Colsman Tunnel Project

Location: Centennial Colorado

Owner: Southgate Sanitation District

Owner Rep: Burns & McDonnell Engineering

Prime Contractor: Garney Construction

Design Engineer: Dewberry Engineering

Consulting Engineer: Shannon & Wilson

Trenchless Slip-Line Contractor: Global Underground Corp

HDPE Provider: ISCO Industries

HDPE Manufacturer: WL Plastics

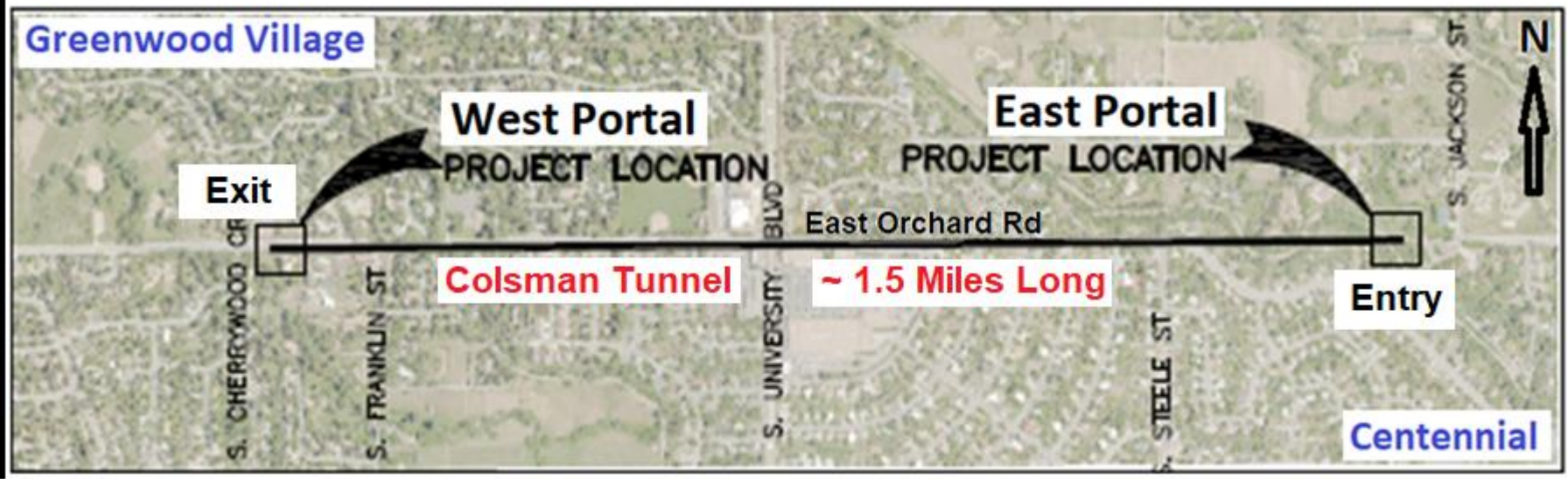
Colsman Tunnel

Non-Interruptible Wastewater Flow

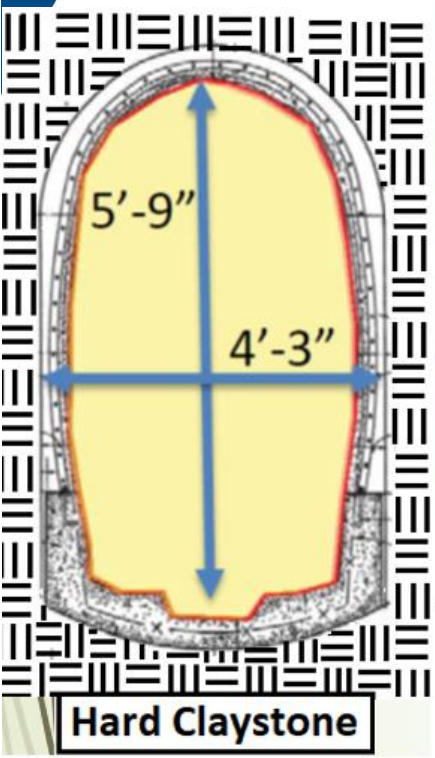
- Length: 7,632 Lineal Feet (LF)
- Hand Dug 1976-1978 thru Hard Claystone
- Tunnel Height and Width Inconsistent
- Tunnel Floor Slope ~ 0.36%
- Maximum Cover Depth 95 feet
- Wire Mesh/Shotcrete/Coal Tar Epoxy Lining

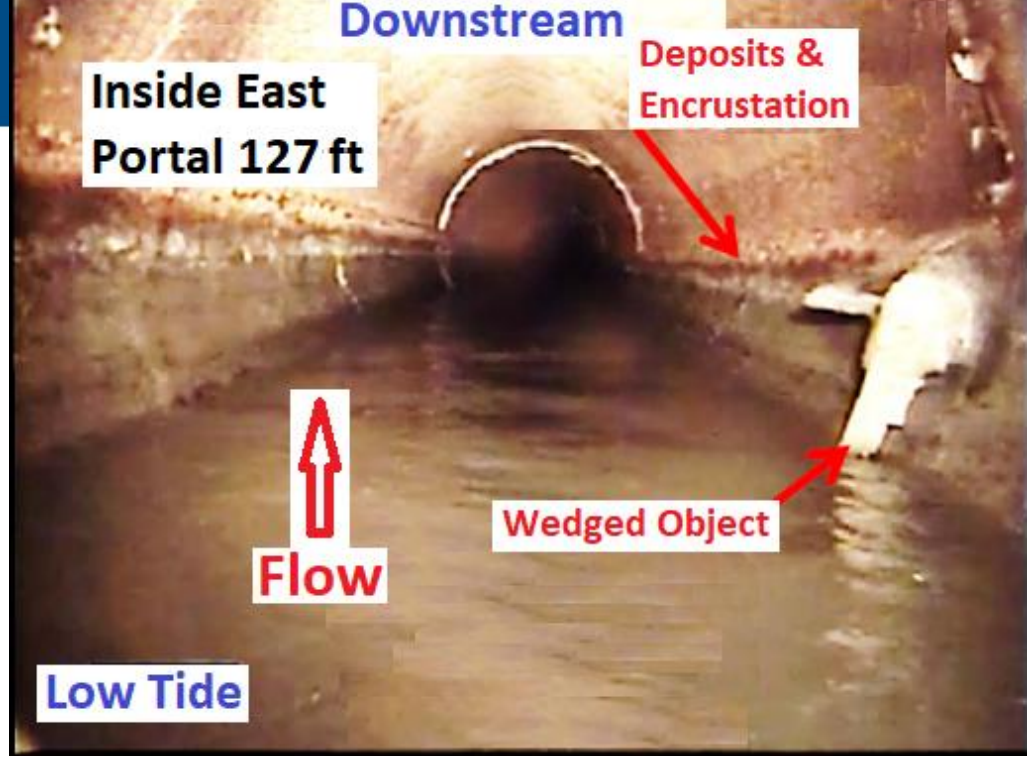
Avg Weekday Flows = 5,000 gpm

Peak Weekday Flows = 7,700 gpm



Defects Verified by Floating Camera





HDR Engineering, Inc.

closed-circuit television (CCTV) survey data

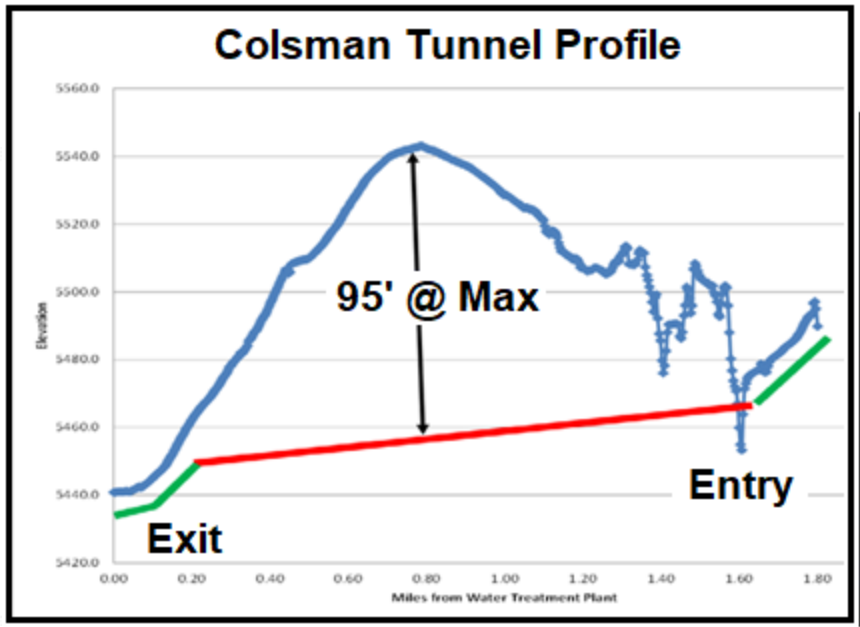
Colsman Tunnel Defect Summary Table

FIGURE 14 - DEFECT CODING	DISTANCE (FT) AT/FROM
LINING FAILURE DETACHED (LFD)	2
LINING FAILURE DETACHED (LFD)	2
SURFACE SPALLING (SSS)	265
SURFACE SPALLING (SSS)	265
TAP BREAK-IN ACTIVE (TBA)	4759
SURFACE AGGREGATE VISIBLE (SAV)	5313
INFILTRATION WEEPER (IW)	5618
SURFACE AGGREGATE VISIBLE (SAV)	5873
SURFACE AGGREGATE VISIBLE (SAV)	7502

Multi-Sensor Robotic Inspection
Float Camera = Hi-Tech

Slip-Line Method Selected

HDD Rig to Pull 7,632 LF of 48” SDR 13.5 IPS weighing over 1,680,000 pounds thru Tunnel



Material Data Set

HDPE Pipe

- Length = 50 ft
- OD = 48” SDR 13.5 IPS
- Wall = 3.56” ID = 40.46”
- Butt Fusion ASTM F-3183
- Wt = 218 lbs/ft on avg.
- Total Wt = 1,680,842 lbs

