Appendix 4-A: Methodology Statement for Bulkhead Penetration and Transition Vault Tie-In

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

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METHODOLOGY STATEMENT

SUBMARINE CABLE INSTALLATION
HARLEM RIVER SEGMENT 20A
CHPE DC CABLE SYSTEM
Bulkhead Penetration
&
Transition Vault Tie-In

SUBMITTED TO:

NKT HV CABLES AB.

SUBMITTED BY:

CALDWELL MARINE INTERNATIONAL

1333 CAMPUS PARKWAY

WALL TOWNSHIP, NJ 07753

732-557-6100

CALDWELL MARINE INTERNATIONAL LLC. 1333 Campus Parkway, Wall Township, New Jersey 07753 **PROJECT QUALITY ASSURANCE**	**Type:** Methodology Statement **Prepared By:** Greg Gashlin **Document #:** **Date**: July 19, 2024 **Revision No:** 2.0

DOCUMENT TITLE: SUBMARINE CABLE INSTALLATION HARLEM RIVER SEGMENT 20A CHPE DC CABLE SYSTEM - Bulkhead Penetration & Transition Vault Tie-In

APPROVALS:

Brett Bailey_____
General Manager – Caldwell Marine International LLC.

Rev.	Description	Date	Approval
0.0	Issued for EM&CP Review	2024-02-05	TU
1.0	Issued for EM&CP Review	2024-03-06	TU
1.1	Issued for EM&CP Review	2024-05-06	TU
1.2	Revised per CHPE Comments	2024-05-22	TU
2.0	Revised per CHPE Comments	2024-07-19	TU

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

Table of Contents

1 Introduction

Champlain Hudson Power Express, LLC and CHPE Properties, Inc. plan to construct, operate and maintain a new 1250 MW high-voltage direct current ("HVDC") underwater/underground electric transmission facility ("HVDC Transmission System") of clean hydro-electric power from Quebec, Canada to the New York City power market.

The CHPE route has been carefully designed to minimize its impact on the environment. Burying the cables keeps it out of sight and protects it from extreme weather. Within the US, the cable route will be comprised of both land and submarine cable segments. Two five-inch power cables and a smaller fiber optic cable will be installed underwater or underground and run approximately 339 miles from the U.S. – Canadian border, south through Lake Champlain, along and under the Hudson and Harlem Rivers to eventually terminate at a DC / AC electrical converter station that will be built in Astoria, Queens.

This document details the methodologies that will be employed during CMI's preparation of the Bulkhead Penetration for the southern cable landing of Harlem River Segment only.

2 Background

Original route landing alignment travelled thru an existing ConEd vault and active power cables crossing easement. An HDD option was reviewed and deemed infeasible due to the combination of existing utilities in the river at the punchout location and the rock formation in underlying strata. The proposed relocation of the CHPE submarine cable landing is approximately 55' NW of the existing concrete bulkhead. This relocation will allow the submarine cable route to remain within the current permitted deviation easement in Harlem River.

The following listing provide an overview of the installation parameters for the CHPE Harlem River Bulkhead Penetration:

Harlem River Route Origin Location:	Bronx Landing Area at Waste Management Property
Cable Bundle Protection Types:	
Bronx Landing, NY	Encasement in 2 x High Density Polyethylene (HDPE) ducts
Segment Route Utility Crossing Count:	Per finalized CHPE, LLC. listings
Time of Year (ToY) Restrictions:	Submarine cable installation is permitted June 1st to January 14th per ACOE Permit and May 15th to November 30th per the WQC Article VII.

3 Scope & Installation

At the southern end of the Harlem River submarine cable segment, CMI proposes installing the submarine cables thru the bulkhead at the property line at the Waste Management - Harlem River Yard Transfer Station. CMI will be installing the proposed bulkhead structure. Trench excavation will occur from proposed bulkhead inland for approximately 60' to the transition vault. The extents of the trench width and depth will be able to accommodate the installation of (2) 12" HDPE pipe conduits. Steel Sheeting, Trench boxes or other approved engineered designed shoring will be used for support of trench excavation.

To maintain the existing timber cribbing and slope stabilization, a proposed 40'± long wall of steel sheeting with secured tie-rod structure is proposed at the property line of the bulkhead, (20' each side of the centerline of proposed route). The bulkhead sheeting will be installed to proposed elevation per approved engineered plans.

A temporary cofferdam cell will be installed riverside of the bulkhead sheeting wall to accommodate the required excavation to install the proposed HDPE pipe below existing mudline in preparation of the power cable install. Upon completion of the pipe installation and backfill, the steel sheeting will be removed.

The trench will be excavated to below the existing river mudline elevation at the bulkhead face and slope up to approximately 8' deep from existing inland grade. After excavation of the shored trench, CMI proposes installing two (2) 12" HDPE SDR 9 pipes (currently used as land to water HDDs conduit for this project) as conduit for the submarine cable landing. The HDPE pipes will be installed to ~60' inland of the bulkhead location and connect to the existing transition vault. The trench will be backfilled with certified clean fill, flow fill, and/or concrete that meet thermal resistivity requirements. The trench sheets will be cut below existing grade, removed completely or combination thereof, as required.

3.1 Land Site Mobilization

- Setup Temporary Security Fence (~100 x150)
- Setup Office Trailer(s)
- Dewatering Filtration System (as Required)
- Soil Disposal Dumpsters (as Required)
- Solid Waste Dumpsters (as Required)
- Excavator(s) - CAT345 or similar, Long Reach Excavator
- CAT 938 Loader or similar
- 150-ton Crane (Crawler, All Terrain, Rough Terrain)
- Vibratory Hammer with Power Pack
- Diver Spread
- Field Office & Port-o-Sans
- Ancillary Equipment (as Required) – generators, compressors, welders, etc.
- Steel Sheeting
- H/W Shape Steel beams
- Precast Concrete
- Rip-Rap Stockpile area
- Stone & Excavated Soils stockpile area(s)
- Trench SOE equipment and materials

3.2 Crane Barge Spread Mobilization

- Mobilize 180'x60' barge or of similar dimension barge
- Mobilize 110'x 36' material barge or of similar dimension barge
- Excavator(s) - CAT345 or similar, Long Reach Excavator
- 150-ton Crane or similar (Crawler, All Terrain, Rough Terrain)
- Vibratory Hammer with Power Pack
- Diver Spread
- Field Office
- Ancillary Equipment (as Required) – generators, compressors, welders, etc.
- Steel Sheeting

- H/W Shape Steel beams
- Precast Concrete or Cast-in-Place anchor structure

3.3 Bulkhead Penetration & Tie-In Installation

- Installation of sheeted bulkhead with tie-back per engineered plan
- Installation of temporary sheeted cofferdam
- Excavate and store existing riprap
- Remove existing timber cribbing, as required
- Installation of trench shoring per engineered plan
- Excavate trench and cofferdam
- Cut opening in bulkhead wall for pipe penetration
- Fuse and install (2) 12" HPDE pipes at ~60' Each
- Connect to Transition Vault
- Backfill trench with stone bedding and certified clean fill / Flow fill / concrete
- Cut sheeting to required depth below grade, leave remaining in place.
- Remove Temporary cofferdam sheeting
- Install precast concrete block retaining wall
- Restore site

4 Materials Required

- Bulkhead –steel sheeting, walers, piles, struts, tie-rods
- Trench – steel sheeting, walers, struts
- Temporary Cofferdam – steel sheeting, walers, struts
- Trench Shoring materials – Trench Boxes, Steel Plate, etc.
- (2) 12" SDR 9 HDPE pipes
- Transition Vault – Concrete & Pipe opening seal
- Concrete retaining wall structure
- Certified Clean Fill
- Flow Fill
- Concrete
- Crushed stone fill

5 Task Methodologies

5.1 Mobilization & Preparation

5.1.1 Harlem River Yard

The Harlem River Yard site is currently occupied by Waste Management. The area of the bulkhead penetration is in an unoccupied area of the property, allowing CMI to setup a temporary area for the Work. CMI will setup temporary fencing area of approximately 150' x 100' around the proposed excavation per **Figure 1** below. Equipment such as excavators, cranes, loader, generators, tool container and temporary offices will be mobilized to site to install and excavate the trench. Dewatering filtration system will be installed onsite, if required. Stockpile areas will be installed for temporary storage of excavated materials. See **Appendix 1 – Site Layout.**

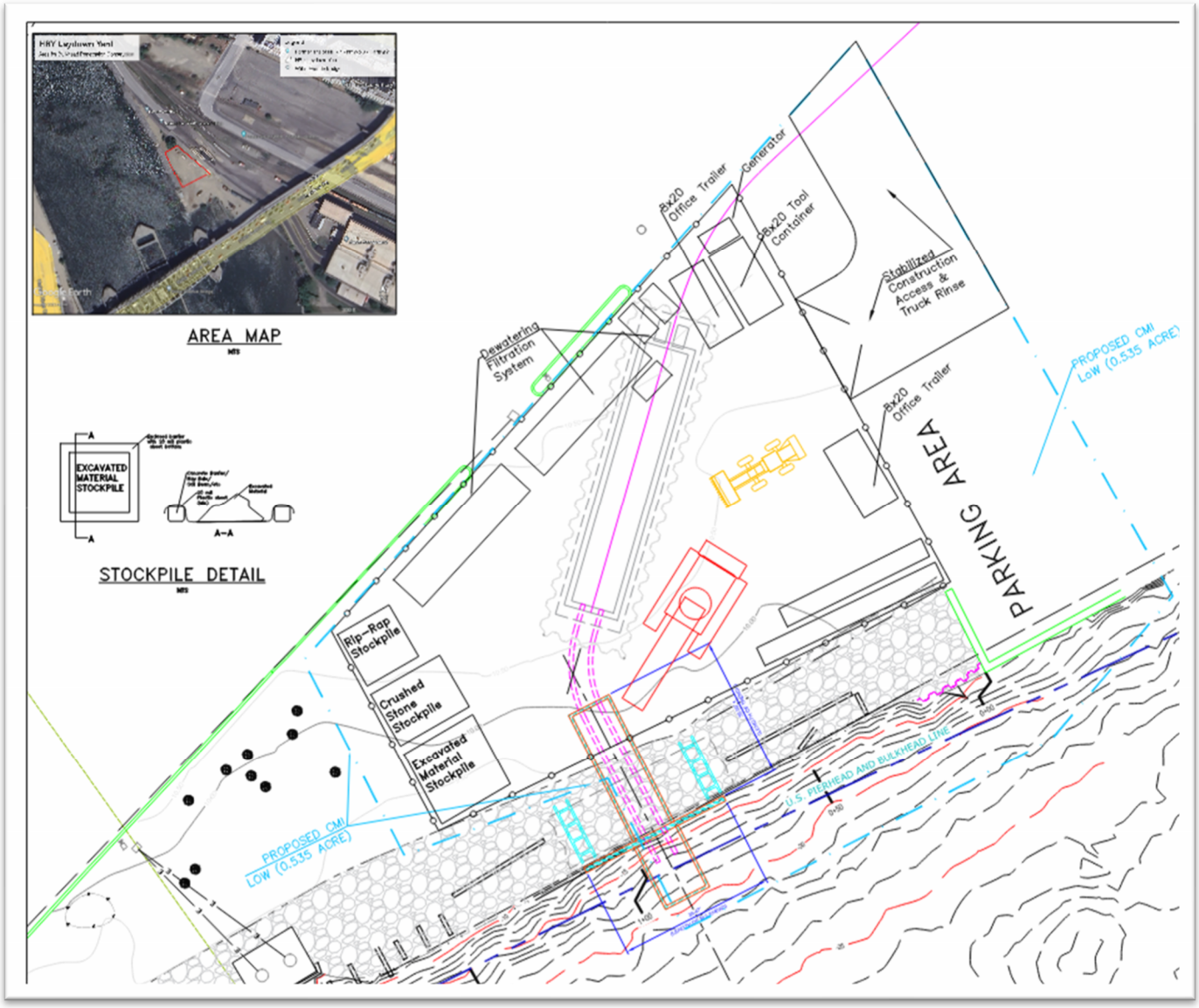

Figure 1 - HRY Work Area - UPDATE

5.1.2 Caldwell Marine Yard (Staten Island, NY)

CMI will use its waterfront property on Staten Island, New York as an operational base. This location has served as CMI's operational base for previous marine projects. CMI will mobilize equipment to this location in the early phases of the CHPE Project. The base will serve multiple support functions including:

- Mobilization and support of Crane Barge Spread and material barge
- Mobilization of & support of CMI operational vessels
- Personnel, Equipment, Services transfer staging point
- Emergency personnel transfer point.
- Exchange / clean-out service point for sanitation equipment (Port-a-Sans etc.)

