piezometers and excavation water levels to verify ground-freezing closure.

6. Brine shall have a specific gravity between 1.24 to 1.28. Brine shall not be capable of freezing in the pumps or circulation lines. Brine shall be non-toxic and comply with applicable environmental requirements.

7. Provide a brine tank with a method to determine if brine has been lost during the freezing operation. If the brine loss is determined to be excessive by the City, the Contractor shall implement the necessary means to reduce leakage including the replacement and abandonment of freezing pipes or at the discretion of the City, abandoning the freezing method of temporary ground support.

1.04 SUBMITTALS

At least 30 days prior to commencing excavation work requiring sheeting, shoring, and bracing, the Contractor shall transmit its plans for trench and excavation support systems to the Engineer. No excavations shall be started until the Contractor has obtained written acceptance of the trench support system. Said acceptance will be to assure the City of Tacoma of the Contractor's general compliance with the Washington Safety Standards for Construction Work (Chapter 296-155 WAC, Part N) and shall not be construed as a detailed analysis for adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall sole responsibility and liability for the work.

Reference the Geotechnical Report or Geotechnical Engineer’s recommendations in this paragraph.

The Contractor’s calculations and plans for trench and excavation support systems shall be prepared, stamped, and signed by a civil or structural engineer licensed in the State of Washington and experienced in the design of the proposed excavation support system. The Contractor’s Trench and Excavation Support Systems Designer shall determine the lateral soil and water pressure and surcharge loads that could result from the anticipated and actual construction methods and dewatering activities. Shoring lateral pressures as contained in the (EXAMPLE: Supplemental Geotechnical Report and Pumping Tests at 93rd & Hosmer Street Pump Station Upgrade, dated February 1999), are for reference only, and shall be considered
minimum shoring lateral pressures. Appropriate surcharge loading shall be used to account for construction operations. The (EXAMPLE: Supplemental Geotechnical Report and Pumping Tests at 93rd & Hosmer Street Pump Station Upgrade, dated February 1999), is provided with the project manual.

The following information shall be submitted in accordance with (Reference submittal submission requirements) prior to beginning site excavations:

1. Design assumptions, engineering calculations, shoring dimensions, and information on the proposed method of installation and removal of all shoring, trench boxes and/or ground freezing systems.

2. If ground freezing design is used by the Contractor, the submittal shall include the circulation pipe layout, size and depths, details of refrigeration equipment, type of brine, calculations for wall stability and heat transfer requirements, insulation materials, methods for monitoring temperatures and brine losses.

3. Detailed shop drawings showing dimensions, member sizes, plate thickness, welded and/or bolted connections, dimensions of coolant circulation system, and any other details necessary for construction. Construction stationing shall be shown on all drawings, where applicable.

4. Provide as-built drawings of the shoring system including final location of soldier piles, jet grout columns, secant piles or the tops of the brine circulation pipes as applicable for the method selected.

5. Detailed shop drawings for temporary utility support, where necessary.

6. Detailed construction sequence and schedule for the design, review, installation, monitoring and removal of the shoring system.

7. The Contractor’s proposed method of monitoring movement and settlement of the shoring and adjacent pavements. Indicate location and types of survey monuments including benchmarks. Readings shall be accurate to 0.01 foot.

8. Provide all survey measurements to the Engineer in a tabulated form within 12 working hours of taking measurements.

9. The Contractor’s proposed procedure and corrective measures to be used should horizontal movement or settlements occur adjacent to the shored excavation or trench.

10. Name and experience of the designated Project Safety Supervisor.

PART 2 PRODUCTS

NOT USED.
PART 3  EXECUTION

3.01  CONSTRUCTION

A.  INSTALLATION

All shoring shall be installed to the dimensions, elevations, and the sequence shown in the reviewed Trench and Excavation Support Systems Plan. The method and sequence shall not cause damage to adjacent structures, utilities, or improvements. At least 14 days prior to the implementation of any changes to the reviewed Trench and Excavation Support Systems Plan, the Contractor's Trench and Excavation Support Systems Designer shall submit the proposed changes to the Engineer for review.

Contractor shall provide support of existing structures where shown, specified, and at all other locations where excavation side slopes are greater than 1-1/2:1 or where excavation infringes upon a 1-1/2:1 slope extending from the bottom of the footing or adjacent structure being protected.

Stockpiling of excavated materials is not allowed within 40-feet of any installed shoring. The area around installed shoring shall be graded to prevent surface runoff from entering shored excavations.

*Piezometers will be necessary for monitoring groundwater levels in and adjacent to excavations. Confirm the location and number of existing piezometers and adjust the number of piezometers required for monitoring groundwater levels during construction based on the recommendations of the Geotechnical Engineer.*

The Contractor shall measure the water level of the three existing piezometers and survey shoring reference points at least once a day during dewatering and excavation. A minimum of two piezometers shall be operational at all times. In the event that a piezometer is damaged during construction, the Contractor shall replace the damaged piezometer at the Contractor's expense. After the excavation is completed, and prior to backfilling, the Contractor shall measure water levels of piezometers and survey reference points once every week or more frequently if necessary.

