APPENDIX L: BRACED EXCAVATION REQUIREMENTS

BRACED EXCAVATIONS

The Contractor shall provide the following for the braced excavation work:

The existing 48" O.D. steel casing pipe crossings will be accessed through approved braced excavation pits for the New Orleans Railroad and the LA 23 dredge pipeline corridor crossings. See permit drawings.

This work shall consist of designing, furnishing, installing, and maintaining the temporary steel sheeting and steel bracing system for the braced excavation pits in accordance with the project plans and specifications. The Contractor shall submit a **Braced Excavation Pit Work Plan** for approval to the CPRA Engineer prior to excavation and placement of the dredge pipe. The Contractor's Braced Excavation Pit Work Plan shall be in accordance with the following sections of the **USACE SECTION 02252-TEMPORARY RETAINING STRUCTURES, May 2001 Edition,** and shall include the following criteria for each proposed temporary braced excavation pit.

- Braced Excavation Pit Work Plan Submittals:
    - ***Shop Drawings*** (24"x36" & 11"x17"): The Shop Drawings shall be stamped by a Professional Engineer registered in the state of Louisiana and adhere to the following criteria.
        - Plan View Layout Sheets: Plan view sheets indicating the plan view of each braced excavation pit along the proposed dredge pipeline corridor.
            - Horizontal scale of 1"=20' minimum or of a sufficient scale to maximize layout per sheet.
                - Horizontal location of the proposed dredge pipeline corridor C.L., existing MR&T levee (toe & crown), MR&T levee inspection road, New Orleans Railroad and R/W, utilities, limits of construction, and LA23 north and southbound travel lanes with R/W.
        - Plan and Section Detail Sheets of Steel Sheeting and Steel Bracing: Plan and section detail sheets indicating all dimensions of the proposed braced excavation pit systems.
            - Horizontal and vertical scale should be of a sufficient scale to maximize the details per sheet.
            - Sheeting and bracing: top of sheeting elevation, natural ground elevation, top of wale elevation, wale location and type, top of strut elevation, strut location and type, dredge/excavation elevation, bottom of sheeting elevation, bottom improvement layer, sump location, existing 48" steel casing, existing utilities, steel sheeting and bracing section type, dimensions, grade of steel, weight, length, and horizontal and vertical dimensions of each pit.

- Construction Notes: The steel sheeting and bracing system properties, excavation sequencing, sheeting installation sequencing, and procedures notes shall be included on the plan sheets.

- Dewatering Plan: (11”x17” & 8.5”x11”) Prior to installation, the Contractor shall submit the dewatering plan for each site to the Engineer. This Plan shall describe the proposed dewatering plan, well point system layout and spacing, equipment, pump out locations, installation sequencing, maintenance, and removal processes.

- Steel Sheeting Installation and Removal Plan: (8.5”x11”) Prior to installation, the Contractor shall submit the Steel Sheeting Installation and Removal Plan for each site to the Engineer. This plan shall include the following. The steel sheeting installation and removal sequencing shall be included in the construction notes.
  - Proposed driving equipment for the steel sheeting.
  - Vibratory hammers or jets shall not be allowed for steel sheeting installation or removal.
  - Ancillary equipment.
  - Installation sequencing.
  - Removal sequencing.

- ***Design Calculations*****:** The Contractor shall develop design calculations for the braced excavation and shall adhere to Section 1.4 Design Calculations, of the **USACE SECTION 02252-TEMPORARY RETAINING STRUCTURES, May 2001 Edition** and shall include the following criteria.
  - Design Safety Factors: The following design safety factors shall be utilized for the analyses of each braced excavation pit.
    - S-Case safety factor greater than 1.0.
    - S-Case safety factor greater than 1.3 for the tip and sheeting.
    - Bracing safety factor greater than 1.0.
    - Heave and uplift safety factor greater than 1.2
  - Loads: All unbalanced loads shall be included and utilized in the design of the braced excavation system(s).
  - Geotechnical Subsurface Investigation Data: The soil strength profile approved by the USACE and developed for the *CPRA, Slope Stability Analyses for the Alliance Anchorage Borrow Site, September 2012 Appendix C, USACE Boring 75MH*, shall be utilized for informational purposes.