NOTE: *Other locations will be used when transit distance to / from Harlem River Yard is deemed excessive*

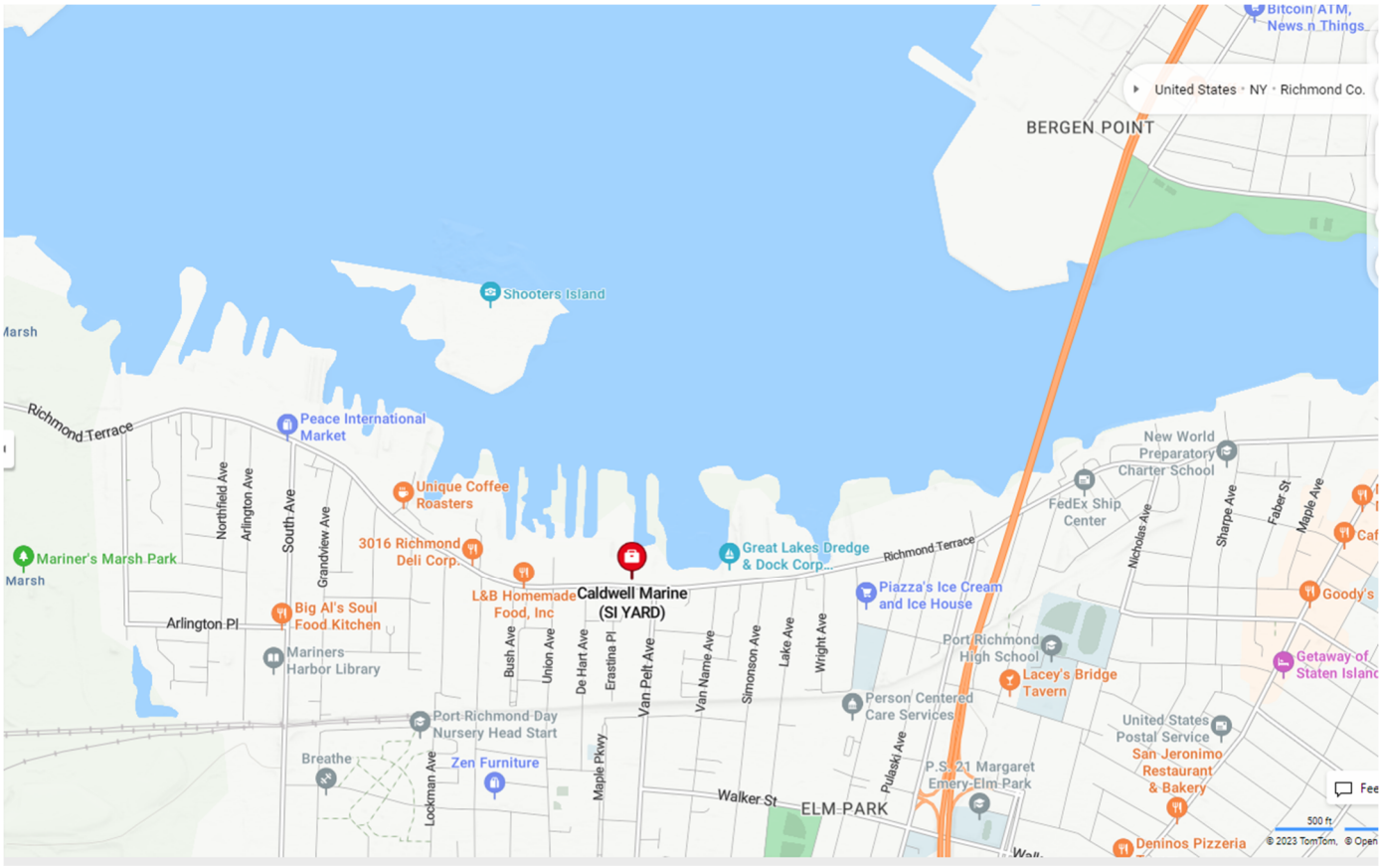

Figure 2 – Caldwell Marine Yard, Staten Island, New York

5.1.3 Marinas

CMI has identified the following locations as proposed locations for crew travel to Crane Barge Spread, delivery of small tools and equipment and services:

1. Englewood Marina at Henry Hudson Drive, Englewood Cliffs, NJ 07632
2. Liberty Harbor Marina Boatyard at 15 Marin Blvd, Jersey City, NJ 07302
3. 3Liberty Landing Marine at 80 Audrey Zapp Drive, Jersey City, NJ 07302

5.2 Bulkhead Penetration Installation

When permitted, CMI will mobilize to the Harlem River Yard. Temporary Fencing will be installed around the work zone and soil erosion and sediment control measures, such as silt fencing, temporary stone construction pad, etc. will be installed. Equipment and materials will then be delivered to site, as needed, to perform the work. Dewatering System and discharge pipe will be installed, as required, and temporary material stockpile areas delineated.

Once the site is mobilized and the trench extents marked, CMI will proceed with bulkhead penetration operations. The existing riprap will be removed and stockpiled on-site. The crane on land and/or on barge will setup in appropriate orientation and install the bulkhead sheeting and temporary cofferdam via vibratory hammer. Vibratory hammer operations will be performed with a soft start before ramping up. Trench

excavation material will be stockpiled onsite and then disposed via trucking. Excavated material from the temporary cofferdam will be placed in containment setup on barge(s). All material will then be disposed of to the previously approved facilities per EM&CP CN 079 & 82. Please refer to **Appendix 9 – Approved Soil Disposal Facilities.**

For installation of the temporary cofferdam, bulkhead wall and trench shoring, the excavator may pre-excavate the area to remove any existing obstructions that would inhibit the proper installation of the proposed shoring method. The crane will vibrate the steel sheets to location and required depth as shown on engineered drawings. CMI will then begin to excavate the trench and temporary cofferdam and install support steel per the SOE plans install procedure. No dredging or excavation will occur outside of sheeted cofferdam. Excavation within temporary cofferdam will be completed by excavator or non-environmental clamshell bucket on crane. Excavation bucket path to temporary storage locations (via scow barge, lined dumpster, stockpile) will be optimized to minimized path over open water. Barges and marine vessels will maintain a minimum 2' clearance above river bottom. Steel sheeting, trench boxes or slide rail may be used for shallower excavation from the cofferdam to the transition vault. The trench will be excavated, and trench shoring lowered sequentially until required elevation is reached. Trench may be lined with ¾" stone or similar to create stabilized work surface. Any excavated soil to be decanted will have a minimum 24-hour settlement period.

Two (2) 12" HDPE conduits will be fused to ~60 fit lengths, de-beaded, proofed and end caps installed. Before installing the conduits into the trench, the marine side end of the sheeting will have a diver cut the opening in the sheets at the required elevation. The conduit will be transitioned into the trench and through the bulkhead penetration, via sinking and diver assistance, then transition to rest on the river bottom. The pipes are then laid into position within the sheeted trench and secured from movement or floatation via tremie poured concrete, concrete collars, ballasts or similar. The pipe ends will be sealed so soil and debris will not infill prior to power cable installation. The onshore ends of the pipe will be installed into the transition vault. The connection to the vault will be finished and secured with hydraulic grout, concrete, or link-seal type product.

Within the temporary cofferdam and excavated trench, the location, elevation, and alignment of the (2) HDPE pipes will be recorded for field records. The trench and cofferdam will then be backfilled and compacted with certified clean fill (DOT/DEC/DEP) or equivalent, flow fill, and concrete or combination thereof from locally sourced supplier. The trench sheeting will be cut to below grade and/or removed as required. The precast retaining wall will be installed and site final graded. The existing riprap will be restored. After the temporary cofferdam is backfilled with clean fill and/or gravel to existing grade elevations, the sheeting system will then be removed.

Once complete and accepted, CMI will restore and demobilize from work site. Please see **Appendix 2 – Proposed SOE Design and Site Plan.**

5.3 Harlem River Yard HDPE Duct Proving / Cleaning

CMI will prove and clean ducts during our civil works duct installation process. The duct proofing and cleaning will utilize marine support vessels and land-based equipment to pull mandrel(s), cleaning and proofing pigs, and messenger wire. Marine support vessels may include but not limited to skiffs, work boats, and/or barges.
On completion of cleaning / proving, the ducts will be left:

1. Threaded end-to-end with adequate length of messenger wire to reach the working deck of the marine support vessel.
2. Cap HDPE pipes with temporary caps to minimize the risk of subsequent duct contamination with foreign materials.

6 Marine Weather Conditions / Operational Weather Limits

Marine Weather Conditions

The following meteorological factors apply to Harlem River waters:

Location:	River waters are categorized as 'inland'.
Tidal effect:	River water levels are effects by tides (~4.5' between High and Low Tide)
Current strength / Direction:	Under normal conditions, current flow direction and strength dependent on incoming or outgoing tide (~3 knots ±) .

Monitoring of Site Weather Conditions & Forecasts

During the operational periods for the Crane Barge Spread or Land work, the Superintendent / appointed alternate will monitor the current and forecast weather conditions for operational work sites and vessel transit routes. The Superintendent will notify the attending NKT Representative if a temporary suspension of project activities is required due to weather (actual or forecast).

The Superintendent's primary weather forecast resource will be NOAA Marine Weather.com (Governmental). The Superintendent will typically also review web-based, non-governmental resources which may include:

- https://www.windy.com
- https://www.buoyweather.com/
- https://www.windalert.com
- https://climeradar.com

Recording of Site Weather Conditions

Site weather conditions will be recorded in a dedicated section of the Daily Report. Recorded values will either be derived from:

a. Local observation, or
b. Download from a local registered NOAA weather observation station (airport or similar)

Operational Weather Limits

Wind:	OSHA safety rules dictate a maximum wind strength of 25mph for crane Operations. All applicable crane manufacturer guidelines with respect to use of crane equipment on vessels will also be adhered to.
Current Strength:	Maximum current strength 2 knots for diving operations outside of temporary cofferdams, trenches, or structures.
Sea / Swell Height:	Marine side Work may be delayed / suspended at the discretion of Marine Superintendent / Dive Supervisor / Tug Captain / Crew Boat Captain; these parties will use a wave height of 3ft to 5ft (~1m -1.5m) as a guideline reference limit.

7 Operational Hours

The overall installation schedule for this scope of work is approximately 3 months. The intended work days and hours shall be 7 days per week from 7 A.M. to 6:00 P.M. Extended work hour requests will be submitted and approved, prior to working beyond allowable work hours. Holidays may be worked to maintain project schedule and complete operations in permitted work in water window(s) and/or Time of Year Restrictions.

8 Environmental Protection Measures

8.1 Oil Pollution Prevention

Please see dedicated SOPEP document in Appendices.

An Emergency Notification Flowchart on board and onsite provides notification requirement and contact details in the event of emergency situations and incidents:

- The operational vessel and laydown yard will carry emergency 'spill kit(s)'
- The operational vessel fuel stocks onboard will be kept to a practical minimum.
- The operational vessel and laydown yard fuel storage vessels will feature double-wall construction.
- As an emergency contingency measure CMI has pre-arranged that US Ecology, a US based Oil Spill Removal Organization (OSRO) will be available on 'call-out' basis to provide professional clean-up support. For further details, please see: https://www.usecology.com/.