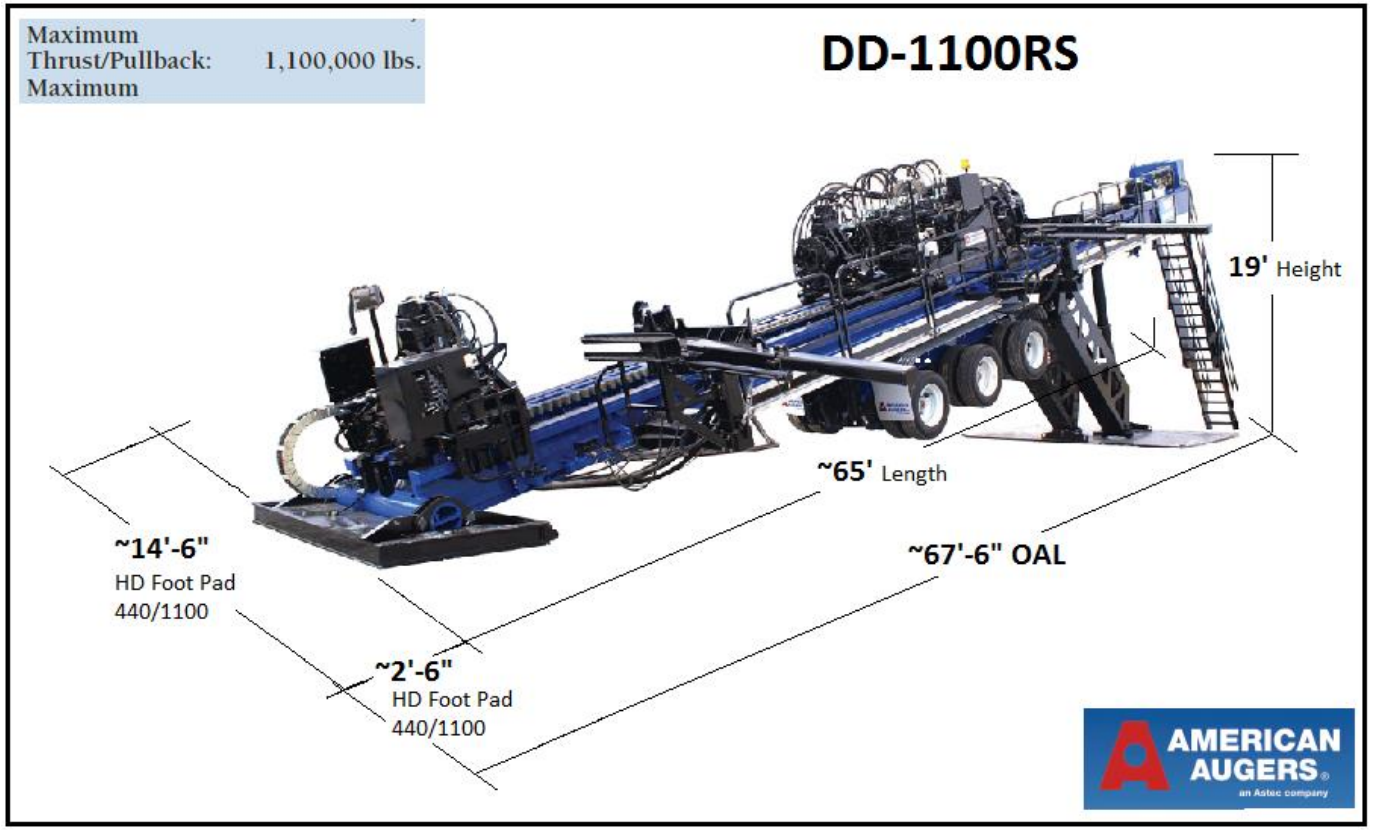
Drill Stem Pipe

- Length Avg = 31.6 ft
- OD = 6-5/8”
- Tool Joint OD = 8-1/2”
- Make-up Torque = 58,840 ft/lbs
- Wt = 38 lbs/ft on average
- Total Wt = 297,312 lbs (7824LF)

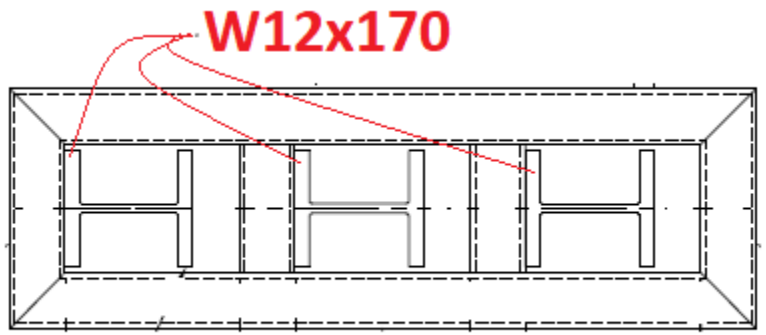
Good Questions NEED Great Answers:

- How do you get 7,700 Feet of Drill Stem thru a Tunnel without Damage to Either?
- What are the expected Pull-Back Forces?
- What Type of Pull-Head is Needed?
- What Size Drill Rig is Needed?
- What Anchorage is Required to keep the Drill Rig from pulling itself into the Tunnel?
- Identify Weakest Link and Strengthen!

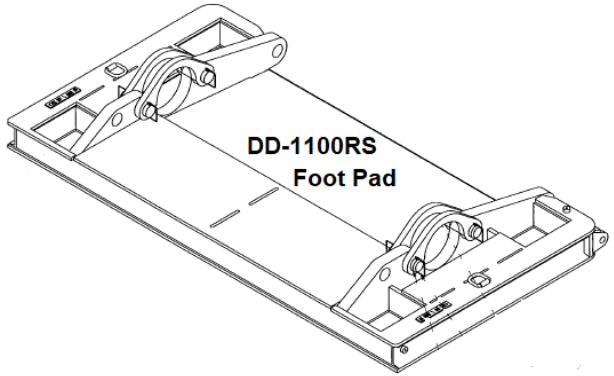
Global Underground used our American Auger DD-440T with a DD-1100RS On-Standby

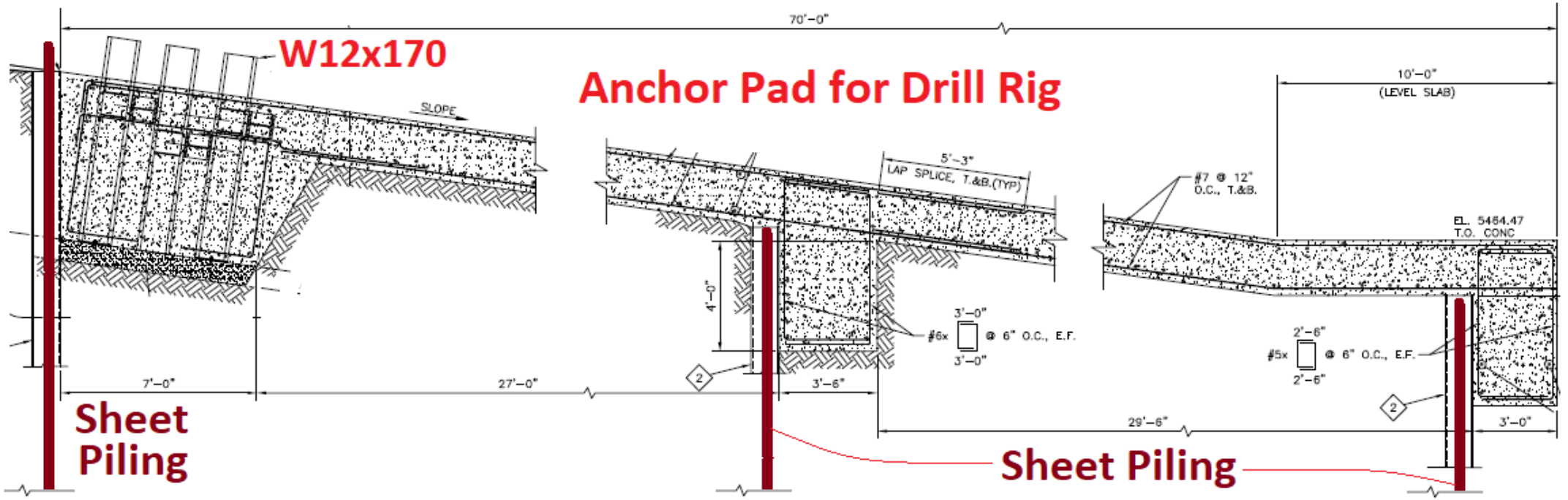


Calculated Max Pull Force
= 660,227 lbs
Match
Anchor Pad Design
& Drill Rig Capacity



Drill Rig Foot Anchor typ.

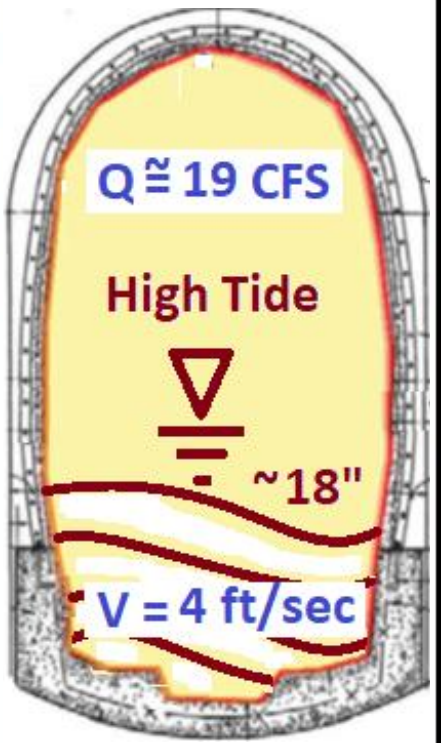




East Portal Drill Rig Set-Up

The Underground Utilities Event

Underground Construction Technology | January 28-30, 2020 | Fort Worth, TX



UCT

ACTION PLAN:

Winch over 297,000 lbs of Drill Stem Thru Tunnel

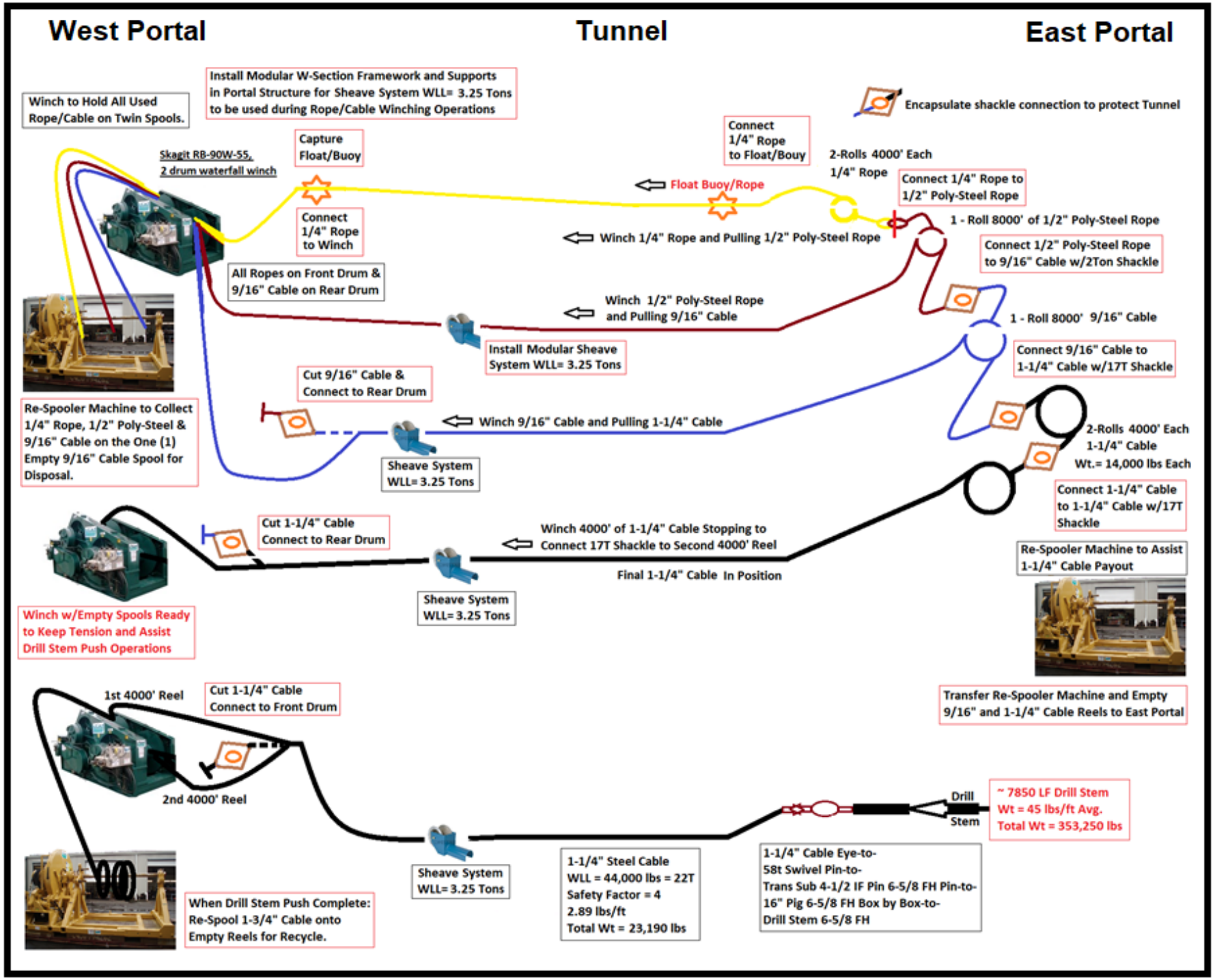
How?

Place a 120,000 lb Capicity Winch at one End w/Modular Sheave Roller System keeping the Cable from hitting the Roof

Float a Bouy Tied to 1/4" Rope Tied to 1/2" Poly/Steel Rope Connected to 9/16" Steel Cable Connected to 1-1/4" Steel Cable

Use the 1-1/4" Steel Cable Connected to 58T Swivel Connected to 16" dia. Pig Connected to the Drill Stem

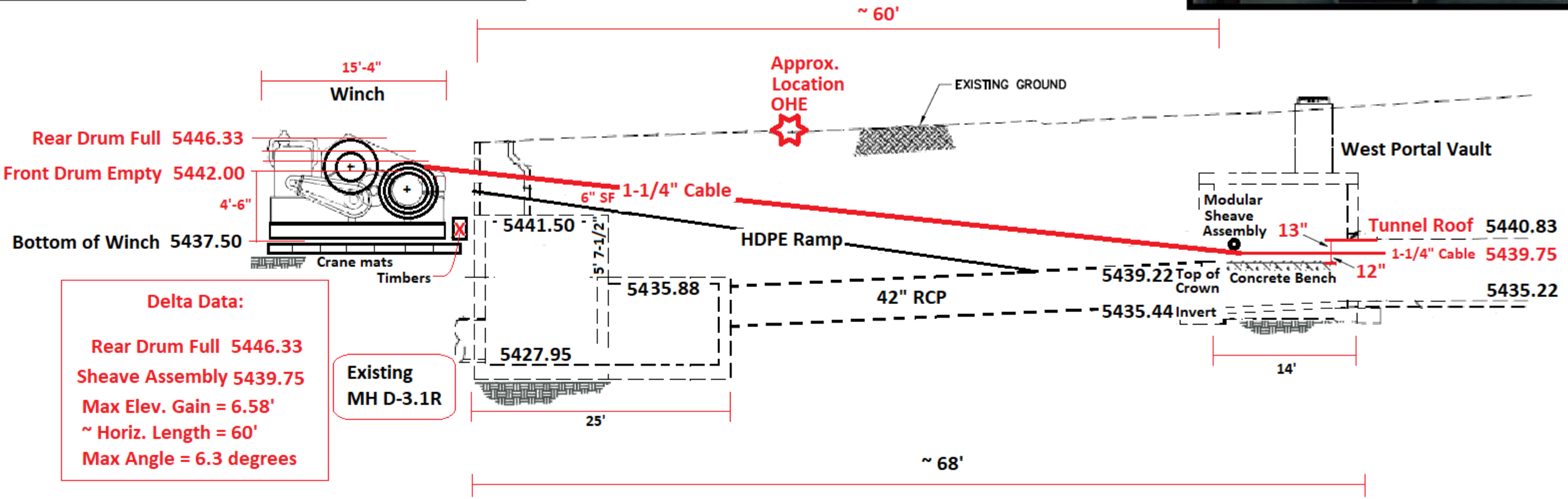
Then Just REEL it IN...




Winch = 35,000 lbs Empty
Winch = 70,000 lbs Full


~120,000 lbs Pull @ 20 FPM


Looking Into Portal

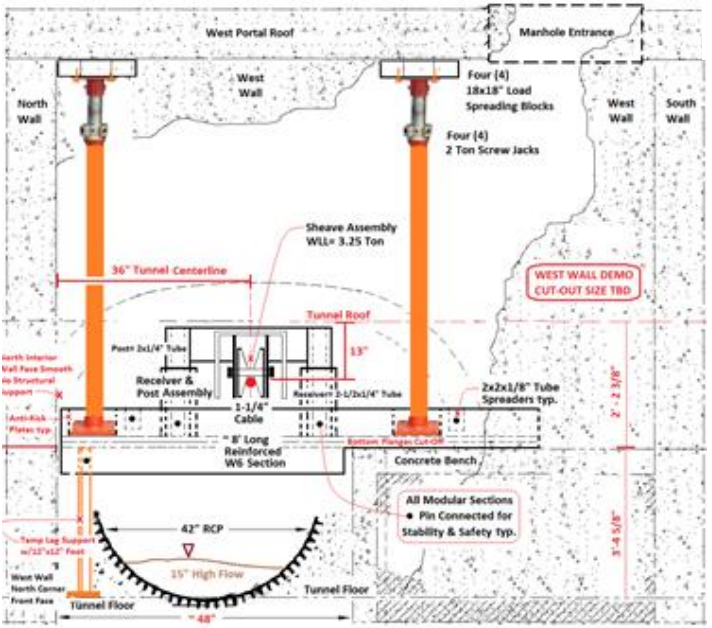

~ 60'
15'-4"
Winch
Approx. Location OHE
EXISTING GROUND
West Portal Vault
Rear Drum Full 5446.33
Front Drum Empty 5442.00
4'-6"
Bottom of Winch 5437.50
Crane mats
Timbers
6" SF
1-1/4" Cable
5441.50
5' 7-1/2"
HDPE Ramp
Modular Sheave Assembly
13"
Tunnel Roof 5440.83
1-1/4" Cable 5439.75
12"
5439.22 Top of Crown
Concrete Bench
5435.22
5435.88
42" RCP
5435.44 Invert
5427.95
14'
Existing MH D-3.1R
25'
~ 68'
Delta Data:
Rear Drum Full 5446.33
Sheave Assembly 5439.75
Max Elev. Gain = 6.58'
~ Horiz. Length = 60'
Max Angle = 6.3 degrees

Design/Build/Install Modular Sheave Roller System in West Vault

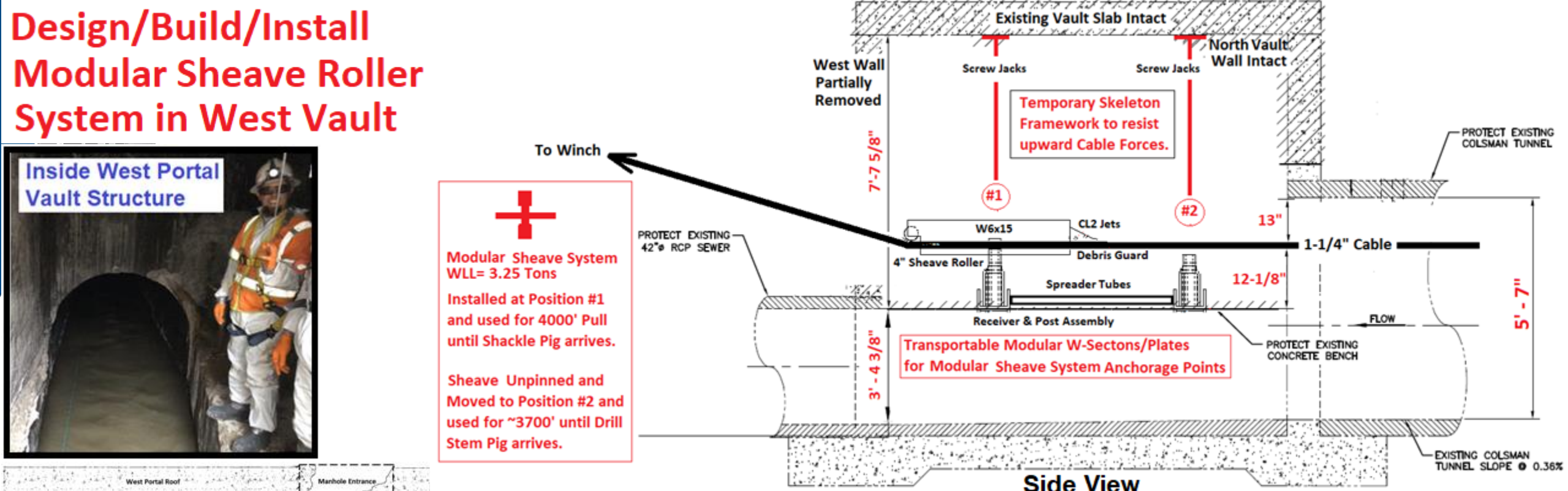
Modular Sheave System
WLL= 3.25 Tons

Installed at Position #1 and used for 4000' Pull until Shackle Pig arrives.