- Steel Sheet Piling Materials: The steel sheeting shall be hot-rolled steel, ASTM A 572 Grade 50, or type and grade specified by the designer. The steel sheeting designation, minimum web thickness, minimum section modulus, and minimum moment of inertia must be specified based on the design calculation stipulations and shall be shown on the shop drawings.
- Structural Steel: Structural steel shapes, plates, and materials shall conform to ASTM A-36 or as specified by the designer. Cutting or notching of the structural wales or struts shall not be allowed.
- Welding: Welding qualification for the reinforcing steel shall comply with the latest edition of the American Welding Society (AWS) Code, D01.1 Structural Welding Code- Steel, or as specified by the designer. Electrodes shall be specified on the plan sheets by the designer.
- Submittals: The Contractor shall submit a design report containing all of the legible engineering analyses and design calculations pertaining to the design for each member of the proposed braced excavation system. All design references and methodologies shall be designated in the report. The design report must be stamped by a Professional Engineer registered in the state of Louisiana.

- *Elevations:* All elevations shall be given in NAVD88.
- *Quality Control:* The Contractor shall adhere to the requirements of the CPRA construction technical specifications.
- *Delivery Storage and Handling of Materials:* The Contractor shall adhere to the requirements of the CPRA construction technical specifications.
- *Installation and Removal:* The Contractor shall adhere to the requirements of the CPRA construction technical specifications. As stated above, vibratory hammers shall not be allowed for steel sheeting installation or removal.

The proposed Braced Excavation Pit Work Plan will be reviewed by the CPRA Engineer and submitted to the USACE New Orleans District Engineering, Geotechnical Branch, Mr. Robert Jolissaint, for review and approval. A 10 working day review period by the USACE of the Braced Excavation Pit Work Plan will be allowed prior to excavation. If no USACE comments are received by the CPRA regarding the review of the Braced Excavation Pit Work Plan after 10 working days, the CPRA will proceed with the Work specified in the CPRA approved Braced Excavation Pit Work Plan.

Section Table of Contents

SECTION 02252 - TEMPORARY RETAINING STRUCTURES
{May 2001 Edition}

Retaining Wall Guide Specification
(Latest revision: Oct2001)

SECTION 02252 - TEMPORARY RETAINING STRUCTURES

PART 1 GENERAL

1.1 SCOPE

This work shall consist of designing, furnishing, installing, maintaining and subsequently removing all temporary retaining structures required to complete this project. The Contractor shall be solely responsible for the design, layout, construction, maintenance and subsequent removal and disposal of all elements of the temporary retaining structures.

1.2 MEASUREMENT AND PAYMENT

There will be no measurement for work specified in this section. Payment will be made at the contract lump sum price for “Temporary Retaining Structures”. Price and payment shall constitute full compensation for furnishing all plant, labor, materials, and equipment; designing, furnishing, installing, maintaining, and removing the temporary retaining structures and all other work incidental thereto.

1.3 SUBMITTALS

Submittals shall be in accordance with Section 01330 - "SUBMITTAL PROCEDURES". No work shall proceed until the submittals have been reviewed and approved by the Contracting Officer. The Contractor shall submit an original and [ ] copies of its complete design package consisting of the following for review not to exceed thirty (30) calendar days by the Contracting Officer:

(1) Design calculations.

(2) Shop Drawings. A detailed layout of temporary retaining structures on standard size (34”x44”) sheets. These shop drawings shall bear the stamp and signature of the Registered Professional Engineer. These drawings shall clearly show:

(a) All pertinent dimensions and locations of these structures with reference to the project centerline (Wall-line, Baseline, etc.).

(b) Material grade, weight, length and designation of steel sheet pile section(s) used.

(c) Bracing details.

(d) Excavation sequence and procedure.

(e) Provisions made for dewatering, indicating stage of excavation vs. necessary drawdown, water loading conditions, soil loads and equipment loads.

(f) Any other items incidental or significant to this work.

(g) Equipment Description. Complete hammer, extractors and other installation appurtenances. (If required by the designer)

1.4 DESIGN CALCULATIONS

1.4.1 Design Procedures

*Note To Designer: The designer must include in the plans and specifications all available soil borings and data resulting from those soil borings as a basis for the Contractor's design. The designer must also include the soil design parameters and require the contractor to use them. The designer must present for the Contractor's use the soil unit weight profile along with design short term (Q) and long term (S) case shear strength profiles. The Engineer Manual, EM 1110-2-2906, Design of Pile Foundations in Table 4-6 recommends (S) case shear strengths appropriate for this area.

