



**37TH INTERNATIONAL
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FLORENCE 2019**

Fortezza da Basso • FLORENCE (Italy)

30th September • 2nd October 2019

Unique Horizontal Drain Installation under a Building
Using Pilot Tube Guided Auger Bore Methods

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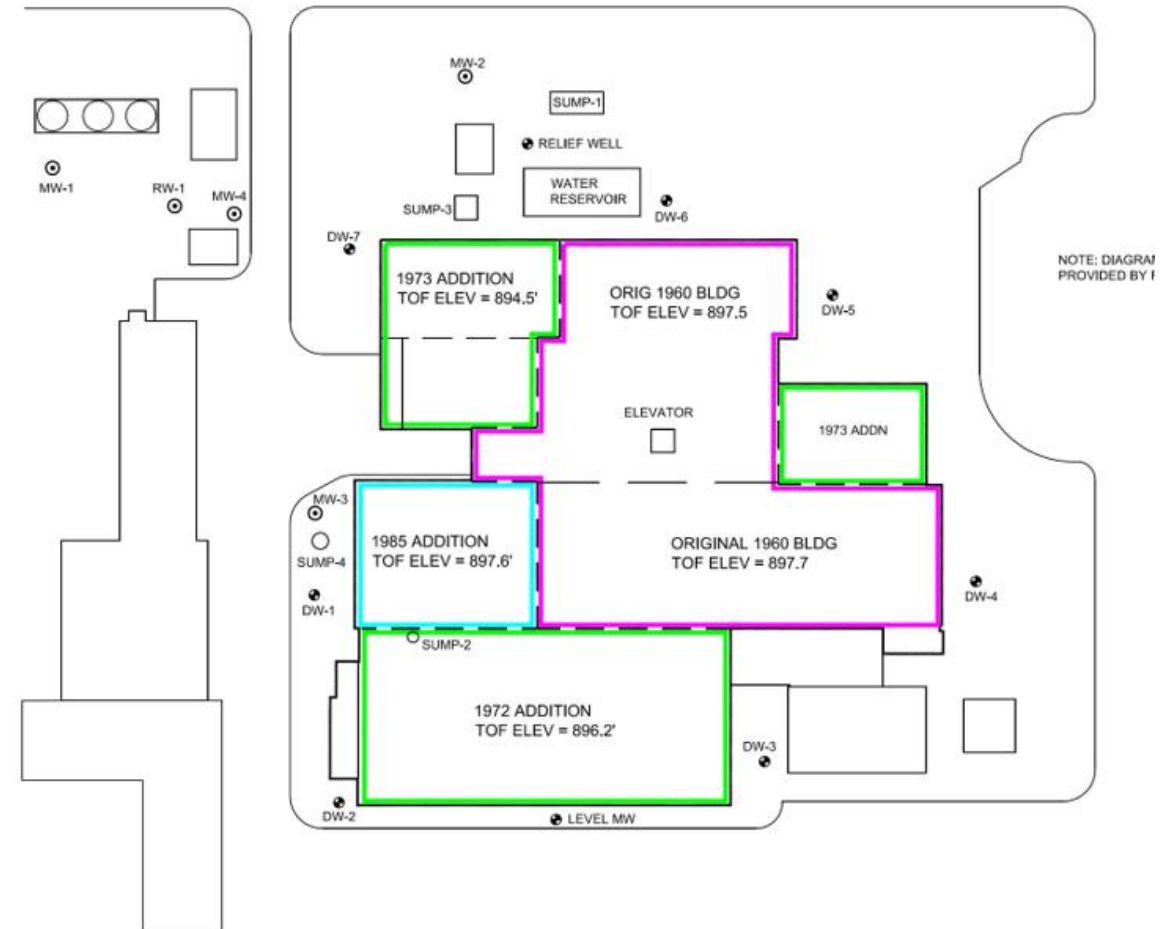
AGENDA

- History of the site
- Trenchless considerations
- Trenchless design
- Pre-construction
- Construction
- Lessons learned





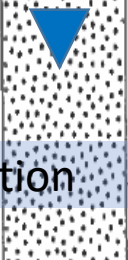
History of the site

- Built in the 1960s in a flood plain
- Additions added over decades at different elevations
- Original design included waterproof membranes, sub-slab drainage, and perimeter drains
- Subsequent additions experienced flooding



Past Solutions for Flooding

- Vertical dewatering wells installed around perimeter in 1990s
- Worked well until 2010
- Investigation found that the wells had reduced capacity due to being fouled with iron-fixing bacteria
- Additional wells were installed in 2014 but only worked for a few years

Contractor/Crew: Layne				Date Started: 8/23/11		Date Completed: 8/23/11			
Drilling Method: Rotasonic				Elevation (ft): 0		Total Depth (ft): 45		Depth to Water (ft): 17	
Depth (ft)	Sample Interval	Recovery	PID (ppm)	Description		Profile	Remarks Lab Samples, etc.		
0	0-10'	2'		Sand, coarse, brown, (fill) <div>Sand</div>			Hole was hydro vac'd to 8' on 8/22/11 and backfilled with coarse sand		
- 2									
- 4									
- 6									
- 8	10-20'	2'							
- 10									
- 12									
- 14									
- 16				Sand, medium-coarse, with few fine rounded gravel, brown <div>Sand</div>			The boring was 25' north of well DW-4 which was active at the time the water level was measured		
- 18									
- 20									
- 22									
- 24	20-30'	2'							
Proposed Drain Elevation									