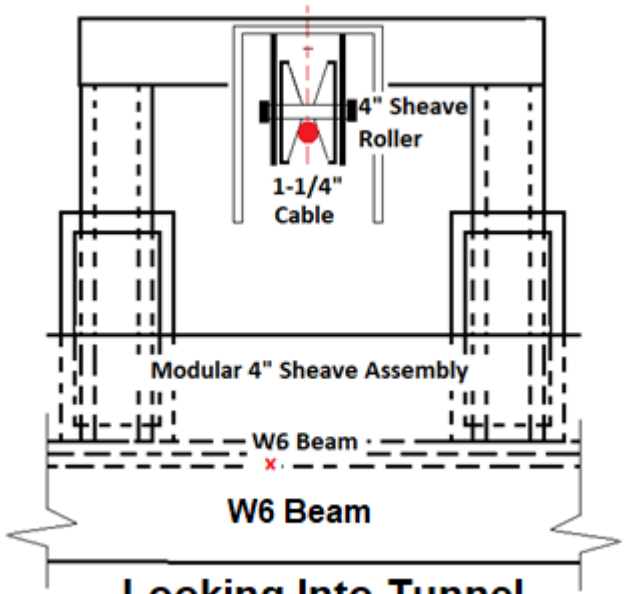
Sheave Unpinned and Moved to Position #2 and used for ~3700' until Drill Stem Pig arrives.



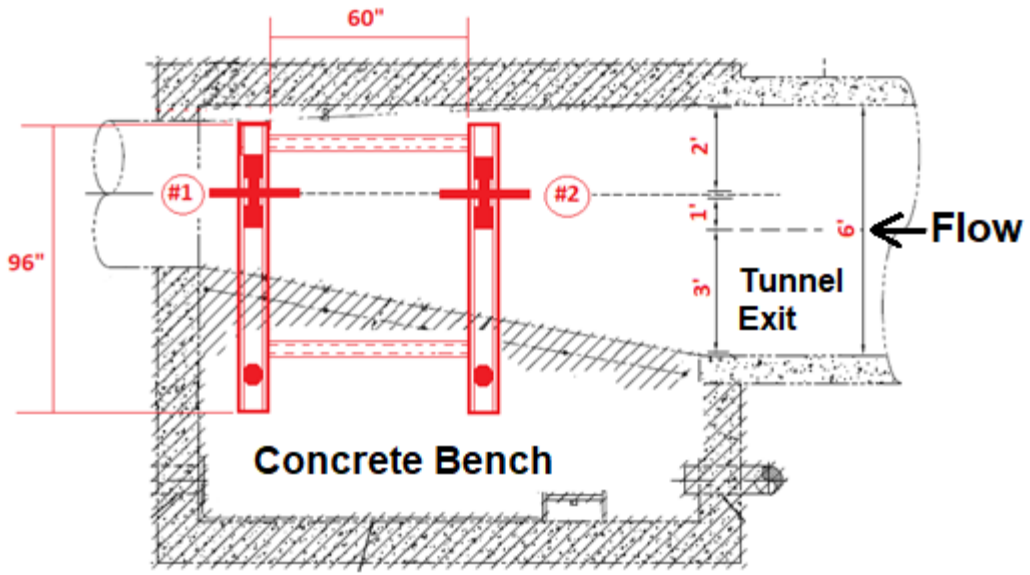
Looking Into Tunnel



Side View

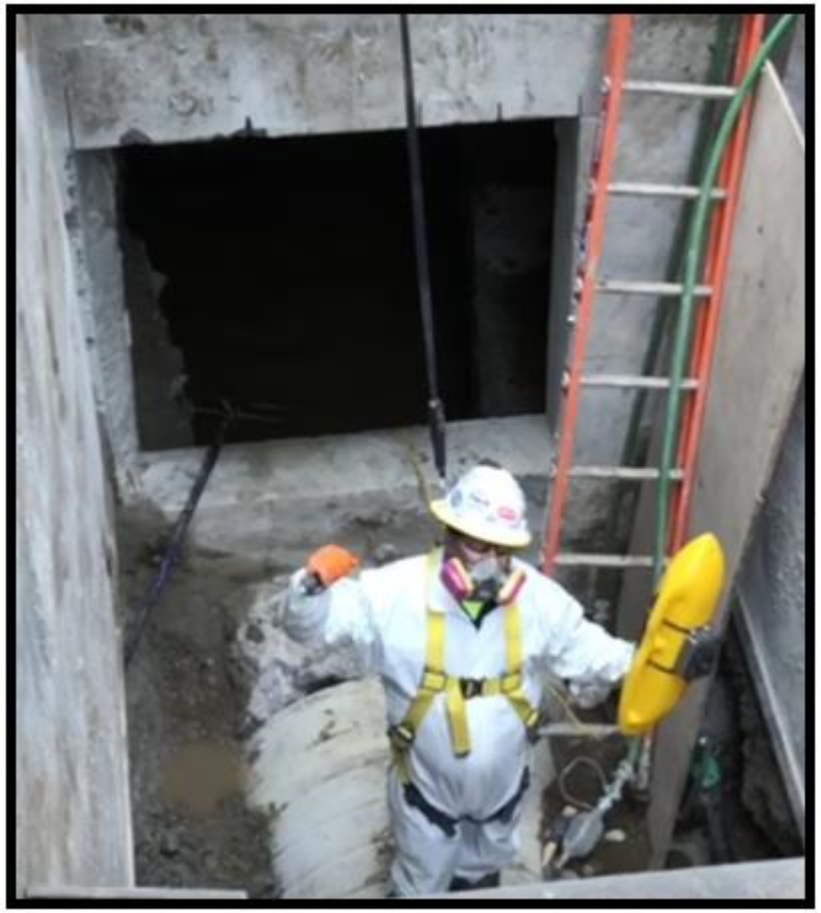


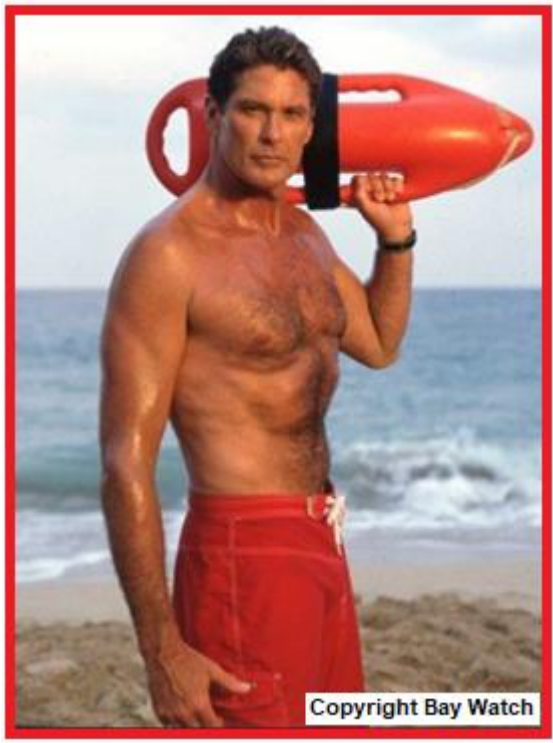
Looking Into Tunnel



Plan View

“Buoy Watch”