The Contractor shall follow design procedures using methods of developing soil pressure for estimating the external forces set forth in "Steel Sheet Piling Design Manual" published by U.S. Steel Corp.; the "Pile Buck Inc.™ Steel Sheet Pile Design Manual"; the Virginia Tech Dept of Civil Engineering paper, "An Engineering Manual for Sheet Pile Walls", dated November 1987 or Chapter 4 of the U.S. Army Corps of Engineers Manual EM 1110-2-2504, "Design of Sheet Pile Walls", excluding the Danish Rules Method. If either the loaded side ground surface or dredge line profiles are irregular/multi-sloped (non-horizontal), a "Wedge Method" must be used in developing all soil pressures as described in Chapter 4 of the U.S. Army Corps of Engineers Manual EM 1110-2-2504, "Design of Sheet Pile Walls" (excluding the Danish Rules Method). Determination of the effects of surcharge loads on the soil pressures shall be based on the procedures set forth in the "Pile Buck Inc. ™ Steel Sheet Pile Design Manual". The design performed by the Contractor must evaluate the overall stability and sizing of the sheet piling and other structural elements for the

temporary retaining structures using the Free Earth or Fixed Earth methods. The Contractor shall use design shear strength profile(s) and unit weight data presented in the figure(s) attached at the end of this section for its design. Soil borings are [as shown on the drawings] [attached at the end of this section] for reference. The structure shall meet all the requirements of the Corps of Engineers Safety Manual EM 385-1-1 for fall protection and ingress and egress.

1.4.2 Elevations

*Note to designer: The designer must select a top and tip elevation of the sheet pile and state those at this location in the specs.

The resulting temporary retaining structure shall have sufficient height to retain [*], and have a minimum sheet pile tip elevation [*]. *(The sheet pile tip elevation specified herein is that required for cut-off of recharge of strata having excess hydrostatic water levels.) As a minimum this tip elevation shall be provided regardless of that computed in overturning computation.

1.4.3 Sheet Pile Wall Design

The design of the sheet pile wall shall be developed using a method of analysis indicated in paragraph 1.4.1, with the safety factor applied to the soil strengths on both sides of the wall, for either the free earth or fixed earth method. The soil strengths with the applied factor of safety will be referred to herein as the “allowable” soil strength parameters. The soil properties and stratifications used shall be those presented in the figure(s) [attached at the end of this section] [as shown on the drawings].

1.4.3.1 Loads

*Note to designer: The designer must specify the maximum design loading case such as water to freeboard or soil to the top of wall with free water to that elevation assuming the most critical case.

The minimum safety factor used in the geotechnical design for the determination of overturning tip elevation and sheet pile section modulus is 1.30 in the short term (Q) case analysis and 1.0 for the long term (S) shear strength cases. For design of the sheet pile wall the water conditions outside the excavation shall be [*], while the water inside the temporary retaining structure excavation is in the drawn-down condition. The design shall also include the loading influence of any equipment or surcharge that may be located adjacent to the temporary retaining structure. If the designer elects to account for wall friction and adhesion in the determination of soil pressures, the following criteria shall be used:

(1) a maximum value of 54% of the “allowable” soil friction angle in granular materials may be used for wall friction,

(2) a maximum value of 56% of the “allowable” soil cohesion may be used for adhesion and

(3) no wall friction or adhesion may be applied to the soils above the dredge line.

1.4.3.2 Design of Anchors and Deadmen

In the design of anchors and deadmen the designer shall develop a minimum safety factor of 2.0 for the soil resistance against pull out.

1.4.3.3 Retaining Wall Members

The structural design of the temporary retaining structure excluding the sheet pile shall be designed using industry standards. The earth pressures for the structural design of these wall members shall be based upon a wedge-type method applying a safety factor chosen by the designer which shall be no lower than 1.0.