8.2 Solid Waste Management

Please refer to Soil and Material Management Plan included as an Appendix in overall EM&CP submission with this document.

General

Disposal of waste into Harlem River waters is strictly prohibited by local, State & Federal law.

- Crews and contractors will be notified accordingly at the Project 'Kick-Off Meeting' and daily shift change / TBT meetings.
- New crew members/ contractors will be notified during the project and vessel and site familiarization processes.

The operational vessel and laydown yard will be mobilized with waste containment bins, these bins will feature closeable lids and heavy grade, disposable plastic liners. Bin liners will be exchanged regularly and filled bags will be transported for proper disposal. Recovered debris will be verified, handled and disposed of in appropriate bins and/or containers.

Excavated Soils

Excavated soils will be stockpiled in containment area for decanting. The material will then be trucked and disposed of to the previously approved facilities per EM&CP CN 079 & 82. Please refer to **Appendix 9 – Approved Soil Disposal Facilities.** The containment area will be barriered off and plastic underlayment to capture the decanted water. Trucks exiting the worksite to be rinsed off, as needed, over the stoned stabilized construction access. For cofferdam excavated soils, the Crane Barge or Material Barge (such as scow) will create a containment with barrier or roll-off type containers lined with plastic. This will be transported to CMI Staten Island Yard and off-loaded landside to be disposed at the project approved facilities.

Additionally, silt fence and silt curtain will be installed onsite. Silt fence to be installed during mobilization of site. The silt curtain will be installed and secured to the extents outside of the Limit of Disturbance. Please see **Appendix 2 – Proposed SOE Design and Site Plan**, page 7305-ESC1&2 for locations and details. Permits will be obtained to have water supply from local hydrant.

8.3 Wastewater Management

Please refer to Soil and Material Management Plan and SWPPP, included as Appendices in overall EM&CP submission with this document.

General

Disposal of untreated wastewater into Harlem River waters is strictly prohibited by local, State & Federal law.

- Crews and contractors will be notified accordingly at the Project 'Kick-Off Meeting' and daily shift change / TBT meetings.
- New crew members/ contractors will be notified during the project and vessel and site familiarization processes.

The operational vessel and laydown yard will be equipped with portable toilet units that will be sourced from a local provider.

- Soiled / clean portable toilet units will be transferred by means of crew transfer vessel / work vessels
- Soiled / clean portable toilet units will be onsite at laydown yard.
- Portable toilet change-out / clean-out service will be performed by the local service provider at the operational base located at CMI Staten Island Yard and/or HRY Laydown Yard.

Dewatering

Per **Appendix 2 – Proposed SOE Design and Site Plan,** dewatering is not required for the installation and excavation of the sheeted trench. In the event water is found at elevations that prohibit installation of the structural components, such walers, struts, footings, etc., dewatering methods may be employed. Dewatering operations will be required for disposal of decanted water from excavated soil stockpile. Proposed water filtration methods will consist of settlement time, filter bag and sand/or carbon filter media. No chemical treatment planned to be utilized.

- **Option 1 - Discharge Offsite** – Pumped groundwater from the excavation can be stored in a settlement frac and/or weir tank, then pumped to tanker trucks and disposed of offsite to approved facility as stated in the Soil and Material Management Plan Appendix.
- **Option 2 - Discharge Onsite** - Pump(s) can be setup within the excavated area and discharged to a holding tank and filtration system. The system will allow time for settlement of TSS via settling tank and or weir tank. Additional filtration, if required, via filter bag type and/or filtration medium tanks. Typical details of the system are found in **Appendix 10 – Dewatering System.** Discharged waters will be tested prior to meet applicable SPDES General Permit requirements and piped to the nearest sewer location as permitted thru NYCDEP / NYSDEC.

Appendix 1 – Site Layout

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

AREA MAP

NTS

STOCKPILE DETAIL

NTS

This document contains ideas and designs that are the property of Caldwell Marine International (CMI). Thus, the information is not to be used, in whole, or in part for any other project without written authorization of CMI.

1333 Campus Parkway
Wall Township, N.J. 07727
(732) 557-6100

Champlain Hudson Power Express

HRY BHP – GA Site Layout

GMG	2024-07-16
TU	2024-07-16
1233	1 | 0

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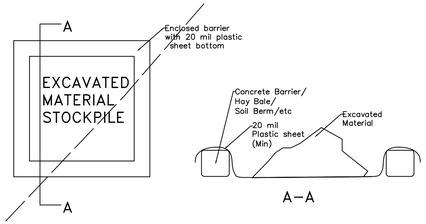
CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

AREA MAP

NTS



STOCKPILE DETAIL

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Wall Township, N.J. 07727
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Champlain Hudson Power Express	
HRY BHP – GA Barge Layout	
NTS	
GMG	2024-07-16
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Appendix 2 – Proposed SOE Design and Site Plan

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

This Appendix contains confidential commercial information, trade secrets, and/or proprietary information and as such is entitled to confidential treatment under Section 87(2) of the New York State Public Officers Law and the Commission's regulations (16 NYCRR 6-1). An unredacted version of this document has been submitted under separate cover to the Records Access Officer.

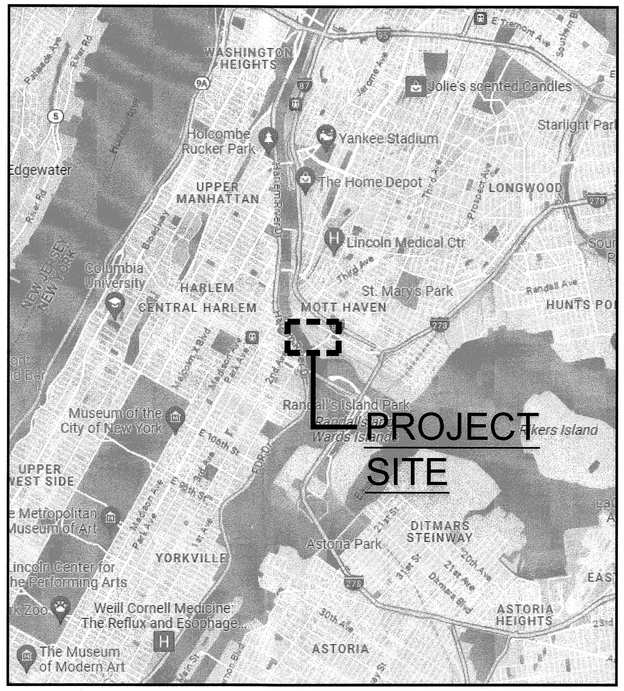
CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

CHPE CABLE LANDING

90 LINCOLN AVE

BRONX, NEW YORK

PREPARED FOR: CALDWELL MARINE INTERNATIONAL
1333 CAMPUS PARKWAY
WALL TOWNSHIP, NJ 07753



LOCATION MAP

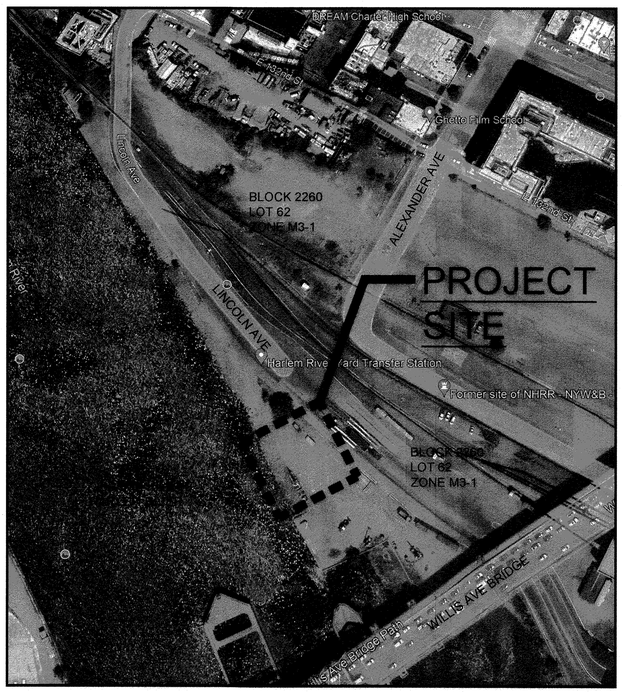
SCALE: NONE — OBTAINED FROM GOOGLE MAP

DRAWING LIST

7305-CVR	COVER SHEET
7305-C1	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH PARTIAL SITE PLAN
7305-C2	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH LOCATION PLAN
7305-C3	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH GRADING PLAN & FINAL LAYOUT
7305-C4	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH OVERALL PLAN
7305-C5	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH PARTIAL PLAN
7306-C6	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH SECTIONS & DETAILS
7305-C7	PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH SECTIONS & DETAILS SHEET 2
7305-ESC1	SOIL EROSION & SEDIMENT CONTROL PLAN ESC SITE PLAN
7305-ESC2	SOIL EROSION & SEDIMENT CONTROL PLAN DETAILS & NOTES

NEW YORK ONE-CALL:

ANYONE WHO INTENDS TO PERFORM EXCAVATION OR DEMOLITION WORK FOR THIS PROJECT SHALL COMPLY WITH "UNDERGROUND FACILITIES: ONE-CALL DAMAGE PREVENTION SYSTEM" AND CONTACT THE "NEW YORK ONE-CALL SYSTEM" AT 811 OR 1-800-524-7603 AT LEAST TWO (2) FULL WORKING DAYS, BUT NOT MORE THAN TEN (10) DAYS, PRIOR TO THE PLANNED START DATE OF THE WORK.



VICINITY MAP

SCALE: NONE — OBTAINED FROM GOOGLE EARTH

APPLICANT: CALDWELL MARINE INTERNATIONAL
1333 CAMPUS PARKWAY
WALL TOWNSHIP, NJ 07753
(732) 557-6100

ENGINEER: ROBERT P. PERLA, PE
RPMS CONSULTING ENGINEERS
1 ROSSMOOR DRIVE, SUITE 300
MONROE TOWNSHIP, NJ 08831
(609) 655-9292