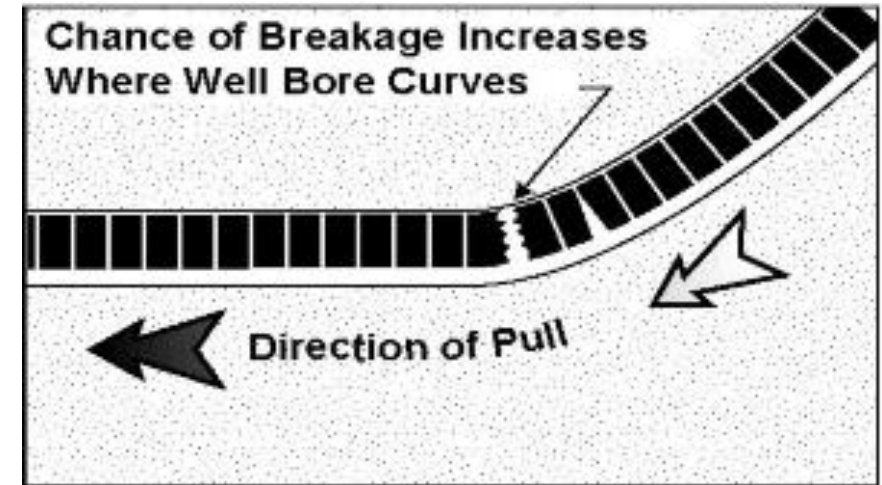
Trenchless Considerations



- 400-foot installation length
- Both 6-inch and 10-inch diameter installations
- No construction access inside the building during horizontal drain installation
- Granular soils with a high groundwater level
- Installed well screen needed to be robust to allow for post-installation (long-term) cleaning.

Trenchless Options

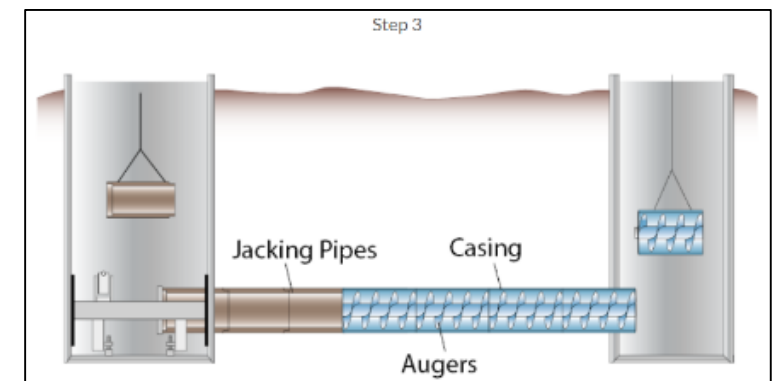
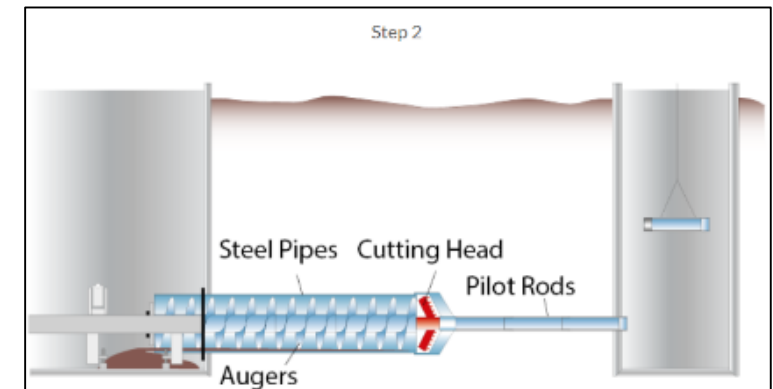
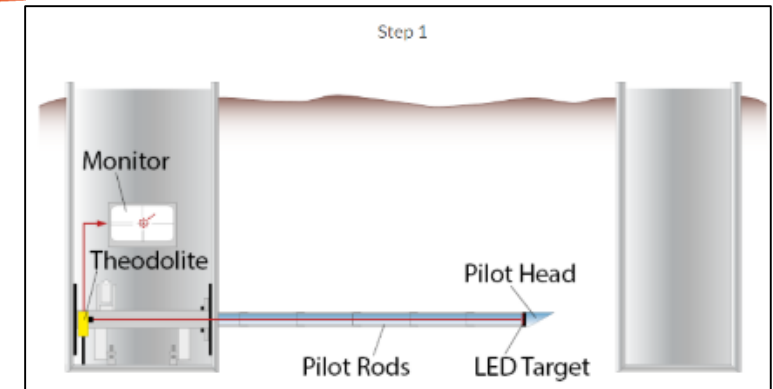
- Horizontal Directional Drilling
 - Settlement potential with overcut borehole
 - Low accuracy (no access to building)
 - Curvature of pullback could damage drains
- Auger Boring
 - Low accuracy
 - Oversize casing
- Pilot Tube Guided Auger Boring
 - Very accurate
 - Unique install w/oversize casing