1.4.3.4 Arch Web “U” Piles.

If arch web “U” piles are used, then the design shall account for and include calculations for shear transfer across their interlocks. Arch web piles or piles with interlocks at or near their center of gravity tend to slip under loading when the shear transfer cannot be achieved across their interlocks. Arch web piles **shall** be designed in accordance with the recommendations set forth in the standard CUR 166 published in 1993 in Holland by the Center for Execution, Investigations and Standardization in Civil Engineering (CUR) (‘*Dammwandconstructies’ Civieltechnisch Centrum Uitvoering Research en Regelgeving, Holland,* available from New Orleans District, Corps of Engineers, ED-T). Anti-slipping connections such as welding or crimping of the interlocks can be employed to **help** prevent displacements of the interlocks. The design calculations shall include all assumptions and shall consider the type(s) of soil, the effects of water, type of wall (i.e. cantilevered versus braced and shall include the location and number of wales, struts, etc), whether the piles are driven singly, in pairs, triple, etc., effects of phased excavation, treatment of the interlocks (i.e. how shear transfer is accomplished through **welding or crimping**), references cited, and any other considerations.

1.4.3.5 Designs and Modifications

All designs and any subsequent modifications to the design presented above shall be performed, certified and stamped by a Registered Professional Engineer and submitted to the Contracting Officer for review and approval. The Registered Professional Engineer shall be present at the Contractor Quality Control preparatory

and initial inspections. The Contractor shall, as a part of the Quality Control, furnish a signed statement by the design Professional Engineer stating that the installation is in conformance with the approved design.

1.4.3.6 Engineering Analysis and Calculations

* Note: The designer must evaluate the potential for use of adjacent structures and address the use in this paragraph.

If the Contractor's construction plan, sequence and/or methods require the use of the existing structures [*] for any purpose, he shall perform engineering analysis and calculations to ascertain that the purpose for which he intends to use the existing structure will not jeopardize the structural integrity of the same or any part, component, or portion thereof. Any damages, direct or indirect, caused to that property and to the property of others due to Contractor's failure to comply with this requirement or negligence in calculations shall be the sole responsibility of the Contractor.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for all operations to assure compliance with contract specifications and maintain records of its quality control for all construction operations, including but not limited to the following:

(1) Designing.

(2) Materials (type, strength, etc.)

(3) Fabrication, installation and workmanship.

(4) Full and proper engagement of Interlock (inspection and strength).

(5) Placing (location, alignment, etc.).

(6) Driving (pile hammer and rate of operation).

(7) Cutting.

(8) Welding.

(9) Final sheet pile position; depth of penetration; tip and top elevations.

(10) Stockpiling and Storage.

(11) Removal and disposal of damaged piles.

1.5.2 Reporting

The original and two (2) copies of these records and tests, as well as the corrective action taken, shall be furnished the Government daily. Format of the report shall be as prescribed in Section 01451 - “CONTRACTOR QUALITY CONTROL”.

1.6 DELIVERY, STORAGE AND HANDLING OF MATERIALS

Materials delivered to the site shall be undamaged and shall be accompanied by certified test reports. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate inspection.

PART 2 PRODUCTS

2.1 SHEET PILING

Note: The hot rolled sheet pile is required to be in conformance with ER 1110-2-8152.

The sheet pile shall be hot rolled sheet pile.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Placing and Driving

3.1.1.1 Placing

Suitable temporary wales, templates, guide structures, or other approved methods shall be provided to insure that the piles are placed and driven to the correct alignment as shown on the Contractor’s shop drawings. Piles shall be placed with each pile interlocked with adjoining piles for its entire length, so as to form a continuous diaphragm throughout the length of each run of piling wall. Interlocks shall be properly engaged. The Contractor’s personnel shall not sit or place themselves on top of the sheet piling during the handling, installation, and removal of the piling.