REVISION	DATE	DESCRIPTION
0	5/9/24	ISSUED FOR CONSTRUCTION
B	4/9/24	RE-ISSUED FOR REVIEW
A	2/14/24	ISSUED FOR REVIEW

RPMS CONSULTING ENGINEERS
1 ROSSMOOR DRIVE, MONROE TOWNSHIP, N. J. 08831

CHPE CABLE LANDING FOR CALDWELL MARINE INTERNATIONAL

COVER SHEET

STATE OF NEW YORK — ROBERT P. PERLA — PROFESSIONAL ENGINEER — 084709
ROBERT P. PERLA
PROFESSIONAL ENGINEER
NY 084709

DRAWN BY: JF	CHECKED BY: JAH
DATE: 6/14/2023	SCALE: AS SHOWN
APPROVED BY: RPP	PROJECT NO.: 7305
DRAWING NUMBER: 7305-CVR	

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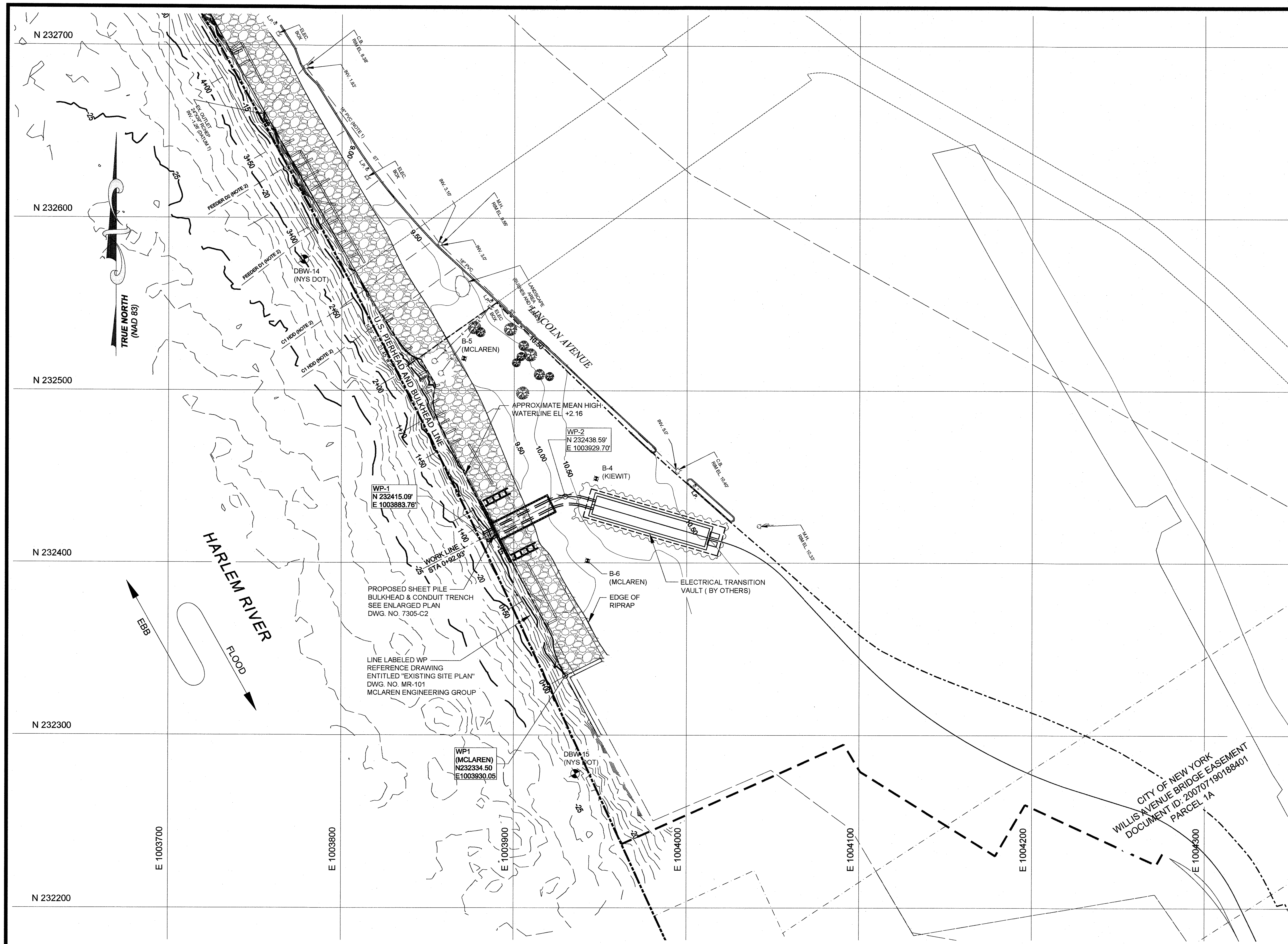
CONTAINS REDACTED INFORMATION IN CASE 10-T-0139



PARTIAL SITE PLAN

30 0 30 60

GRAPHIC SCALE
1"=30'

NOTES:

1. STORM SEWER AND CON EDISON CABLES INFORMATION FROM " HARLEM RIVER YARD INTERMODEL TRANSPORTATION AND DISTRIBUTION CENTER" DRAWING CC-2 DATED 7/25/97, TAMS CONSULTANTS, INC.
2. ELECTRICAL HDD CROSSINGS FROM "98 LINCLON AVENUE BULKHEAD REHABILITATION" DRAWING MR-104 DATED 10-14-2022 BY MCLAREN ENGINEERING GROUP.
3. RIVER SOUNDINGS FROM "98 LINCLON AVENUE BULKHEAD REHABILITATION" SITE SURVEY DRAWING NO. MR-100 DATED 10-14-2022 BY MCLAREN ENGINEERING GROUP. BATHYMETRIC SURVEY PERFORMED JULY 2020.
4. TIDE WATER ELEVATIONS BASED ON NOAA VDATUM V3.9 AS PER MCLAREN ENGINEERING GROUP DRAWINGS.

REVISION	DATE	DESCRIPTION
1	7/16/24	REVISED PER CLIENT'S REQUEST - RE-ISSUED FOR REVIEW
0	5/9/24	ISSUED FOR CONSTRUCTION
B	4/9/24	RE-ISSUED FOR REVIEW
A	2/14/24	ISSUED FOR REVIEW

RPMS
CONSULTING ENGINEERS
1 ROSSMOOR DRIVE, MONROE TOWNSHIP, N. J. 08831

CALDWELL MARINE INTERNATIONAL
CHPE CABLE HARLEM LANDING
PROPOSED SHEET PILE BULKHEAD & CONDUIT TRENCH
PARTIAL SITE PLAN

STATE OF NEW YORK · ROBERT P. PERLA · 054709 · LICENSED PROFESSIONAL ENGINEER

ROBERT P. PERLA
PROFESSIONAL ENGINEER
NY LICENSE NUMBER 054709

DRAWN BY GT	CHECKED BY JAH
DATE 6/14/2023	SCALE AS SHOWN
APPROVED BY	PROJECT NO. 7305
DRAWING NUMBER 7305-C1	

Appendix 3 – Additional Shoring

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

TABULATED DATA

This Trench Shield will comply with O.S.H.A. REF: U.S. Dept. of Labor O.S.H.A. Safety & Health Standards (29 CFR 1926/1910)
Revised March 5, 1990 Subpart P - Excavations, Trenching & Shoring Selection of Protective Systems 1926 652 Appendix C
THIS STRUCTURAL ANALYSIS WAS MADE IN ACCORDANCE WITH THE STANDARDS OF THE "SPECIFICATION FOR THE
Design, Fabrication & Erection of Structural Steel for Buildings" of the American Institute of Steel Construction

TRENCH SHIELD DESCRIPTION

DESIGN BY REGISTERED PROFESSIONAL ENGINEERS

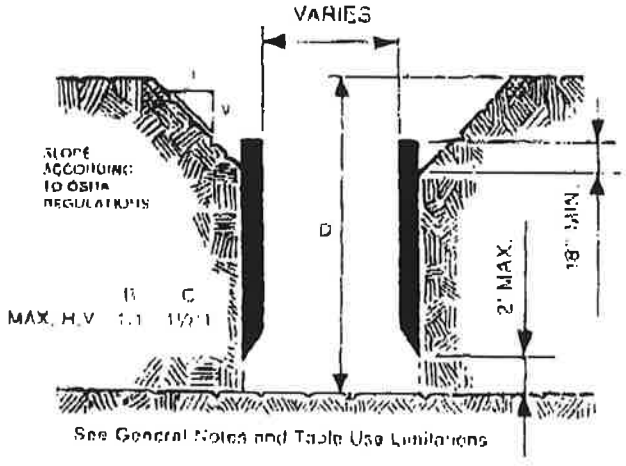
HEIGHT 4' LENGTH 12' MODEL NO. 6 EZT 4 X 12 EXT.

2525 Lbs

MAXIMUM ALLOWABLE DEPTH OF CUT-FEET

D = DEPTH

O.S.H.A SOIL CLASSIFICATION A-B-C		
A25 CEMENTED HARD COMPACT 25 PSF PER FOOT OF DEPTH	**B45** MOIST SOIL 45 PSF PER FOOT OF DEPTH	**C60** WET MUCKY SOIL 60 PSF PER FOOT OF DEPTH
96'	**54'**	**40'**
DESCRIPTION DRY CLAY HIGHLY COHESIVE CALICHE & HARDPAN SELDOM ENCOUNTERED SEE SOIL CLASSIFICATIONS FOR EXCLUSIONS	**DESCRIPTION** MOIST FINE SAND & GRAVEL OR CLAY SOILS WITH LIQUID PRESSURE NOT EXCEEDING 45 PSF PER FOOT OF DEPTH	**DESCRIPTION** WET MUCKY CLAY SILT SOILS WITH LIQUID PRESSURE NOT EXCEEDING 60 PSF PER FOOT OF DEPTH



CERTIFIED BY REGISTERED PROFESSIONAL ENGINEERS

JOHN A. GEARY, P.E.
N.J. LICENSE NO. 29210

** MADE IN THE U.S.A **

SHORING INTERNATIONAL
45 EDISON AVE.
OAKLAND, NJ 07436

MANUFACTURING SINCE 1956 TRENCH BOXES

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201-337-0380 FAX
TOLL FREE
800-881-4691
800-889-8887 FAX

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

TABULATED DATA

This Trench Shield will comply with O.S.H.A. REF: U.S. Dept. of Labor O.S.H.A. Safety & Health Standards (29 CFR 1926/1910) Revised March 5,1990 Subpart P - Excavations, Trenching & Shoring Selection of Protective Systems 1926.652 Appendix F

THIS STRUCTURAL ANALYSIS WAS MADE IN ACCORDANCE WITH THE STANDARDS OF THE "SPECIFICATION FOR THE Design, Fabrication & Erection of Structural Steel for Buildings" of the American Institute of Steel Construction

TRENCH SHIELD DESCRIPTION

DESIGN BY REGISTERED PROFESSIONAL ENGINEERS

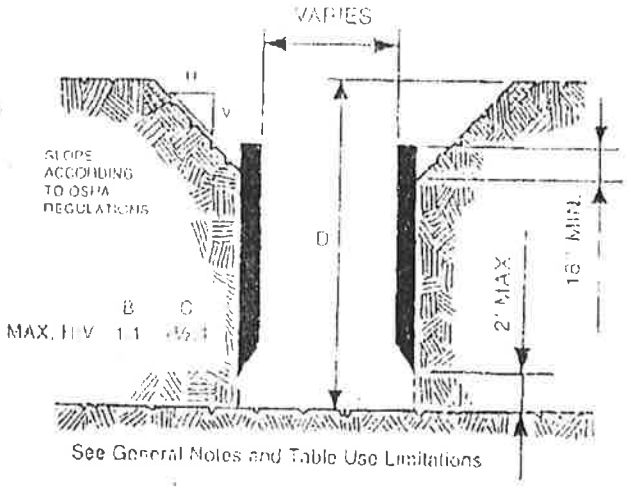
HEIGHT 4' LENGTH 16' MODEL NO. 6 EZT 4 X 16 EXT.