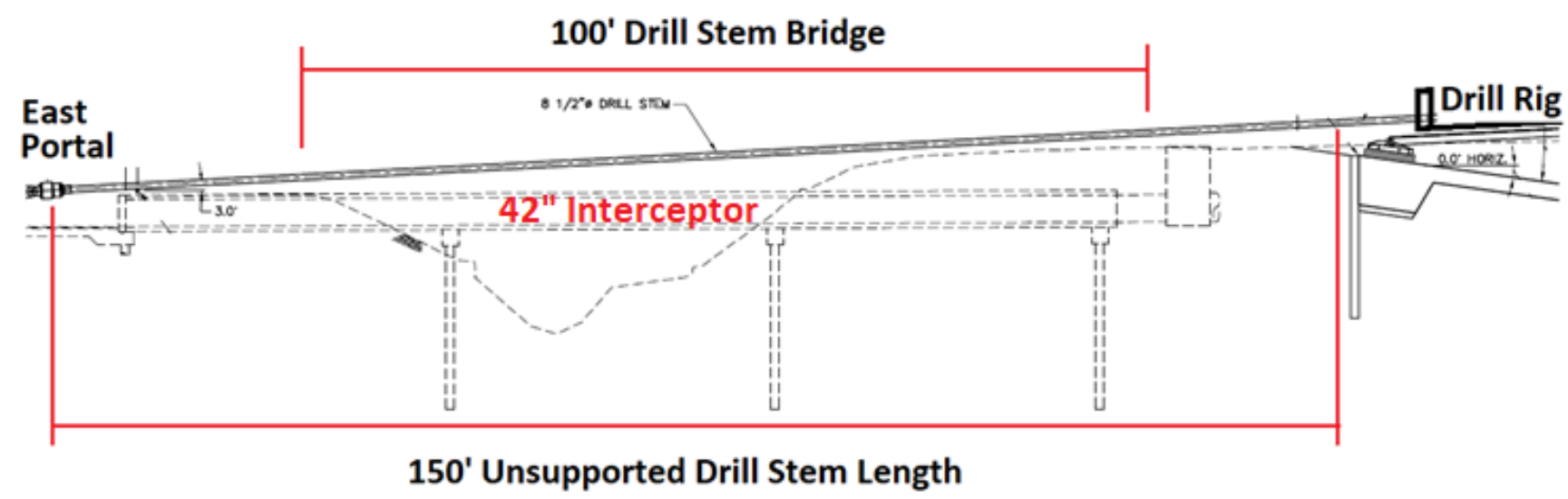


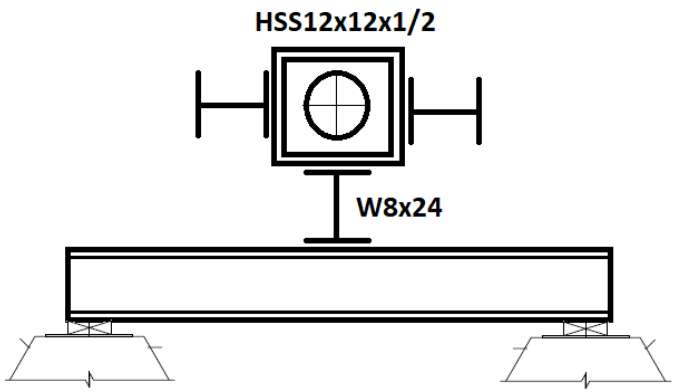


Buoy w/Beacon Buzzer tied to 8000 LF of 1/4” Rope

Set Adrift and Captured ~ 2 Hours Later

Encapsulate Shackles in PIGS & Spool-Out Down Stream

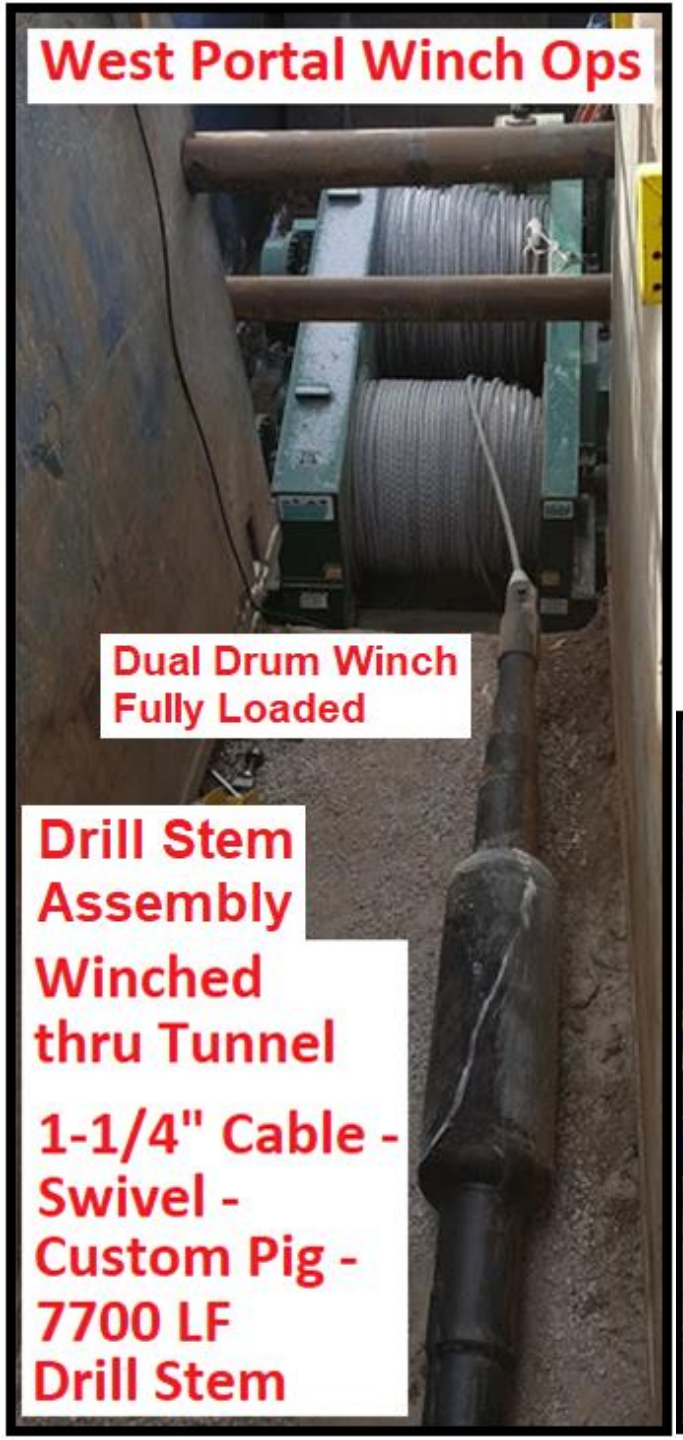




Drill Stem Bridge Cross-Section

UCT The Underground

Preparing to Winch Drill Stem thru Tunnel


West Portal Winch Ops
Dual Drum Winch
Fully Loaded
Drill Stem
Assembly
Winched
thru Tunnel
1-1/4" Cable -
Swivel -
Custom Pig -
7700 LF
Drill Stem

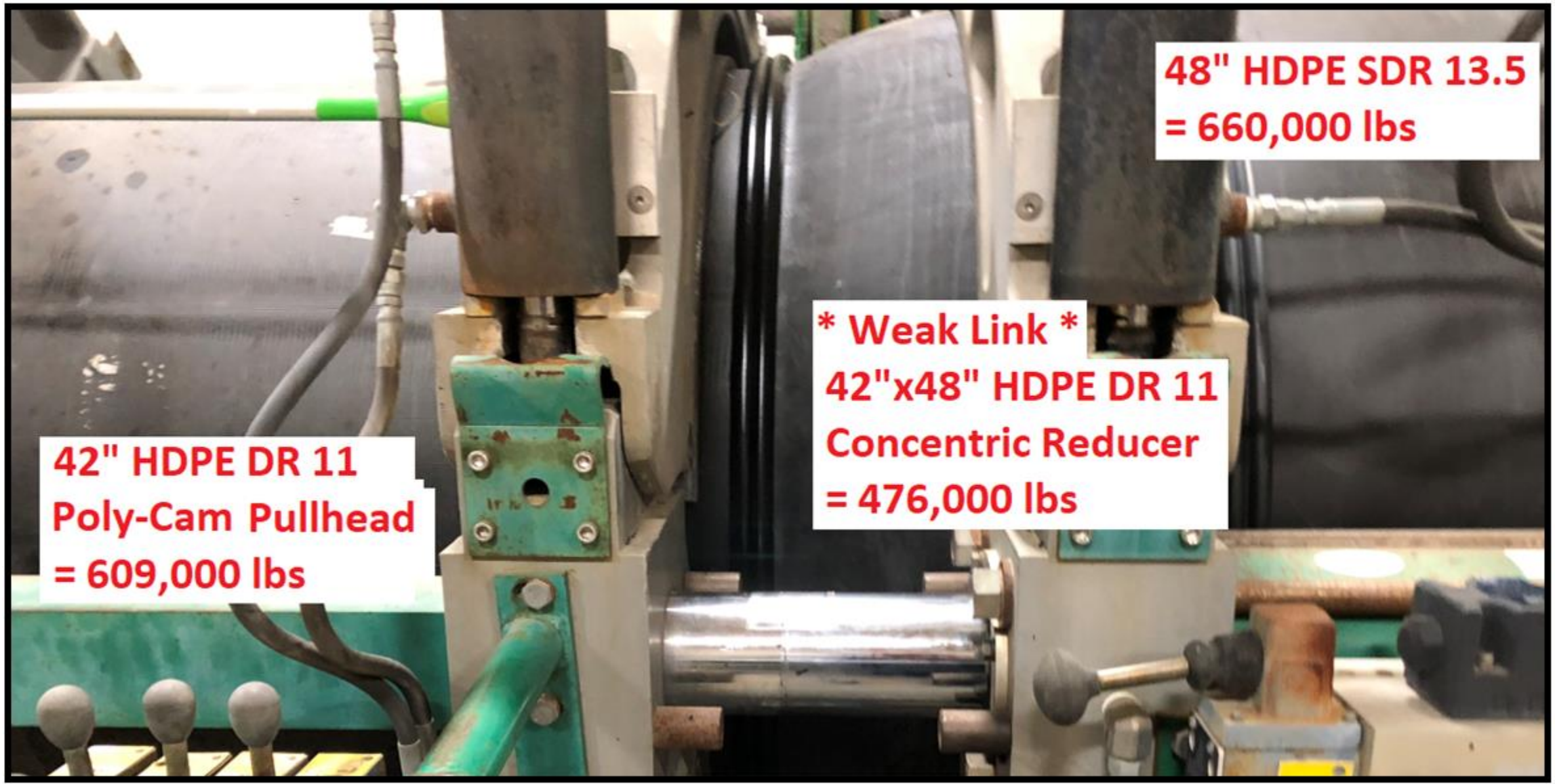

Threading
550 Ton
Swivel


LaValley TONG-HAND
Torque Make-up = 60,000 ft/lbs


Winch Loaded
w/Cable ≅ 70K lbs
Winch
Going Up!
200 Ton Crane

Safe Pull Force Analysis

3 - HDPE Components



Design/Build Reinforced Pull-Head Assembly
Pull Force Gained = 163,730 lbs.