SOQ 2005, DTD Inc,

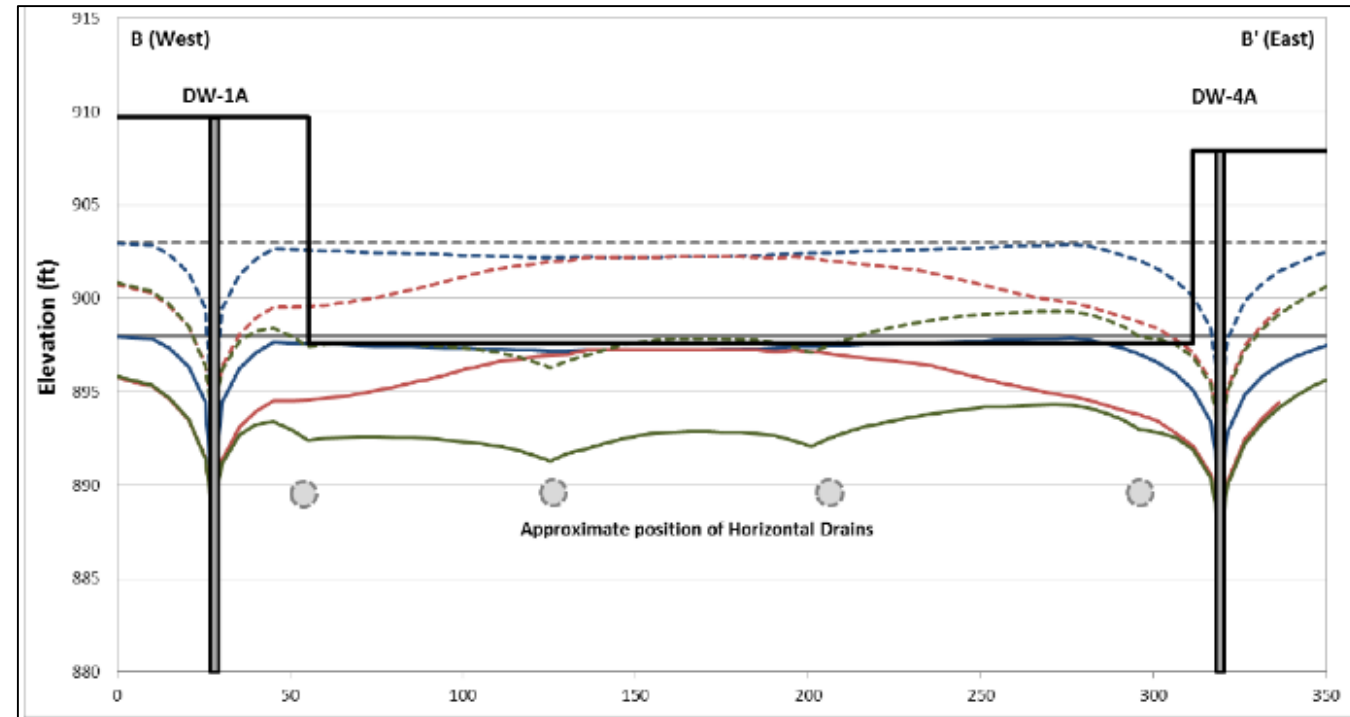
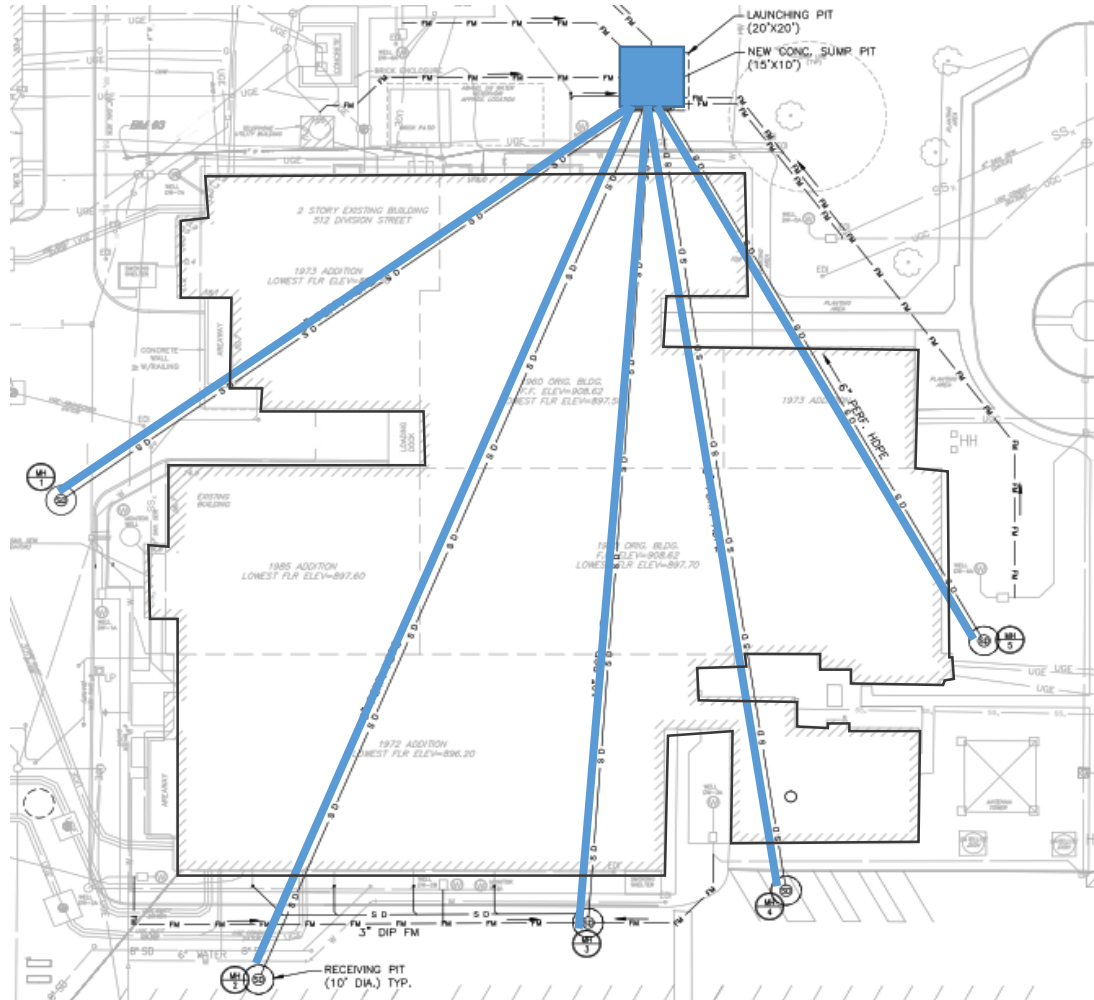
Benefits of Pilot Tube Guided Auger Bore