MAXIMUM ALLOWABLE DEPTH OF CUT-FEET

D = DEPTH

O.S.H.A SOIL CLASSIFICATION A-B-C

A25	B45	C60
CEMENTED HARD COMPACT 25 PSF PER FOOT OF DEPTH	MOIST SOIL 45 PSF PER FOOT OF DEPTH	WET MUCKY SOIL 60 PSF PER FOOT OF DEPTH
75'	42'	31'
DESCRIPTION: DRY CLAY HIGHLY COHESIVE CALICHE & HARDPAN SELDOM ENCOUNTERED SEE SOIL CLASSIFICATIONS FOR EXCLUSIONS	DESCRIPTION: MOIST FINE SAND & GRAVEL OR CLAY SOILS WITH LIQUID PRESSURE NOT EXCEEDING 45 PSF PER FOOT OF DEPTH	DESCRIPTION: WET MUCKY CLAY-SILT SOILS WITH LIQUID PRESSURE NOT EXCEEDING 60 PSF PER FOOT OF DEPTH



See General Notes and Table Use Limitations

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JOHN A. GEARY, P.E.
N.J. LICENSE NO. 23240

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Aug 24 01 09:51a Shoring Inc. 7888688008 p.2

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

EFFICIENCY PRODUCTION, INC.
P.O. BOX 24126 LANSING, MI 48909
PHONE 517-676-8800

EFFICIENCY TRENCH SHIELD

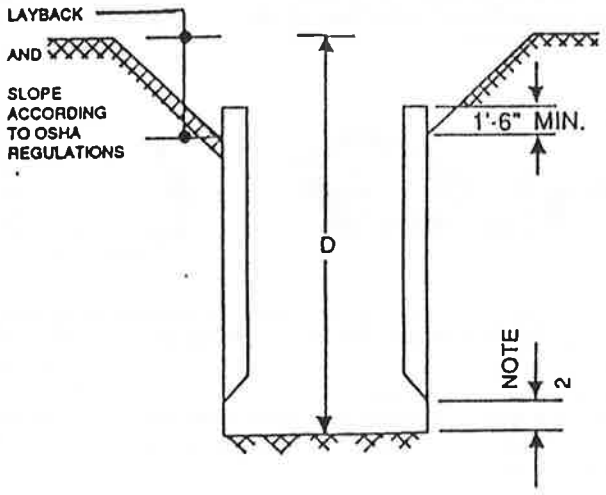
MODEL **416 HT6** SERIAL NUMBER **116077**

REFERENCE TO OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION RULES AND REGULATIONS. VOL. 54, NO. 209, 10-31-89, PART 1926, SUBPART P

SHIELD SIZE		PSF RATING	MAXIMUM ALLOWABLE DEPTH OF CUT (FEET) D		
			SOIL TYPE TO BE EXCAVATED		
HEIGHT (FEET)	LENGTH (FEET)	MAXIMUM LATERAL EARTH PRESSURE CAPACITY AT TRENCH BOTTOM IN POUNDS PER SQUARE FOOT	**TYPE A** Stiff, cohesive soil. 25 PSF per foot of depth.	**TYPE B** Medium cohesive to granular soil. 45 PSF per foot of depth.	**TYPE C** Soft cohesive to submerged soil. 60 PSF per foot of depth.
4	16	1710	68	38	29
			DESCRIPTION Clay, silty clay, sandy clay, clay loam, unconfined compressive strength of 1.5 tons per square foot or greater. (See note 8 on reverse side).	**DESCRIPTION** Clay with unconfined compressive strength greater than .5 TSF but less than 1.5 TSF. cohesionless gravel, silt, silt loam or sandy loam. (See Note 9 on reverse side).	**DESCRIPTION** Clay with unconfined compressive strength less than .5 TSF, submerged sand, clay or fractured rock that is not stable. (See Note 10 on reverse side).

LIMITATIONS IN USE OF TABLE

1. TRENCH SHIELD TO BE ASSEMBLED AND INSTALLED AS SHOWN AND IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
2. EXCAVATION 2 FEET BELOW BOTTOM OF SHIELD IS PERMITTED WHEN NO LOSS OF SOIL FROM BEHIND OR BELOW THE BOTTOM OF SHIELD IS ENCOUNTERED.
3. CONSULT MANUFACTURER WHEN RESTRICTION OF NOTE 2 IS NOT MET.
4. ADDITIONAL SHIELDS MAY BE STACKED WITH NO PENALTY IN DEPTH OF CUT.
5. DEPTHS OF CUTS SHOWN ARE BASED ON EXAMPLES OF VARIOUS SOIL CONDITIONS. VERIFY ACTUAL SOIL PRESSURES PRIOR TO EACH USE.
6. ANY MODIFICATIONS OR ALTERATIONS NOT ALLOWED UNLESS APPROVED IN WRITING BY EFFICIENCY PRODUCTION, INC.
7. DEPTH CERTIFICATION IS BASED ON SHORT TERM EXPOSURE WITH EXCAVATION OPEN A PERIOD OF TIME EQUAL TO 24 HOURS OR LESS. CONSULT THE MANUFACTURER SHOULD LONG TERM EXPOSURE BE REQUIRED.



STATE OF MICHIGAN
ALLEN J. NIEBER
ENGINEER NO. 17221
LICENSED PROFESSIONAL ENGINEER

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McCLURG & ASSOCIATES, INC. CONSULTING ENGINEERS

EFFICIENCY PRODUCTION, INC.
ALL RIGHTS RESERVED

MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENT NUMBERS:
4,090,365-4,114,383-4,259,028
ONE OR MORE OF THE FOLLOWING CANADIAN PATENT NUMBERS: 1,062,683-1,062,684

USE THIS PRODUCT ONLY IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, OR LOCAL LAWS

Any use of this product not specifically described on this certificate could cause cave-in, collapse,

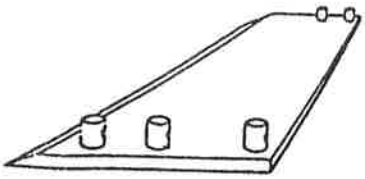
CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

Type A if fissured, subject to vibration, previously disturbed or part of a sloped layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V) or greater.

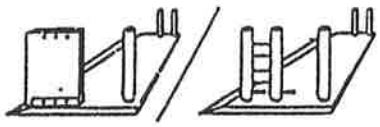
9. Previously disturbed soils may be Type B unless they would be classed as Type C. Soil that meets requirements of Type A, but is subject to vibration or fissured may be Type B. Dry rock that is not stable or soil that is part of a sloped, layered system where layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V) are Type B if material would otherwise be classified as Type B.
10. Soil in a sloped layered system where layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper may be Type C. Submerged soil is material with water freely seeping and entering the trench, but only part of the depth of the retained soil is submerged. Conditions more severe would require dewatering or sealing four sides of the excavation and pumping the trench. Such severe conditions would require the services of a soils engineer to establish the design pressure. Consult the manufacturer for pressures exceeding tabulated values.

Assembly

Lay side panel flat on ground with collar sockets up . . .

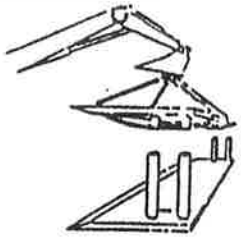


Place spreader pipe and/or plate onto collars or into brackets and pin in place. Secure pins with keepers. A minimum of 2 spreader units are required at each end of trench shield.



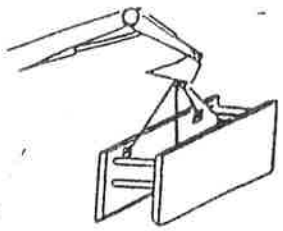
Oval Plate Spreader System Shown | 6" Pipe Spreader System Shown

Lower second sidewall onto spreaders and pin.



6" Pipe Spreader System Shown

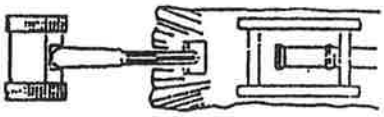
Stand trench shield in upright position and prepare for installation.



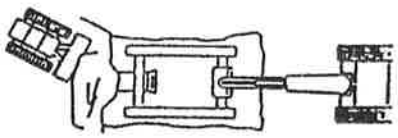
Using a trench shield in stable soil

Excavate to grade just slightly wider than the trench shield. Dig walls vertical to a minimum of 18" below the top of the shield. Slope soil above shield according to OSHA regulations. Install shield in trench.

Excavate in front of the trench shield.

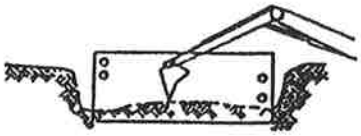


Pull shield forward by front top spreader pipe or with pulling eyes.
(Pulling eyes should be used with spreaders wider than 72" or when soil pressure is severe enough to cause spreader to deflect).

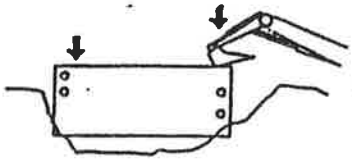


Using a shield in unstable soil

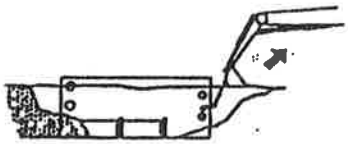
Excavate until soil begins to crumble beyond desired trench width. Place shield on line of excavation.



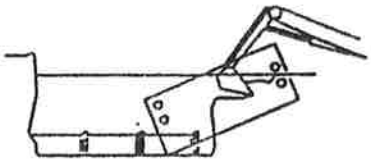
Press down on corners to push shield down to grade.



Pull shield forward and up on appropriate angle.



Excavate soil within the shield and repeat previous process.

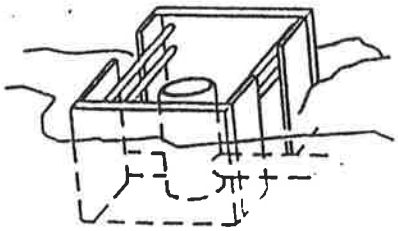


Using shields for patchwork, repairs, or tie-ins

- Center shield over work area.
- Lay soil at ends back according to OSHA regulations or use manufacturer's designed end plates to protect from cave-ins.

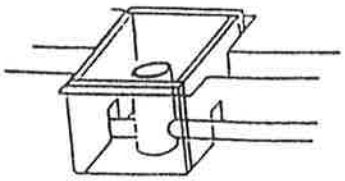
Manhole box with corner end plates

Corner end plates help prevent loose material from running into the end of the shield. Soil at ends should be sloped according to OSHA regulations.



Using 4-sided shields

When using shields as protection during manhole assembly work, insure that proper end panels are used, or lay soil at the ends back according to OSHA regulations.



- This material is intended to provide basic assembly and installation information only.
- Always use trench shields in accordance with applicable local, state, and federal safety laws and regulations. Failure to do so could cause severe injury or death.
- No deviation from the shield specifications, recommendations, and limitations is allowed without EPI's written approval.

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

TB-

REPLACEMENT FEE: $75.00

MANUFACTURER'S TABULATED DATA

For use by a qualified competent person
and to be kept on file at job site location.

(O.S.H.A. requirement for excavations
effective March 5th, 1990)

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MANUFACTURER'S TABULATED DATA

GENERAL NOTES AND TABLE USE LIMITATIONS

1. All shoring systems are to be used under the supervision of a Competent Person and in accordance with all regulations included in O.S.H.A. Standards Revised March 5th., 1990.

2. All shoring systems shall be inspected by a Competent Person prior to each use.

3. Maximum allowable depths indicated are published to assist the Competent Person in making a selection as to the proper shoring method to be employed. The Tabulated Data and Structural Analysis is provided as a reference guide. Prior to the use of any shoring system, a qualified Soils Engineer should be consulted to determine the actual soil conditions and pressures.

4. Stack multiple units to required depths (refer to depth charts). All sloped embankments above shoring systems shall conform to O.S.H.A. requirements.

5. Maximum allowable depths are based on shields being in new or as new condition. Unusual wear and tear, unauthorized modification or alterations, distorted or damaged components or structural members as well as other causes can weaken and otherwise reduce the depths shown on these tables.

6. The working area inside the shoring system shall be maintained free of water to ensure stability of the trench bottom as well as the shoring system.

7. Surcharge loads will reduce maximum allowable depths.

8. Shoring systems are to be installed in accordance with Manufacturer's recommendations. Uses other than those specified can result in serious injury or death. Modifications not allowed unless approved in writing by Shoring International Inc.

9. Shoring systems requiring major structural repairs should be returned to the factory for repair and recertification.

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MANUFACTURER'S TABULATED DATA

O.S.H.A. SOIL CLASSIFICATION
(APPENDIX A TO SUBPART P)

Type A Cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

1. The soil is fissured; or
2. The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
3. The soil has been previously disturbed; or
4. The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or
5. The material is subjected to other factors that would require it to be classified as a less stable material.