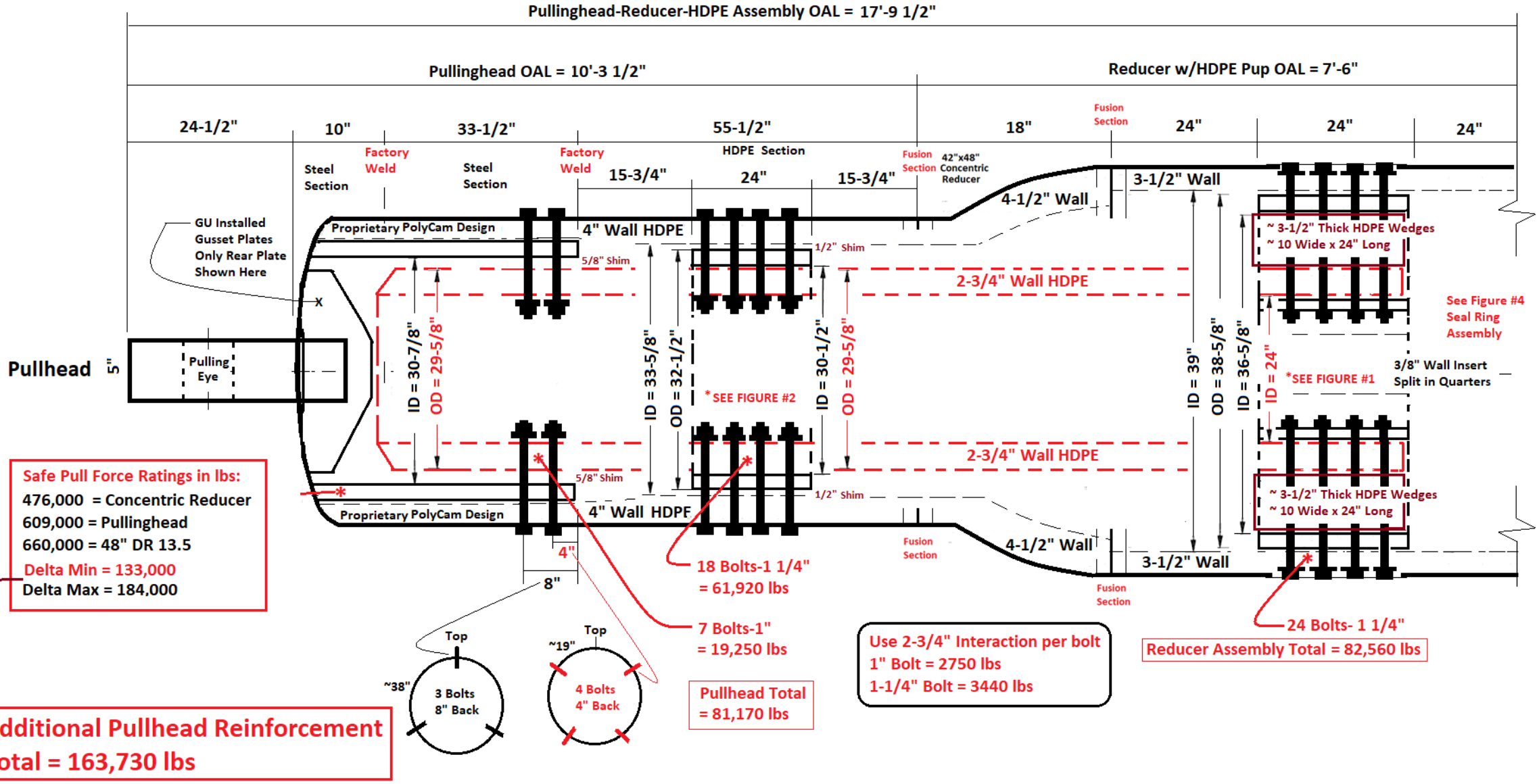
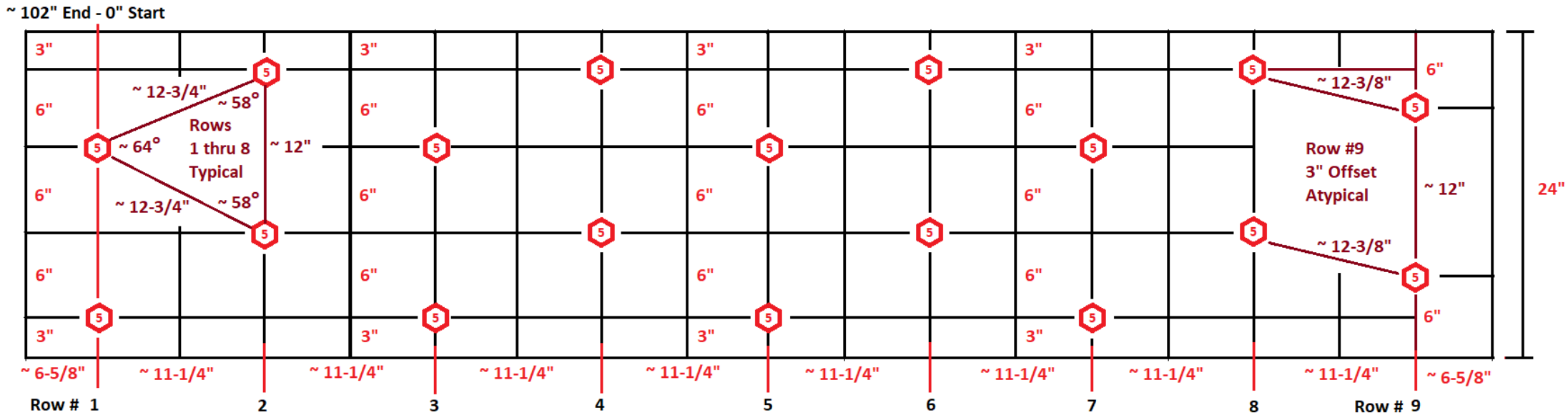


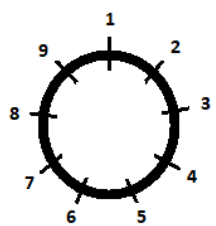
Figure #2

Total Number of Bolts = 18

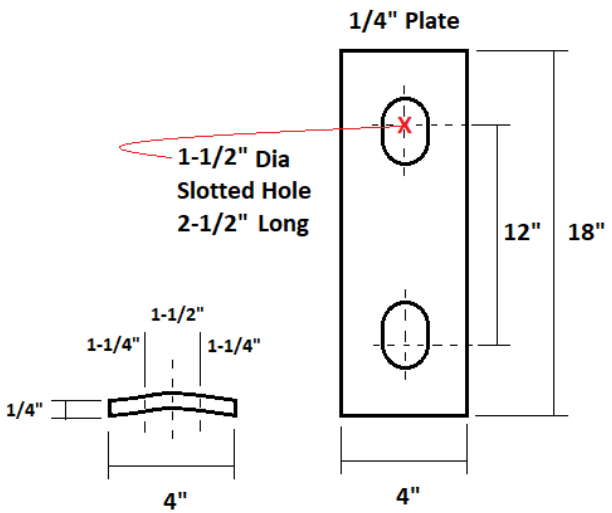
BOLT PATTERN 42" HDPE Rolled Steel Insert

~ 102" Circumference for 32-1/2" Rolled Steel Insert



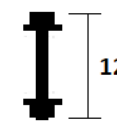


Bolt Pattern



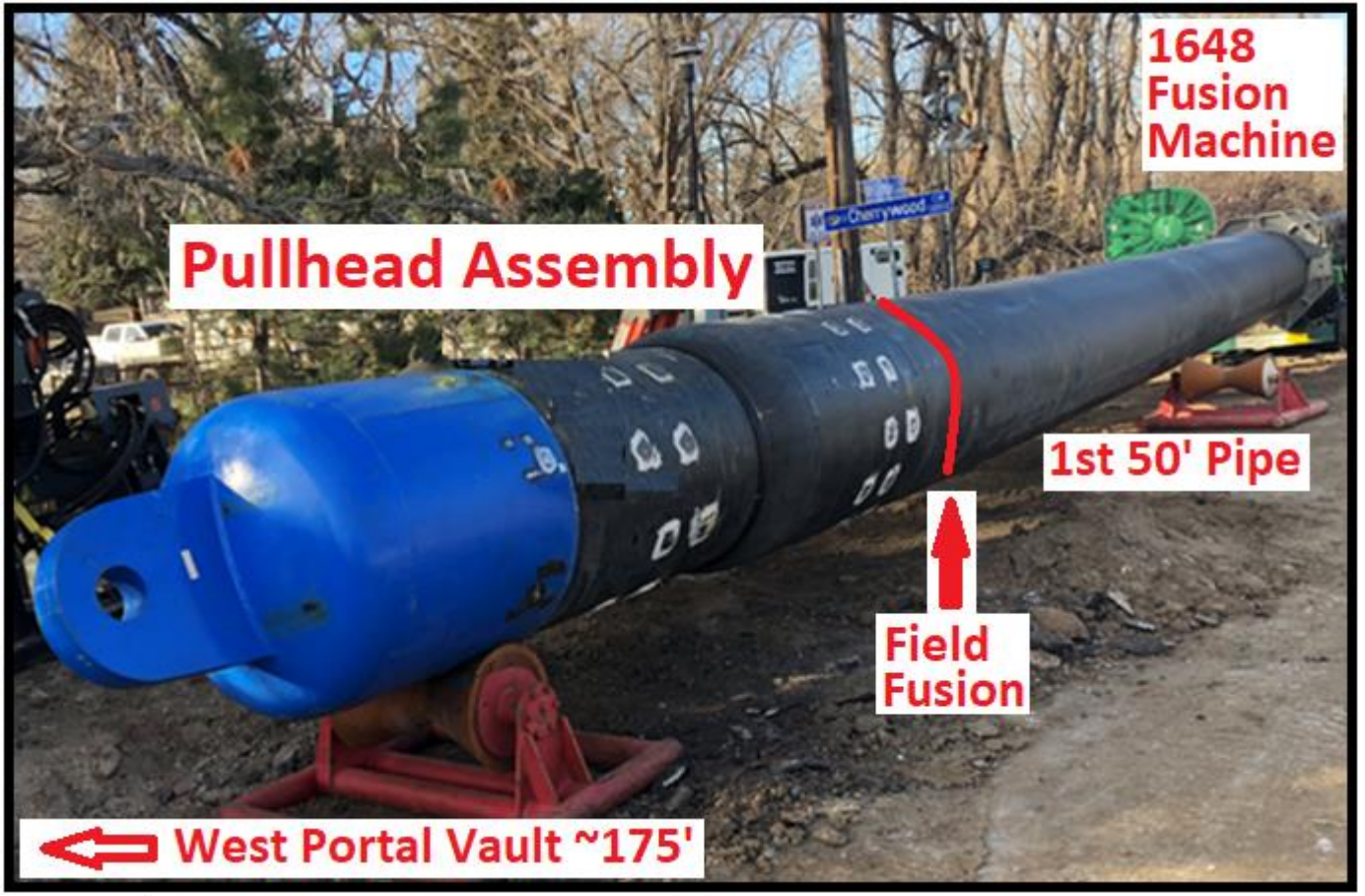
Interior Double Plate Washer Assembly

Grade Marking		Mechanical Properties				Hardness Rockwell	
	Nominal Size	Proof Load	Yield Str.	Tensile Str.	Elong. %	R.A. %	Min	Max
5 = B7 PB	¼" - 2½"		105	125	16	50		C35