- All steering and guidance is located in the launch pit
- Straight pit-to-pit installation method, no curves
- No drilling fluid is typically used during installation that could foul the well screens
- The amount of over-cut is considerably smaller than HDD, which reduces the potential for settlement

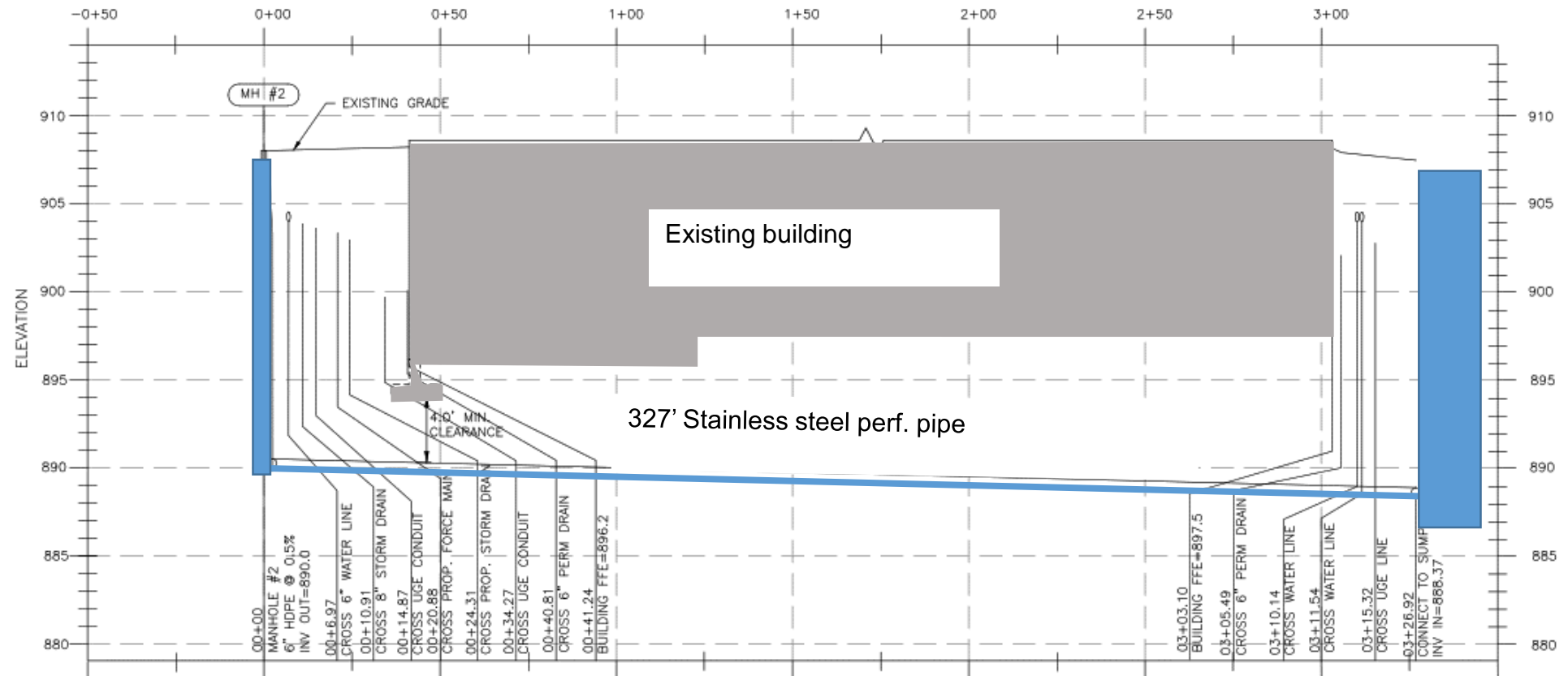


Pilot tube process from Bohrtec website

Trenchless Design

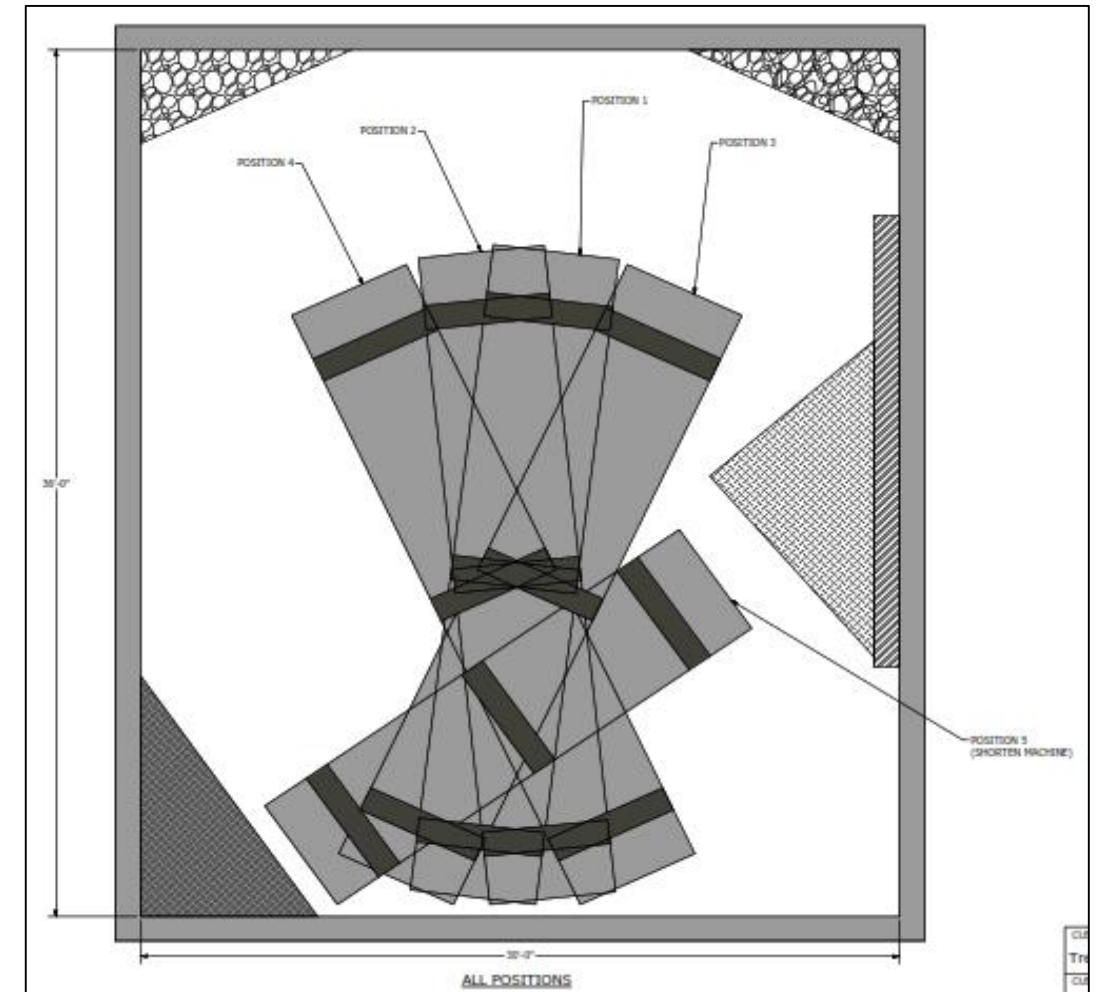


Trenchless Design



Pre-Construction Considerations

- Contractor submits a change
 1. Pilot tube install
 2. Follow with sizing tool
 3. Product pipe jacked
- Trenchless work plan indicating:
 - the equipment layout
 - the reaction wall locations for each splay within the shoring and
 - the well casing/ adapters
- Pre-Construction verification of screen strength
 - Expect minimal increase in jacking force (7 3/8" vs 6")
 - Pre-construction testing of screen strength
 - Johnson Screens on-site
- Typically cannot reverse, except in pilot mode