Type B:

1. Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 (144 kPa); or
2. Granular cohensionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
3. Previously disturbed soils except those which would otherwise be classified as Type C soil.
4. Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subjected to vibration; or
5. Dry rock that is not stable; or
6. Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C:

1. Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
2. Granular soils including gravel, sand, and loamy sand; or
3. Submerged soil or soil from which water is freely seeping; or
4. Submerged rock that is not stable; or
5. Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

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MANUFACTURER'S TABULATED DATA

MINIMUM STANDARDS TYPE A SOIL

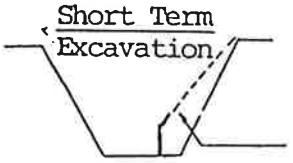
INCLUDES:

1. Unconfined compressive strength exceeds 1.5 T/SF.
2. Cemented granular or caliche is included.

EXCLUDES:

A. Fissured or subject to vibration from heavy traffic or similar effects.
B. Sloped layered system dipping into excavation area on 4:1 or greater.
C. Other factors requiring a less stable classification such as excessive moisture or free running or standing water.
D. Previously disturbed soil.
E. Cuts in excess of 20 ft.

Slope to 1/2H to 1V
Short Term
Excavation



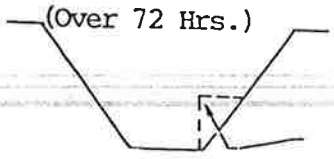
CONDITION A

Top Width equals 1 X depth plus bottom width.
If Bottom width is 4 ft. then:

DEPTH	WIDTH
8 ft.	12 ft.
10 ft.	14 ft.
12 ft.	16 ft.

* Cuts in excess of 12 ft. require slopping on 3/4H to 1V.

Slope to 3/4H to 1V
Long Term
Excavation
(Over 72 Hrs.)



CONDITION B

Top Width equals 1.5 X depth plus bottom width. If bottom width is 4 ft. then:

DEPTH	WIDTH
8 ft.	16 ft.
10 ft.	19 ft.
12 ft.	22 ft.
14 ft.	25 ft.
16 ft.	28 ft.
18 ft.	31 ft.
20 ft.	34 ft.

Condition A - 3½ft. Maximum vertical height is allowable for Type A Soils short term - Maximum 12 ft. cut.
Condition B - 4 ft. Maximum vertival height is allowable for Type A Soils. Horizontal bench width must equal or exceed bench depth.
Condition A & B - Applies to cohesive soils only - not granular.

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MANUFACTURER'S TABULATED DATA

MINIMUM STANDARDS TYPE B SOIL

INCLUDES:

1. Unconfined compressive strength of .5 T/SF minimum to 1.5 T/SF maximum.
2. Type A soils subject to external vibration or loading.
3. Type A soils that are fissured.
4. Type A soils previously disturbed, but well compacted.
5. Type A soils that have excessive moisture.

EXCLUDES:

A. Cuts in excess of 20 ft.
B. Soils with free running or standing water.

Slope to 3/4H to 1V

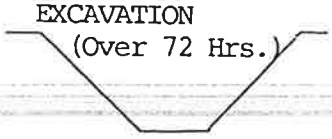
SHORT TERM EXCAVATION

Top width equals 1.5 X depth plus bottom width. If bottom width is 4 ft., then:

DEPTH	WIDTH
8 ft.	16 ft.
10 ft.	19 ft.
12 ft.	22 ft.
14 ft.	25 ft.
16 ft.	28 ft.
18 ft.	31 ft.
20 ft.	34 ft.

Slope to 1H to 1V

LONG TERM EXCAVATION (Over 72 Hrs.)



Top width equals 2 X depth plus bottom width. If bottom width is 4 ft., then:

DEPTH	WIDTH
8 ft.	20 ft.
10 ft.	24 ft.
12 ft.	28 ft.
14 ft.	32 ft.
16 ft.	36 ft.
18 ft.	40 ft.
20 ft.	44 ft.

** TYPE C SOILS

INCLUDES:

1. Unconfined compressive strength less than .5T/SF.
2. Saturated or submerged soils.
3. Unstable moving soils.
4. Type "A" and "B" soils - depth of cut over 20 ft.
5. Type "A" and "B" soils subject to heavy external vibration or loading.

** Requires specific written safety plan.
** May require trench box or sheeting.

**Consult with Soils Engineer immediately.
**Do not Proceed.

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MANUFACTURER'S TABULATED DATA

COHESIVE SOILS - CLAY AND CLAYSTONES

Unconfined Compressive Strengths (UCS)

DESCRIPTION	BLOWS (Per Ft.)	UCS (T/SF)	SOIL TYPE
Very Soft	Under 2	Under .25	C80 (82)
Soft	2 to 4	.25 to .50	C65 - C50
Medium	4 to 8	.50 to 1.0	B45
Stiff	8 to 15	1.0 to 2.0	B30
Very Stiff	15 to 30	2.0 to 4.0	A25
Hard	Over 30	Over 4.0	A25

Test for Cohesive Soils

1. Cohesive soils do not crumble and are plastic and easily molded when moist.
2. Can easily be shaped into a ball and/or rolled into pencil-sized threads before crumbling.
3. Type A Soil - UCS = 1.5 or more T/SF.
   Type B Soil - UCS = 0.5 to 1.5 T/SF.
   Type C Soil - UCS = 0.5 or less T/SF.
4. Refer to soils report for blow counts or UCS.
5. Use penetrometer or shear vane to determine UCS.

MANUFACTURER'S NOTE: The difference between hard clay and very soft clay is the presence and percentage of water. Only a Soils Engineer can make a determination of differences. C 80(82) represents saturated muck, a highly unstable soil which may preclude the practical use of a Trench Shield, unless a satisfactory dewatering system is employed.

Whenever a totally saturated unstable material is encountered, the competent person is advised to seek the services of a qualified Soils Engineer to determine the actual soil pressures. These findings should then be compared with our engineering calculations to judge the suitability of the subject Trench Shields.

GRANULAR SOILS - FINE TO COARSE SANDS

Unconfined compressive strength of loose granular soil is less than .5 T/SF.

Relative Density of Sands According to
Results of Standard Penetration Tests

BLOWS PER FOOT	RELATIVE DENSITY	SOIL TYPE
0 - 4	Very Loose	C 80(82)
4 - 10	Loose	C 65
10 - 30	Medium	C 50
30 - 50	Dense	B 45 - B 30
Over 50	Very Dense	B

Very Dense Sand may Be Type "A" if Cemented.

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MANUFACTURER'S TABULATED DATA

Test for Granular Soils

1. Granular soil cannot be molded when moist and crumbles easily when dry.
2. Moist granular soils that contain some cohesive material will exhibit signs of cohesion between particles.

WARNING

1. Excessive moisture or drying will cause changes in the apparent angle of repose of granular soils and thus the time an excavation is open is of critical importance. Long term excavation is 48 hours in granular soils.

2. Granular soils are susceptible to shock and/or vibration failure.

3. Granular material that would exhibit cohesive properties when moist will lose those properties when either saturated or dried.

ADDITIONAL SAFETY CONSIDERATIONS:

1. Ladders required within 25 ft. of men working in ditches over 4 ft. in depth.

2. Excavated materials must be stored more than 2 ft. from the edge of the excavation.

3. Do not allow employees underneath suspended loads.

4. Hard hats must be worn by all personel at all times when on the job site.

5. Personal protective equipment (eye shields, toe shields, ets.) must be used when a hazard exists.

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MANUFACTURER'S CERTIFICATION AND STRUCTURAL ANALYSIS

This Trench Shield will comply with O.S.H.A. REF: U.S. Dept. of Labor O.S.H.A. Safety and Health Standards (29 CFR 1926/1910) Revised March 5, 1990 Subpart P - Excavations, Trenching, & Shoring Selection of Protective Systems. 1926.652 Appendix F.

THIS STRUCTURAL ANALYSIS WAS MADE IN ACCORDANCE WITH THE STANDARDS OF THE "SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS" OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION.

TRENCH SHIELD DESCRIPTION

DESIGN BY REGISTERED PROFESSIONAL ENGINEERS

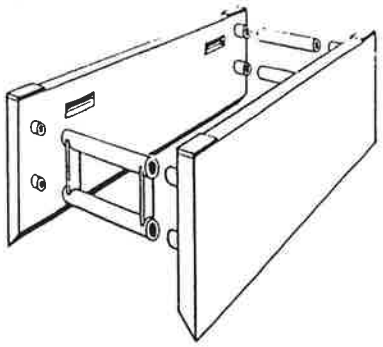
HEIGHT 4' LENGTH 26' MODEL NO. 8SDW-426X

MAXIMUM ALLOWABLE DEPTH OF CUT-FEET

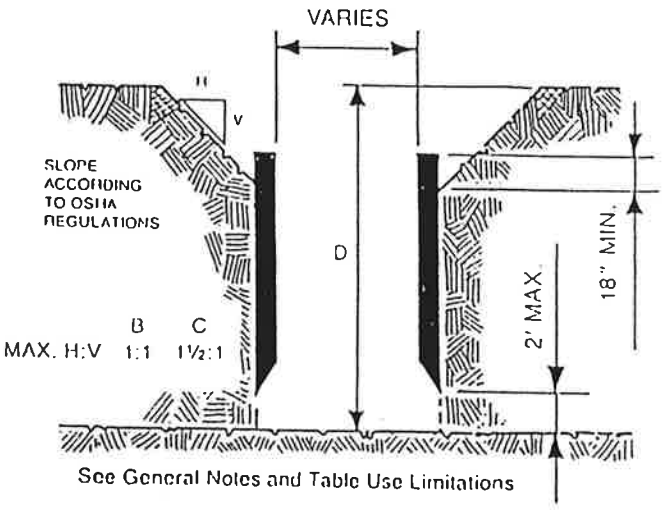
D = DEPTH

O.S.H.A. SOIL CLASSIFICATION A-B-C

A25	B45	C60
CEMENTED HARD COMPACT 25 PSF PER FOOT OF DEPTH	MOIST SOIL 45 PSF PER FOOT OF DEPTH	WET MUCKY SOIL 60 PSF PER FOOT OF DEPTH
33.5'	18.5'	14'
DESCRIPTION: DRY CLAY HIGHLY COHESIVE CALICHE AND HARDPAN. SELDOM ENCOUNTERED SEE SOIL CLASSIFICATIONS FOR EXCLUSIONS.	DESCRIPTION: MOIST FINE SAND, AND-GRAVEL OR CLAY SOILS WITH LIQUID PRESSURE NOT EXCEEDING 45 PSF PER FOOT OF DEPTH	DESCRIPTION: WET MUCKY CLAY-SILT SOILS WITH LIQUID PRESSURE NOT EXCEEDING 60 PSF PER FOOT OF DEPTH



4-PIPE SPREADER SYSTEM -
STANDARD CONFIGURATION.
FOR 4', 6' AND 8' HIGH UNITS
(TAPER OPTIONAL)



See General Notes and Table Use Limitations

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STATE OF NEW YORK CHANDU S. PATEL 054755 LICENSED PROFESSIONAL ENGINEER

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TABULATED DATA

This Trench Shield will comply with O.S.H.A. REF: U.S. Dept. of Labor O.S.H.A. Safety & Health Standards (29 CFR 1926/1910)
Revised March 5,1990 Subpart P - Excavations, Trenching & Shoring Selection of Protective Systems 1926.652 Appendix F
THIS STRUCTURAL ANALYSIS WAS MADE IN ACCORDANCE WITH THE STANDARDS OF THE "SPECIFICATION FOR THE
Design, Fabrication & Erection of Structural Steel for Buildings" of the American Institute of Steel Construction

TRENCH SHIELD DESCRIPTION

DESIGN BY REGISTERED PROFESSIONAL ENGINEERS

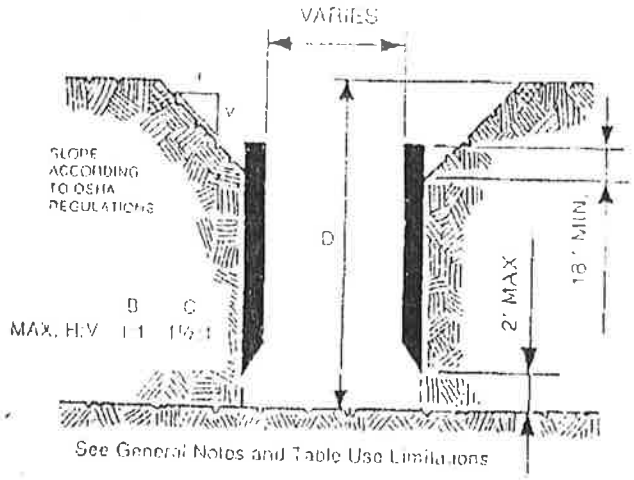
HEIGHT 8' LENGTH 16' MODEL NO. 6 EZT 8 X 16 HD