1-1/4" All-Thread Bolt-Nut Assembly

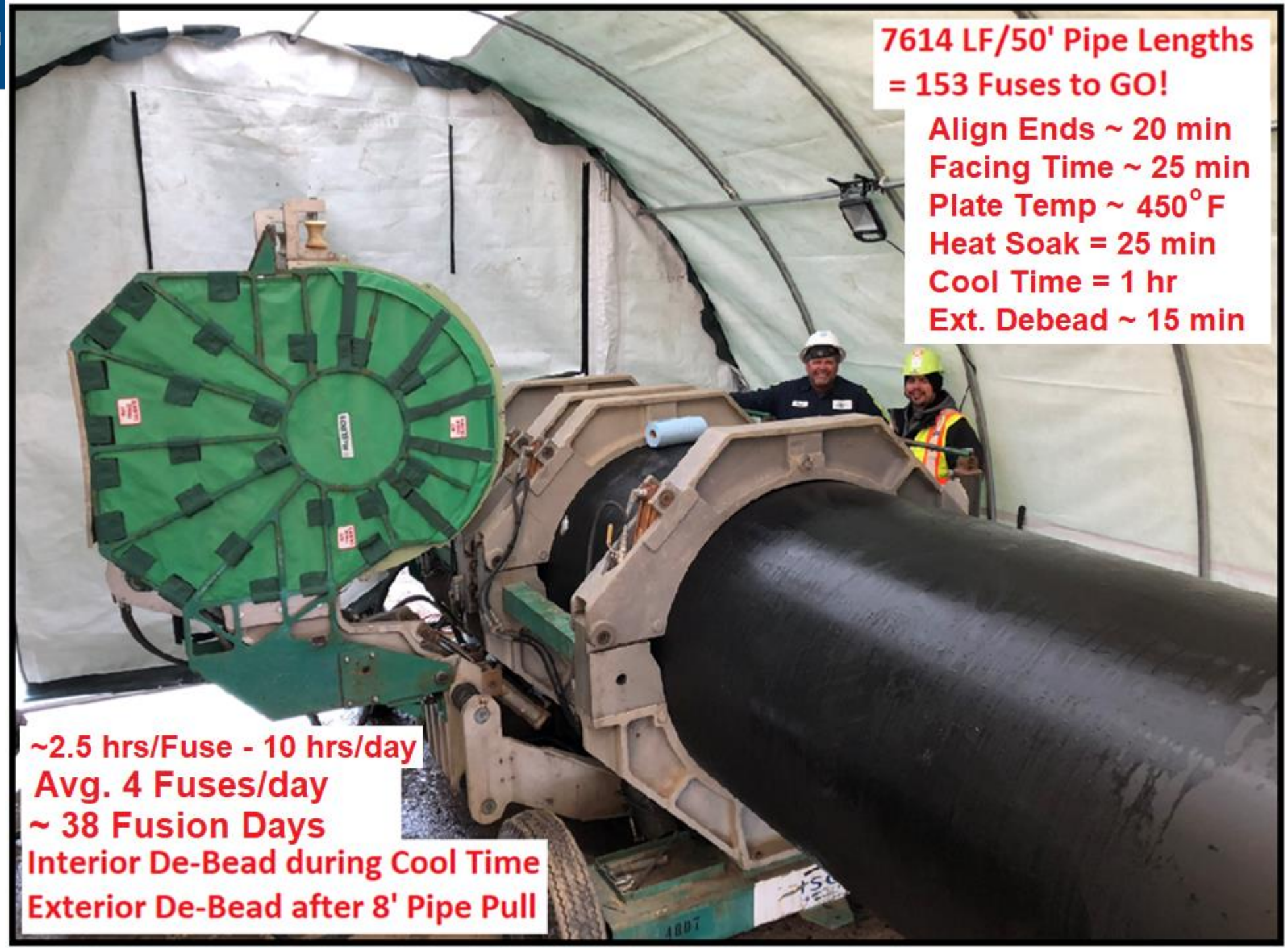
Global Underground Fabricated HDPE Pull-Head



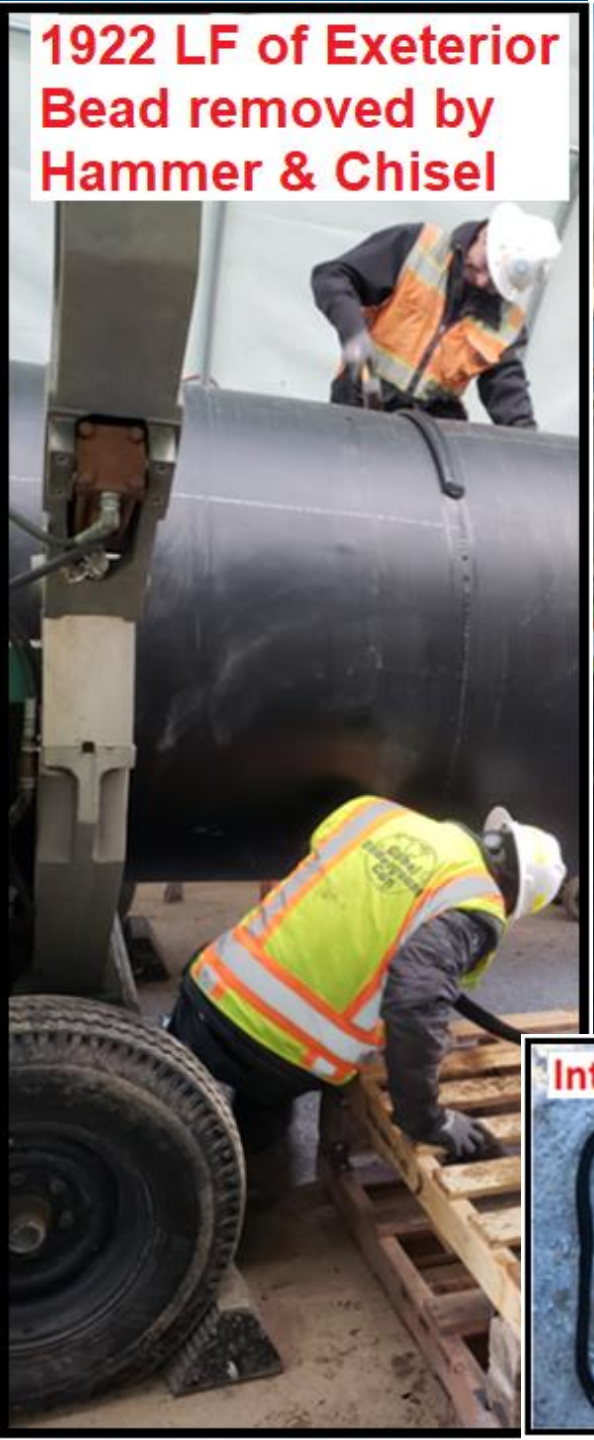
Now to Connect Pull-Head to Drill Stem and Ease it into the Tunnel,

Very Carefully!

Rocky Mountain Winter = Controlled Fusion Environment

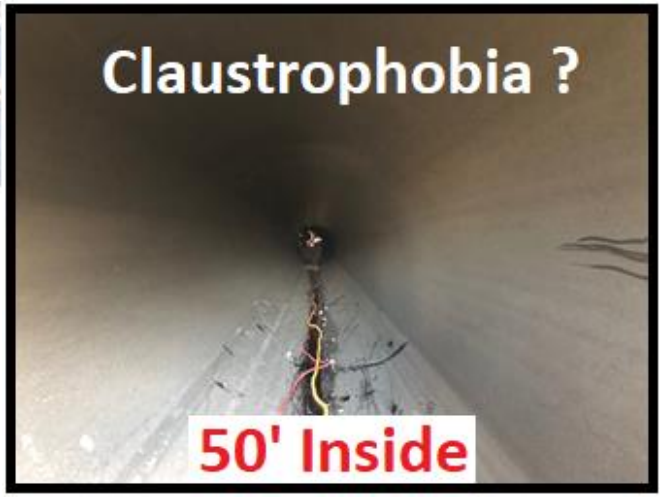

7614 LF/50' Pipe Lengths
= 153 Fuses to GO!
Align Ends ~ 20 min
Facing Time ~ 25 min
Plate Temp ~ 450°F
Heat Soak = 25 min
Cool Time = 1 hr
Ext. Debead ~ 15 min
~2.5 hrs/Fuse - 10 hrs/day
Avg. 4 Fuses/day
~ 38 Fusion Days
Interior De-Bead during Cool Time
Exterior De-Bead after 8' Pipe Pull