Specialty Adapters

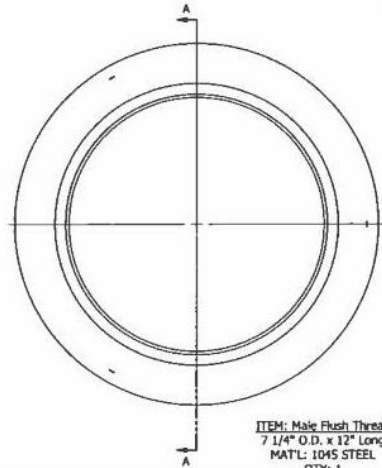


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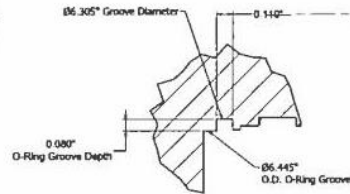
FRONT VIEW

APPROXIMATE WEIGHT OF PART
46 POUNDS



ITEM: Male Flush Thread
7 1/4" O.D. x 12" Long
MAT'L: 1045 STEEL
QTY: 1

PILOT TUBE ADAPTER -
"GERMAN THREADED PIPE"
STUB ACME THREAD
4 TPI
Ø5.305" Major Diameter
Ø5.180" Minor Diameter
Ø5.243" Pitch Diameter
0.125" Groove Width



DETAIL B
O-Ring Groove

JOHNSON SCREEN ADAPTER
MALE FLUSH THREAD
2 TP1
5.393" \pm 0.003" Major Diameter
5.283" \pm 0.003" Minor Diameter
0.255" \pm 0.003" Groove Width



REAR VIEW



APPENDIX

FRONT VIEW



- Delays
 - Mobilized November 26th (in Minnesota)
- Order of construction
 1. Excavate launch shaft
 2. Additional dewatering
 3. Storm drain line install
 4. Excavate the launch shaft further
 5. HD 4 through HD 1



**Added complication:
Looming Government Shutdown
starting December 22nd**

Storm Drain

- Started on November 28th
 - Anticipated high quantities of groundwater
 - Planned to use water auger
 - Encountered clay, which plugged auger
 - Jacking forces climbed
 - Water soluble lubricant clumped and caused system to repeatedly plug
 - Switched to regular bentonite-based lubricant since storm drain wasn't a drain --- Jacking forces reduced
- 2 days for pilot tube installation, 2 days for auger/casing, 2 days for 10-inch drain installation



Storm Drain Construction



Horizontal Drains 4 and 3

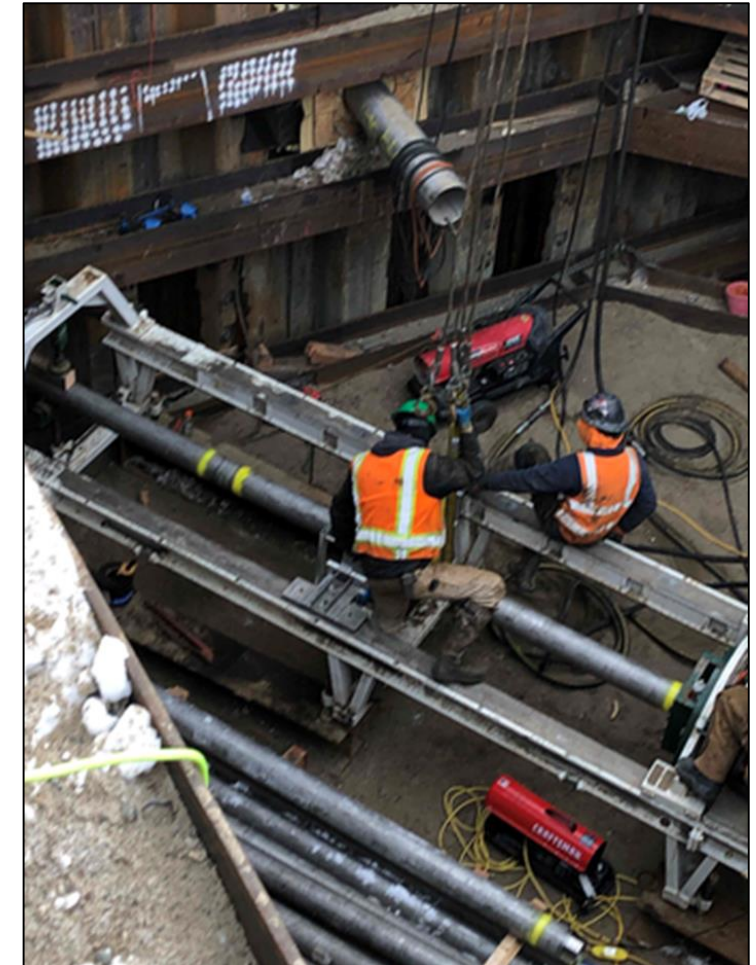
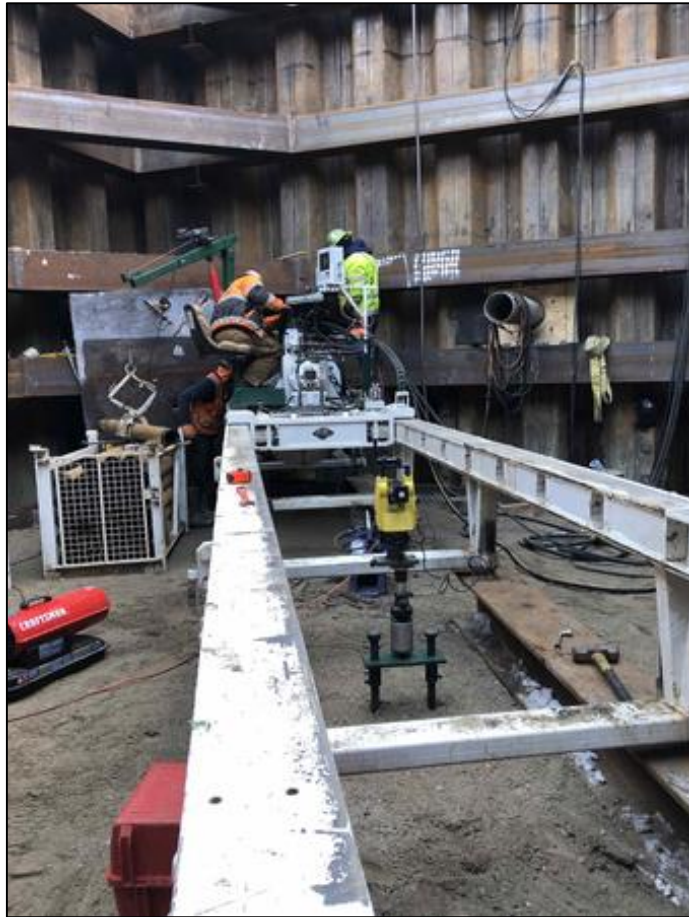