Horizontal deflection of the shoring system into the excavation shall be limited to one-inch. If the deflection exceeds one-inch, the Contractor shall stop the excavation and take immediate corrective actions to prevent further inward movements.

Prior to installing pumping station structures, the Contractor shall verify that the subgrade is firm and unyielding. Prior to backfilling the shored excavation, the Contractor shall remove all unacceptable materials such as wood and metal debris and loose soils from the bottom of the excavation.

B.  REMOVAL:

Shoring and cribbing shall be removed in a manner that does not loosen the bedding or backfill associated with the pumping station structures. Shoring may be removed during the backfilling operation. The Contractor shall not excavate soil, or create voids, which may result in pipe or structure deformation or backfill settlement. If the Contractor elects to leave any
shoring or cribbing in place, it shall be cut off a minimum 5 feet below finish grade. Any wood shoring and cribbing that is left in place shall have been pressure treated to minimize decay.

For the ground freezing alternative, abandon ground freeze pipes by filling with cement grout or by removing the pipes and grouting the holes. All pipes shall be cut-off a minimum of 5-feet below finished grade.

Where sheeting, shoring, and bracing cannot be removed with the progression of backfill, it shall be designed in such a way that its removal shall not adversely affect the integrity of the pipeline or adjacent structures and the backfill shall be reconsolidated after final removal to the satisfaction of the Engineer.

Where sheeting, shoring, or bracing cannot be removed without resulting in damage to the pipeline or adjacent structure, or where such sheeting, shoring, or bracing is specified to remain, it shall be cut off five feet (5’) below finish grade and the cut off portions shall be removed from the site. All voids which exist behind the sheeting or shoring left in place, together with all other sheeting or shoring, shall be backfilled in a manner acceptable to the Engineer.

Sheeting, shoring, and bracing placed as a cutoff wall between dewatered and recharged areas shall remain in place as long as dewatering is required. Following removal, the resulting voids shall be backfilled in lifts not exceeding 8 inches. Compact backfill to 90 percent of optimum density as determined from the Modified Proctor Test.

C. MONITORING AND SUPERVISION:

The design of the shoring system, method of construction, and stability monitoring of the shored excavations by surveying methods shall be the responsibility of the Contractor. The Contractor shall ensure that the integrity of the existing structures and pipelines are maintained and that appropriate construction techniques are employed at all times to protect existing structures and pipelines. In the event the shoring becomes unstable or large surface settlements occur, the Contractor shall be responsible for implementing corrective measures. The Contractor shall be solely responsible for any and all liability that may arise from his failure to provide adequate shoring or sheeting as necessary to support the excavation under any and all of the loading conditions that may exist or arise during construction.

The Contractor shall be responsible for maintaining a safe work site and shall protect workers and the public health and safety from the consequences of its operations. The Contractor shall provide fencing and barricades around shored excavation to prevent unauthorized persons to access the shored excavation during non-working hours. Trenches shall be covered and barricaded after completion of the day’s work, weekends, and other times as necessary.

The Contractor shall appoint a project safety supervisor, other than the Project Superintendent who shall be experienced in the installation, maintenance, and removal of the selected support system. The project safety supervisor shall have full authority over the work in all job safety matters and shall be on the job at all times when work is in progress in excavations and trenches.
D. EXISTING PIPING:

Contractor shall provide sheeting, shoring, and bracing to protect existing piping where excavation could expose the pipe and/or cause damage to the pipe.

3.02 SEQUENCING

Describe any sequencing requirements associated with sheeting, shoring and bracing. Sequencing requirements should also be reflected in a specification section on work sequence requirements for the entire project.

Excavation shall not commence until the Engineer has returned review comments on the Contractor’s design for sheeting, shoring, and bracing. The 24-inch sanitary line between the existing manhole and the Wet Well shall be installed after the Wet Well shaft has been constructed.

3.03 PAYMENT

Coordinate payment requirements with the bidding schedule. To satisfy state law, the bid schedule must have a line item for Trench and Excavation Support Safety Systems if trenching and excavation is included in the project. The line item for Trench and Excavation Support Safety Systems should be as defined by state requirements and should not be defined to include sheeting, shoring and bracing activities.

The lump sum contract price for Pumping Station Installation in (Reference Bid Item Description) shall be full payment for all labor, materials, tools, and equipment needed to install and remove the temporary sheeting, shoring, and bracing for the new pumping station, wet well, and 24-inch sanitary sewer line; including installation, maintenance and removal of all necessary dewatering systems; providing a project safety supervisor; and designs, submittals, and revisions of the temporary sheeting, shoring, bracing, and dewatering plans.

**END OF SECTION**