3.1.1.2 Driving

All sheet piles shall be driven to the depths shown on the Contractor' shop drawings. Pilings shall be driven by approved methods so as not to subject the pilings to damage and to insure proper interlocking throughout their lengths. (NOTE DESIGNER COULD SPECIFY A TYPE of HAMMER, IF REQUIRED AND EQUIPMENT PARAGRAPH SHOULD BE ADDED AS PARAGRAPH 3.1.1) Pilings damaged during driving or driven out of interlock shall be removed and replaced. All piles shall be driven without the aid of a water jet, unless otherwise authorized (THE DESIGNER COULD SPECIFY A HYDRAULIC HAMMER THAT PUSH THE STEEL SHEET PILING INTO THE GROUND, YOU MAY ALLOW JET WITH RESTRICTIONS). Unless specifically indicated otherwise, each run of piling wall shall be driven to grade progressively from the start and pilings in each run shall be driven alternately in increments of depth to the required depth or elevation. On each day of sheet pile driving, the Contractor shall stab only the number of piles that can be driven to grade by the end of the day, and all piling stabbed shall be driven to grade by the end of each working day except that the last two piles may remain tapered up to receive the next days piles. If the piling next to the one being driven tends to follow below final grade, it may be pinned to the next adjacent piling. The Contractor is advised that buried stumps or similar debris may be encountered periodically on the sheet pile wall alinement and appropriate consideration should be given to hard driving conditions should they occur. Piles shall not be driven within 100-feet of concrete less than 7 days old nor within 30- feet of concrete less than 28 days old and driving shall cease if peak particle velocity exceeds 0.25 inches per second (ips) at the nearest placed concrete. These time requirements can be relaxed to no driving within 100-feet of concrete placed less than 3 days old nor within 30-feet of concrete less than 7 days old, only if the Contractor meets all of the following requirements:

a. Concrete shall reach a minimum of 75% of it's 28 day strength at 3 days. (i.e. for 4000 psi concrete, 3 day strength would be 3000 psi)
b. Concrete shall reach the 28 day strength at 7 days.
c. Use all cement concrete (no fly ash).
d. Cease driving if peak particle velocity exceeds 0.25 ips for concrete placed within 3 days and 0.50 ips for concrete placed within 7 days, and 0.75 ips for concrete placed after 7 days.
e. The Contractor shall submit a plan for monitoring the vibration levels stated above. At a minimum, vibrations should be monitored at the base of the nearest concrete and up to 30 feet away on each side of the nearest point, since the maximum vibration may not occur at the nearest point. The Contractor shall also monitor vibrations at the top of any concrete walls, since vibrations could be amplified up to eight times at this location.

3.1.2 Emergency Locking System on Pile Driving Head

All pile driving equipment shall be equipped so as to prevent piles from falling when a single or multiple power failure occurs after the pile driving head is attached to the pile. The jaws of vibratory hammers shall be equipped with devices such that upon loss of hydraulic pressure, the jaws will not release the pile.

3.1.3 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be damaged or driven out of interlock shall be removed and replaced.

3.1.4 Void Backfill

Where voids adjacent to the steel sheet piling are induced by pile driving operations, the Contractor shall pump out all seepage and rain water and backfill with a tremie-placed slurry. The slurry shall consist of one part cement, two parts bentonite, and six parts sand mixed with enough water to produce a slurry viscous enough to thoroughly fill the voids.

3.2 REMOVAL OF MATERIAL

3.2.1 Removal Criteria

The temporary retaining structures shall not be removed until suitable backfill, between the finished structure and the steel sheet pile wall of the temporary retaining structures, is satisfactorily placed and compacted to an elevation approximately one (1') foot below the finished surface. Temporary retaining structures or piles shall not be pulled within 100-feet of concrete less than 7 days old nor within 30- feet of concrete less than 28 days old. Nor, shall the temporary retaining structures be removed until the completed permanent structure and/or excavations are rewatered. For a relaxation of the time requirements for temporary retaining structures removal, all the requirements specified in paragraph 3.1.1.2 items (a) thru (g) shall be met. Where voids are induced by removal operations, the Contractor shall pump out all seepage and rainwater and backfill to within 3 feet of the ground surface with a tremie-placed slurry. The slurry shall consist of one part cement, two parts bentonite and six parts sand mixed with sufficient water to produce a slurry viscous enough to thoroughly fill the voids but have no less than 12 pounds of solids per gallon. The upper 3 feet shall be filled with backfill. Backfill and compaction requirements shall be as defined in [Section 02320 - "STRUCTURAL EXCAVATION AND BACKFILL"]. All Contractor-furnished temporary retaining structures shall be removed from the site of work upon completion of work.

3.2.2 Safety

The removal of the temporary retaining structures shall be accomplished in a manner not injurious to the properties adjacent to and in the proximity of the project excavations.