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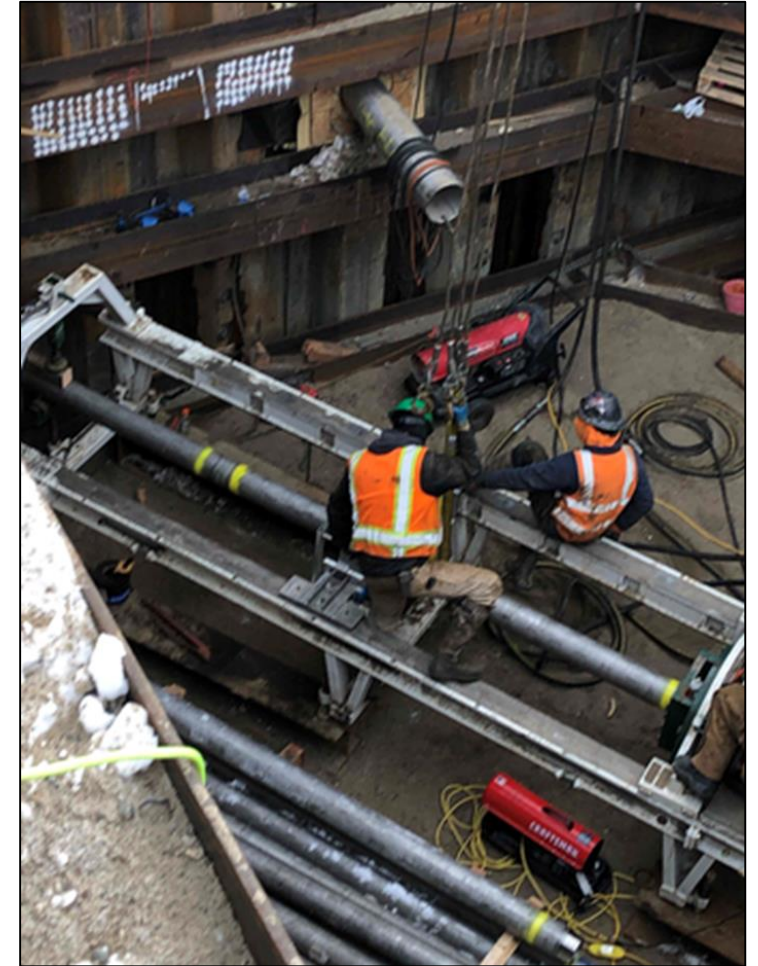
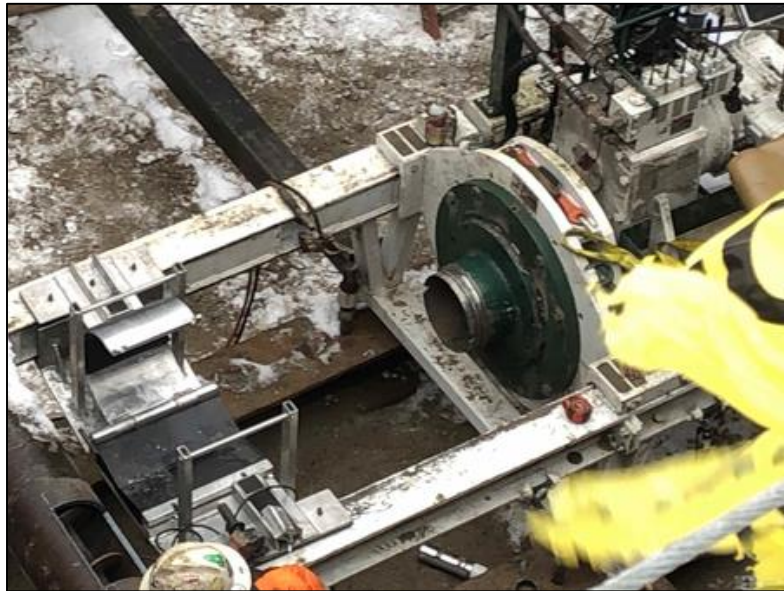
- HD 4
 - Started on December 10th
 - Went very well
 - 3 days for horizontal drain installation
- HD 3
 - Started on December 13th
 - Went very well
 - 2 days for horizontal drain installation