MAXIMUM ALLOWABLE DEPTH OF CUT-FEET

D = DEPTH

O.S.H.A SOIL CLASSIFICATION A-B-C

A25	B45	C60
CEMENTED HARD COMPACT 25 PSF PER FOOT OF DEPTH	MOIST SOIL 45 PSF PER FOOT OF DEPTH	WET MUCKY SOIL 60 PSF PER FOOT OF DEPTH
96'	54'	40'
DESCRIPTION: DRY CLAY HIGHLY COHESIVE CALICHE & HARDPAN SELDOM ENCOUNTERED SEE SOIL CLASSIFICATIONS FOR EXCLUSIONS	DESCRIPTION: MOIST FINE SAND & GRAVEL OR CLAY SOILS WITH LIQUID PRESSURE NOT EXCEEDING 45 PSF PER FOOT OF DEPTH	DESCRIPTION: WET MUCKY CLAY-SILT SOILS WITH LIQUID PRESSURE NOT EXCEEDING 60 PSF PER FOOT OF DEPTH



CERTIFIED BY REGISTERED PROFESSIONAL ENGINEERS

JOHN A. GEARY P.E.
N.J. LICENSE NO. 22240

** MADE IN THE U.S.A **

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45 EDISON AVE.
OAKLAND, NJ 07436

MANUFACTURING SINCE 1956 TRENCH BOXES

201-337-2233
201-337-0360 FAX
TOLL FREE
800-881-4691
800-889-8887 FAX

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

SPEED SHORE®
PIONEERING TRENCH SAFETY

TABULATED DATA AND TRENCH SHIELD CERTIFICATION

SERIAL NUMBER: 4-2106		MODEL: TS- 08 20 DW 6
HEIGHT = 08 feet	LENGTH = 20 feet	THICKNESS= 6 inches
MAXIMUM LATERAL EARTH PRESSURE =	1,282 Pounds per square foot	

MAXIMUM DEPTH OF EXCAVATION		
O.S.H.A. Soil Type	Equivalent Weight Effect *(p.c.f.)*	Depth "H" *(feet)*
A	25	50
B	35	39
B	45	31
C	60	24
C	80	19
Spreader Size = 8 inch Schedule 80 Pipe / Maximum Spreader Length = 20 feet		

This shield is manufactured to meet the requirements of O.S.H.A. CFR 29, Part 1926, Subpart P. This shield must be used in a manner consistent with safe working procedures, Federal, State and local regulation and manufacturer's instructions. Contact manufacturer for any non-standard use of this trench shield.

GENERAL NOTES AND INSTRUCTIONS:

1. Contractors must assign a ***"competent person"***, knowledgeable and capable of complying with all federal regulations, state and local laws and ordinances. **NOTE:** For copies of applicable federal or state laws contact: Dept. of Labor, Occupational Safety and Health Division
2. A ***"competent person"***, trained and experienced in the proper use of trench shields, safe excavation practices and soil classification methods must direct and control the use of this trench shield.
3. This Tabulated Data applies to standard products manufactured exclusively by SPEED SHORE CORPORATION. This data complies with the requirements of federal O.S.H.A. CFR 29, Part 1926, Subpart P-Excavations. Information not found in this data shall be referenced by obtaining copies of the applicable Federal or State laws governing excavation
4. Modifications of this product shall be approved by the manufacturer in writing and shall accompany this Tabulated Data sheet. Any modification not specifically allowed by SPEED SHORE CORPORATION voids this data.

SPEED SHORE CORPORATION
P.O. Box 450889
Houston, Texas 77245-0889
Phone (713) 943-0750 Fax (713) 943-8483

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TB-014 8x24

REPLACEMENT FEE: $75.00

MANUFACTURER'S TABULATED DATA

For use by a qualified competent person and to be kept on file at job site location.

(O.S.H.A. requirement for excavations effective March 5th, 1990)

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MANUFACTURER'S TABULATED DATA

GENERAL NOTES AND TABLE USE LIMITATIONS

1. All shoring systems are to be used under the supervision of a Competent Person and in accordance with all regulations included in O.S.H.A. Standards Revised March 5th., 1990.

2. All shoring systems shall be inspected by a Competent Person prior to each use.

3. Maximum allowable depths indicated are published to assist the Competent Person in making a selection as to the proper shoring method to be employed. The Tabulated Data and Structural Analysis is provided as a reference guide. Prior to the use of any shoring system, a qualified Soils Engineer should be consulted to determine the actual soil conditions and pressures.

4. Stack multiple units to required depths (refer to depth charts). All sloped embankments above shoring systems shall conform to O.S.H.A. requirements.

5. Maximum allowable depths are based on shields being in new or as new condition. Unusual wear and tear, unauthorized modification or alterations, distorted or damaged components or structural members as well as other causes can weaken and otherwise reduce the depths shown on these tables.

6. The working area inside the shoring system shall be maintained free of water to ensure stability of the trench bottom as well as the shoring system.

7. Surcharge loads will reduce maximum allowable depths.

8. Shoring systems are to be installed in accordance with Manufacturer's recommendations. Uses other than those specified can result in serious injury or death. Modifications not allowed unless approved in writing by Shoring International Inc.

9. Shoring systems requiring major structural repairs should be returned to the factory for repair and recertification.

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MANUFACTURER'S TABULATED DATA

O.S.H.A. SOIL CLASSIFICATION
(APPENDIX A TO SUBPART P)

Type A Cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

1. The soil is fissured; or
2. The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
3. The soil has been previously disturbed; or
4. The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or
5. The material is subjected to other factors that would require it to be classified as a less stable material.

Type B:

1. Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 (144 kPa); or
2. Granular cohensionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
3. Previously disturbed soils except those which would otherwise be classified as Type C soil.
4. Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subjected to vibration; or
5. Dry rock that is not stable; or
6. Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C:

1. Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
2. Granular soils including gravel, sand, and loamy sand; or
3. Submerged soil or soil from which water is freely seeping; or
4. Submerged rock that is not stable; or
5. Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

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MANUFACTURER'S TABULATED DATA

MINIMUM STANDARDS TYPE A SOIL

INCLUDES:

1. Unconfined compressive strength exceeds 1.5 T/SF.
2. Cemented granular or caliche is included.

EXCLUDES:

A. Fissured or subject to vibration from heavy traffic or similar effects.
B. Sloped layered system dipping into excavation area on 4:1 or greater.
C. Other factors requiring a less stable classification such as excessive moisture or free running or standing water.
D. Previously disturbed soil.
E. Cuts in excess of 20 ft.

Slope to 1/2H to 1V
Short Term
Excavation

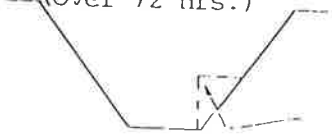
CONDITION A

Top Width equals 1 X depth plus bottom width.
If Bottom width is 4 ft. then:

DEPTH	WIDTH
8 ft.	12 ft.
10 ft.	14 ft.
12 ft.	16 ft.

* Cuts in excess of 12 ft. require slopping on 3/4H to 1V.

Slope to 3/4H to 1V
Long Term
Excavation
(Over 72 Hrs.)



CONDITION B

Top Width equals 1.5 X depth plus bottom width. If bottom width is 4 ft. then:

DEPTH	WIDTH
8 ft.	16 ft.
10 ft.	19 ft.
12 ft.	22 ft.
14 ft.	25 ft.
16 ft.	28 ft.
18 ft.	31 ft.
20 ft.	34 ft.

Condition A - 3½ft. Maximum vertical height is allowable for Type A Soils short term - Maximum 12 ft. cut.
Condition B - 4 ft. Maximum vertival height is allowable for Type A Soils. Horizontal bench width must equal or exceed bench depth.
Condition A & B - Applies to cohesive soils only - not granular.

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MANUFACTURER'S TABULATED DATA

MINIMUM STANDARDS TYPE B SOIL

INCLUDES:

1. Unconfined compressive strength of .5 T/SF minimum to 1.5 T/SF maximum.
2. Type A soils subject to external vibration or loading.
3. Type A soils that are fissured.
4. Type A soils previously disturbed, but well compacted.
5. Type A soils that have excessive moisture.

EXCLUDES:

A. Cuts in excess of 20 ft.
B. Soils with free running or standing water.

Slope to 3/4H to 1V

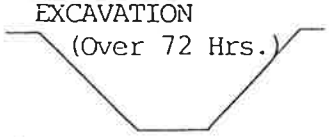
SHORT TERM EXCAVATION

Top width equals 1.5 X depth plus bottom width. If bottom width is 4 ft., then:

DEPTH	WIDTH
8 ft.	16 ft.
10 ft.	19 ft.
12 ft.	22 ft.
14 ft.	25 ft.
16 ft.	28 ft.
18 ft.	31 ft.
20 ft.	34 ft.

Slope to 1H to 1V

LONG TERM EXCAVATION (Over 72 Hrs.)



Top width equals 2 X depth plus bottom width. If bottom width is 4 ft., then:

DEPTH	WIDTH
8 ft.	20 ft.
10 ft.	24 ft.
12 ft.	28 ft.
14 ft.	32 ft.
16 ft.	36 ft.
18 ft.	40 ft.
20 ft.	44 ft.

** TYPE C SOILS

INCLUDES:

1. Unconfined compressive strength less than .5T/SF.
2. Saturated or submerged soils.
3. Unstable moving soils.
4. Type "A" and "B" soils - depth of cut over 20 ft.
5. Type "A" and "B" soils subject to heavy external vibration or loading.

** Requires specific written safety plan.
** May require trench box or sheeting.

**Consult with Soils Engineer immediately.
**Do not Proceed.

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MANUFACTURER'S TABULATED DATA

COHESIVE SOILS - CLAY AND CLAYSTONES

Unconfined Compressive Strengths (UCS)

DESCRIPTION	BLOWS (Per Ft.)	UCS (T/SF)	SOIL TYPE
Very Soft	Under 2	Under .25	C80 (82)
Soft	2 to 4	.25 to .50	C65 - C50
Medium	4 to 8	.50 to 1.0	B45
Stiff	8 to 15	1.0 to 2.0	B30
Very Stiff	15 to 30	2.0 to 4.0	A25
Hard	Over 30	Over 4.0	A25

Test for Cohesive Soils

1. Cohesive soils do not crumble and are plastic and easily molded when moist.
2. Can easily be shaped into a ball and/or rolled into pencil-sized threads before crumbling.
3. Type A Soil - UCS = 1.5 or more T/SF.
   Type B Soil - UCS = 0.5 to 1.5 T/SF.
   Type C Soil - UCS = 0.5 or less T/SF.
4. Refer to soils report for blow counts or UCS.
5. Use penetrometer or shear vane to determine UCS.

MANUFACTURER'S NOTE: The difference between hard clay and very soft clay is the presence and percentage of water. Only a Soils Engineer can make a determination of differences. C 80(82) represents saturated muck, a highly unstable soil which may preclude the practical use of a Trench Shield, unless a satisfactory dewatering system is employed.

Whenever a totally saturated unstable material is encountered, the competent person is advised to seek the services of a qualified Soils Engineer to determine the actual soil pressures. These findings should then be compared with our engineering calculations to judge the suitability of the subject Trench Shields.

GRANULAR SOILS - FINE TO COARSE SANDS

Unconfined compressive strength of loose granular soil is less than .5 T/SF.