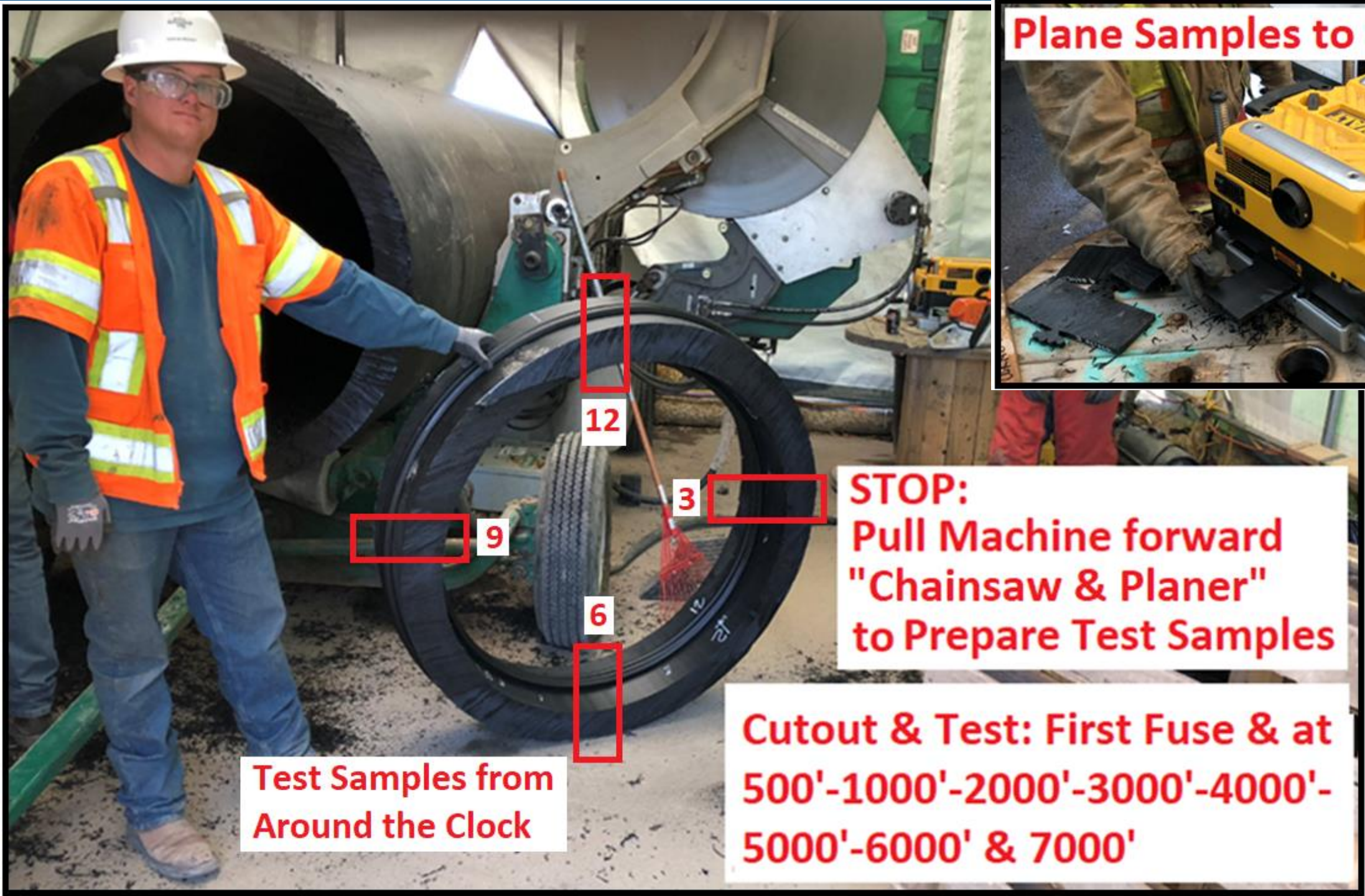
1922 LF of Exeterior Bead removed by Hammer & Chisel



3rd Party Inspection = AOK

1373 LF of Interior Bead was Removed using the Confined Space Entry Team, Roller Boarding 50' Inside Pipe and removing Bead when Warm




12
3
9
6
Test Samples from
Around the Clock
STOP:
Pull Machine forward
"Chainsaw & Planer"
to Prepare Test Samples
Cutout & Test: First Fuse & at
500'-1000'-2000'-3000'-4000'-
5000'-6000' & 7000'


Plane Samples to 1/4" Thick

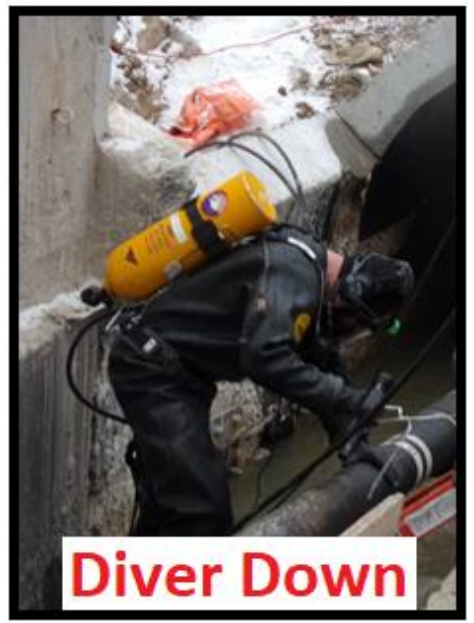
Pre-Test: Samples from 12, 3, 6 & 9 o'clock positions Planed Flat to ¼" Thick

Sample Bent at 90-degree angle

Post-Test: Visual Inspection of Combined Fusion Bead Zone


East Portal
24" Bypass Pumping
Tunnel Roof
Cut-Back
Pullhead
~ 200'
Drill Stem


Final Checks


Diver Down

UCT 25 YEARS
Underground Construction Technology

Due to Pipe Spiral/Rotation into Tunnel TEE is Fused at Max Angle

ISCO 48"x36"x24" Reducing Tee w/MJ adapters
Fused at Max Rotation to enter Tunnel at Vertical

Pull-Back Forces during the Slip-Line Operations:

Max = 100,000 lbs

Average = 60,000 lbs

Final Pull = 53,000 lbs

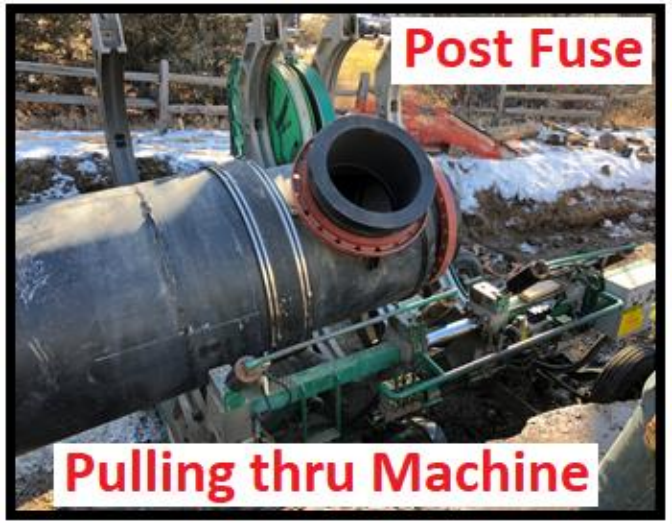
Pull Back Operations effect the Tee Position

John Deere 225C w/LaValley Deckhand Removing Drill Stem during Pull-Back Ops

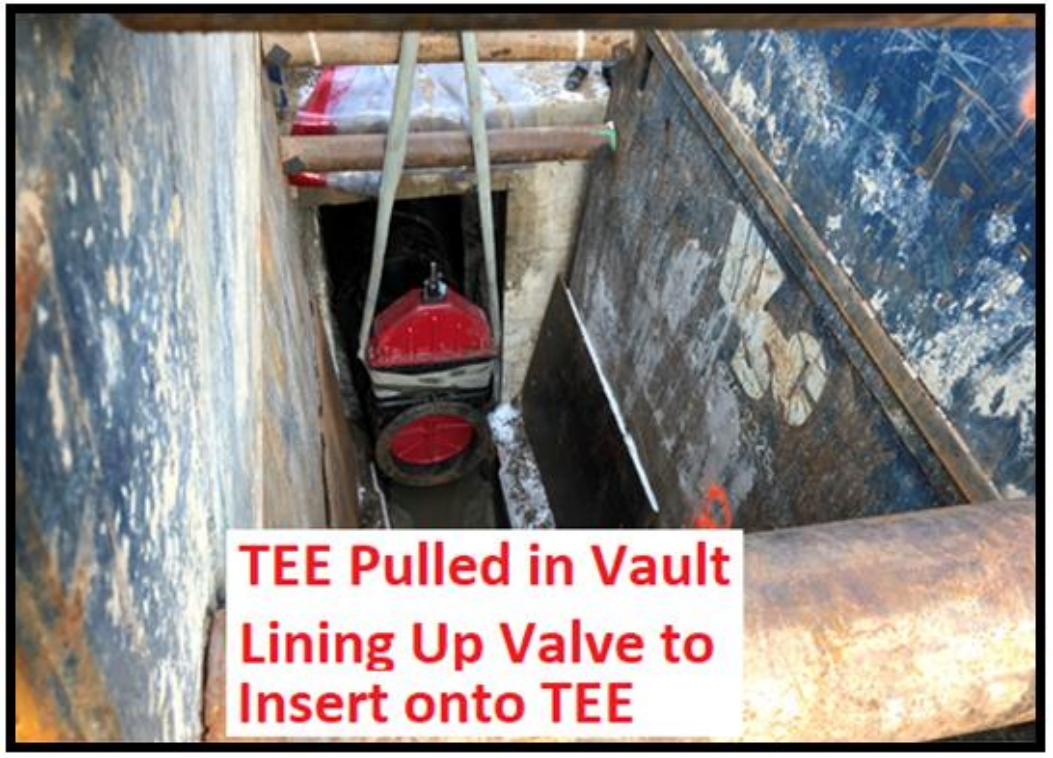
The Pipe had Rotated at 1/8 of a Turn Clockwise over the ~ 200' into the Tunnel for Two Weeks!

New Challenge: STOP REGROUP

Lift TEE w/8' Pup to the Side
Move Fusion Machine into Position



Job Well Done!




After 42 Days
of Darkness our
Pullhead Finally
Sees the Light!
East Portal


42" Steel/HDPE - 42"-48" HDPE Reducer to 48" HDPE
Pull Head Assembly 17'-2" Long
24" Bypass Pump Line
East Portal Tunnel
Steve McCandless
Garney Const.
CUT LINE
East Portal
Bldg Floor
End of Existing
42" Interceptor
550 Ton
Brewis Swivel

? Questions ?

Robert Meadows, President
Rob Powilleit, Vice President
Eric Ensign, Chief Financial Officer
Richard Bond, PE, Project Specialist
Call: 719-471-7414
641 Winters Drive
Colorado Springs, CO 80907

Global Underground Corp

In Memoriam: Steve McCandless
The project team would like to recognize Steve McCandless of Garney Construction, who passed away shortly after completion of the tunnel lining. His colleagues saw Steve as an incredible person in every way and an inspiration to many.

Colorado Safety Association
Be smart. Get safe.

GOLD SHOVEL STANDARD

NATIONAL SAFETY COUNCIL