Relative Density of Sands According to
Results of Standard Penetration Tests

BLOWS PER FOOT	RELATIVE DENSITY	SOIL TYPE
0 - 4	Very Loose	C 80(82)
4 - 10	Loose	C 65
10 - 30	Medium	C 50
30 - 50	Dense	B 45 - B 30
Over 50	Very Dense	B

Very Dense Sand may Be Type "A" if Cemented.

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MANUFACTURER'S TABULATED DATA

Test for Granular Soils

1. Granular soil cannot be molded when moist and crumbles easily when dry.
2. Moist granular soils that contain some cohesive material will exhibit signs of cohesion between particles.

WARNING

1. Excessive moisture or drying will cause changes in the apparent angle of repose of granular soils and thus the time an excavation is open is of critical importance. Long term excavation is 48 hours in granular soils.

2. Granular soils are susceptible to shock and/or vibration failure.

3. Granular material that would exhibit cohesive properties when moist will lose those properties when either saturated or dried.

ADDITIONAL SAFETY CONSIDERATIONS:

1. Ladders required within 25 ft. of men working in ditches over 4 ft. in depth.

2. Excavated materials must be stored more than 2 ft. from the edge of the excavation.

3. Do not allow employees underneath suspended loads.

4. Hard hats must be worn by all personel at all times when on the job site.

5. Personal protective equipment (eye shields, toe shields, ets.) must be used when a hazard exists.

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MANUFACTURER'S CERTIFICATION AND STRUCTURAL ANALYSIS

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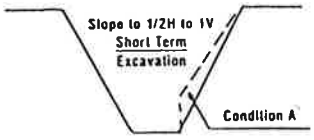
TRENCH SHIELD DESCRIPTION

HEIGHT 8' LENGTH 24' MODEL NO. 8SDW-824

MINIMUM STANDARDS TYPE A SOIL

Includes:
1. Unconfined compressive strength exceeds 1.5 T/SF.
2. Cemented granular or caliche is included.

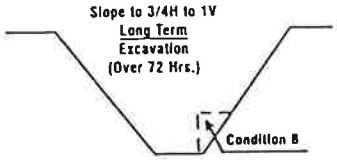
Excludes:
A. Fissured or subject to vibration from heavy traffic or similar effects.
B. Sloped layered system dipping into excavation area on 4:1 or greater.
C. Other factors requiring a less stable classification such as excessive moisture or free running or standing water.
D. Previously disturbed soil.
E. Cuts in excess of 20 ft.



Top width equals 1 X depth plus bottom width.
If bottom width is 4 ft., then:

Depth	Width
8 ft	12 ft
10 ft	14 ft
12 ft	16 ft

*Cuts in excess of 12 ft. require sloping on 3/4H to 1V



Top width equals 1.5 X depth plus bottom width.
If bottom width is 4 ft., then:

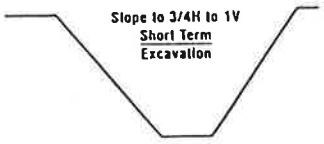
Depth	Width
8 ft	16 ft
10 ft	19 ft
12 ft	22 ft
14 ft	25 ft
16 ft	28 ft
18 ft	31 ft
20 ft	34 ft

Condition A - 3 ft maximum vertical height is allowable for Type A soils short term - max. 12 ft. cut.
Condition B - 4 ft maximum vertical height is allowable for Type A and Type B soils. Horizontal bench width must equal or exceed bench depth.
Condition A & B - Applies to cohesive soils only — not granular.

MINIMUM STANDARDS TYPE B SOIL

Includes:
1. Unconfined compressive strength of .5 T/SF minimum to 1.5 T/SF maximum
2. Type A soils subject to external vibration or loading.
3. Type A soils that are fissured.
4. Type A soils previously disturbed, but well compacted.
5. Type A soils that have excessive moisture.

Excludes:
A. Cuts in excess of 20 ft.
B. Soils with free running or standing water.



Top width equals 1.5 X depth plus bottom width.
If bottom width is 4 ft., then:

Depth	Width
8 ft	16 ft
10 ft	19 ft
12 ft	22 ft
14 ft	25 ft
16 ft	28 ft
18 ft	31 ft
20 ft	34 ft

Top width equals 2 X depth plus bottom width.
If bottom width is 4 ft., then:

Depth	Width
8 ft	20 ft
10 ft	24 ft
12 ft	28 ft
14 ft	32 ft
16 ft	36 ft
18 ft	40 ft
20 ft	44 ft

**TYPE C SOILS

Includes:
1. Unconfined compressive strength less than .5T/SF.
2. Saturated or submerged soils.
3. Unstable moving soils.
4. Type "A" and "B" soils - depth of cut over 20 ft.
5. Type "A" and "B" soils subject to heavy external vibration or loading.

** Requires specific written safety plan. ** Consult with Safety Manager immediately
** May require trench box or shoring. ** Do not proceed.

COHESIVE SOILS — CLAY AND CLAYSTONES

Unconfined Compressive Strengths (UCS)

Description of Clay	Blows Per Ft.	UCS T/SF	Soil Type
Very Soft	Under 2	Under .25	C
Soft	2 to 4	.25 to .50	C
Medium	4 to 8	.50 to 1.0	B
Stiff	8 to 15	1.0 to 2.0	B - A
Very Stiff	15 to 30	2.0 to 4.0	A
Hard	Over 30	Over 4.0	A

Test For Cohesive Soils
1. Cohesive soils do not crumble and are plastic and easily molded when moist.
2. Can easily be shaped into a ball and/or rolled into pencil-sized threads before crumbling.
3. Type A Soil - UCS = 1.5 or more T/SF. Type B Soil - UCS = .5 to 1.5 T/SF.
   Type C Soil - UCS = .5 or less T/SF.
4. Refer to soils report for blow counts or UCS.
5. Use penetrometer or shear vane to determine UCS.

GRANULAR SOILS — FINE TO COARSE SANDS

Unconfined compressive strength of loose granular soil is less than 5 T/SF

Relative Density of Sands According To Results of Standard Penetration Tests

Blows Per Ft.	Relative Density	Soil Type
0 - 4	Very Loose	C
4 - 10	Loose	C
10 - 30	Medium	C - B
30 - 50	Dense	B
Over 50	Very Dense	*B

*Very dense sand may be Type "A" if cemented.

Test For Granular Soils
1. Granular soil cannot be molded when moist and crumbles easily when dry.
2. Moist granular soils that contain some cohesive material will exhibit signs of cohesion between particles.

WARNING

1. Excessive moisture or drying will cause changes in the apparent angle of repose of granular soils and thus the time an excavation is open is of critical importance. Long term excavation is 48 hours in granular soils.
2. Granular soils are susceptible to shock and/or vibration failure.
3. Granular material that would exhibit cohesive properties when moist will lose those properties when either saturated or dried.

ADDITIONAL SAFETY CONSIDERATIONS:

1. Ladders required within 25 ft. of men working in ditches over 4 ft in depth.
2. Excavated materials must be stored more than 2 ft. from edge of the excavation.
3. Do not allow employees underneath suspended loads.
4. Hard hats must be worn by all personnel at all times when on the job site.
5. Personal protective equipment (eye shields, toe shields, etc.) must be used when a hazard exists.

USING THE ABOVE ASSUMPTIONS, THE SUBJECT TRENCH SHIELD MAY BE USED.

TYPE A SOIL 48 (FT) TYPE B SOIL 24 (FT) TYPE C SOIL 12 (FT)

IT IS RECOMMENDED THAT PRIOR TO EACH USE A QUALIFIED ENGINEER BE CONSULTED TO DETERMINE THE ACTUAL SOIL PRESSURE THAT WILL BE ENCOUNTERED AND IT BE CHECKED WITH THE CALCULATIONS.

DESIGN BY REGISTERED PROFESSIONAL ENGINEERS T&M ENGINEERING C.F. PATEL N.J. LICENSE #17112

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Appendix 4 – HPDE Pipe Specifications

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

FORTILINE
HDPE FUSION GROUP
a MORSCO brand

Iron Pipe Size (IPS) and Dimension Data

PE4710

Pipe for Municipal and Industrial Applications

Pressure Ratings are calculated using 0.63 design factor for HDS at 73°F as listed in PPI TR-4 for PE 4710 materials. HDPE can accomodate up to 1.5 times the pipe pressure rating for a recurring surge and up to 2.0 times the pipe pressure rating for an occasional surge. Temperature, Chemical, and Environmental use considerations may require use of additional design factors.

Pressure Rating		335 psi DR 7.0			250 psi DR 9.0			200 psi DR 11.0			160 psi DR 13.5			
Nominal Pipe Size	IPS OD (in)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Nominal Pipe Size
1 1/4"	1.660	0.237	1.158	0.46	0.184	1.270	0.37	0.151	1.340	0.31	0.123	1.399	0.26	1 1/4"
1 1/2"	1.900	0.271	1.325	0.61	0.211	1.453	0.49	0.173	1.533	0.41	0.141	1.601	0.34	1 1/2"
2"	2.375	0.339	1.656	0.95	0.264	1.815	0.77	0.216	1.917	0.64	0.176	2.002	0.53	2"
3"	3.500	0.500	2.440	2.06	0.389	2.675	1.66	0.318	2.826	1.39	0.259	2.951	1.16	3"
4"	4.500	0.643	3.137	3.40	0.500	3.440	2.75	0.409	3.633	2.31	0.333	3.794	1.92	4"
6"	6.625	0.946	4.619	7.37	0.736	5.065	5.96	0.602	5.349	5.00	0.491	5.584	4.15	6"
8"	8.625	1.232	6.013	12.50	0.958	6.594	10.11	0.784	6.963	8.47	0.639	7.270	7.04	8"
10"	10.750	1.536	7.494	19.42	1.194	8.219	15.70	0.977	8.679	13.16	0.796	9.062	10.93	10"
12"	12.750	1.821	8.889	27.31	1.417	9.746	22.08	1.159	10.293	18.51	0.944	10.749	15.38	12"
14"	14.000	2.000	9.760	32.93	1.556	10.701	26.63	1.273	11.301	22.32	1.037	11.802	18.54	14"
16"	16.000	2.286	11.154	43.01	1.778	12.231	34.78	1.455	12.915	29.15	1.185	13.488	24.22	16"
18"	18.000	2.571	12.549	54.43	2.000	13.760	44.02	1.636	14.532	36.89	1.333	15.174	30.65	18"
20"	20.000	2.857	13.943	67.20	2.222	15.289	54.34	1.818	16.146	45.54	1.481	16.860	37.84	20"
22"	22.000	3.143	15.337	81.32	2.444	16.819	65.75	2.000	17.760	55.10	1.630	18.544	45.79	22"
24"	24.000	3.429	16.731	96.77	2.667	18.346	78.25	2.182	19.374	65.58	1.778	20.231	54.49	24"
26"	26.000				2.889	19.875	91.84	2.364	20.988	76.96	1.926	21.917	63.95	26"
28"	28.000				3.111	21.405	106.51	2.545	22.605	89.26	2.074	23.603	74.17	28"
30"	30.000				3.333	22.934	122.27	2.727	24.219	102.47	2.222	25.289	85.14	30"
32"	32.000				3.556	24.462	139.12	2.909	25.833	116.58	2.370	26.976	96.87	32"
34"	34.000				3.778	25.991	157.05	3.091	27.447	131.61	2.519	28.660	109.36	34"
36"	36.000				4.000	27.520	176.07	3.273	29.061	147.55	2.667	30.346	122.60	36"
42"	42.000							3.818	33.906	200.84	3.111	35.405	166.88	42"
48"	48.000													48"
54"	54.000													54"

This size and dimension chart is intended for reference purposes. It should not be used in place of the advice from a licensed Professional Engineer. Pipe weights are calculated in accordance with PPI TR-7. Average inside diameter is calculated using IPS OD and Minimum wall plus 6% for use in estimating fluid flows. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimension and tolerances in the applicable pipe manufacturing specification.