Horizontal Drains 4 and 3



Horizontal Drains 4 and 3



Horizontal Drain 2

- Started on December 15th
- Very oblique angle. The waler near the bottom of the excavation resulted in a long section of exposed pipe
- Within 15 feet of progress, well casing became cross-threaded
- Tried to pull casing, even though machine not geared for it; damaged pipe further
- Tried innovative approach to push the damaged drain casing out



Horizontal Drain 2

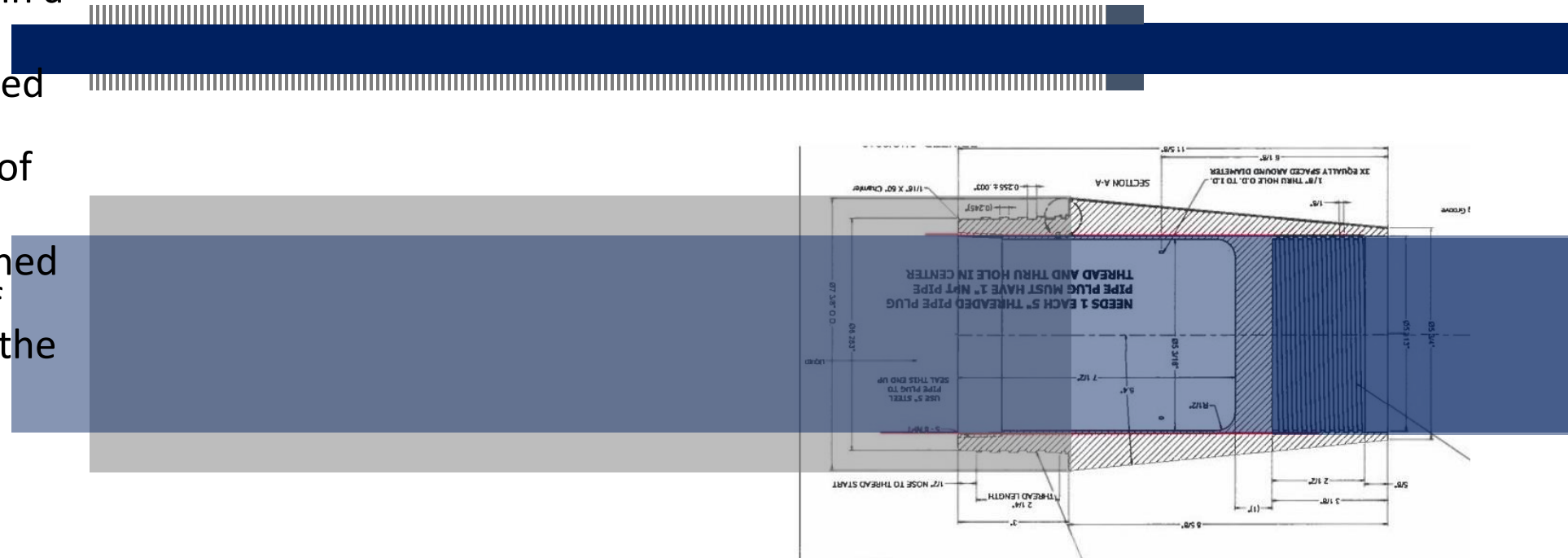


- Innovative approach
 - Cut off exposed tail end of horizontal drain
 - Cut off threaded end of pilot tube resulting in a blunt end
 - Pilot tube was pushed inside remaining (damaged) portion of the horizontal drain
 - Pilot tube then pushed damaged section of drain screen out of the alignment

Horizontal Drain

Adapter

Pilot tube



Horizontal Drain 2 Conclusions

- Unexpected benefit: the damaged section of screen acted like an HDD pre-ream
- The installation of second screen was very easy
- Entire installation took 4 days
 - With a quick trip to Johnson Screen



Horizontal Drain 1

- Started December 20th (two days before government shutdown)
- Last one: went very well
- Finished just in time
- Drove off with 26 minutes to spare before mandatory site closure due to government shutdown



Lessons Learned



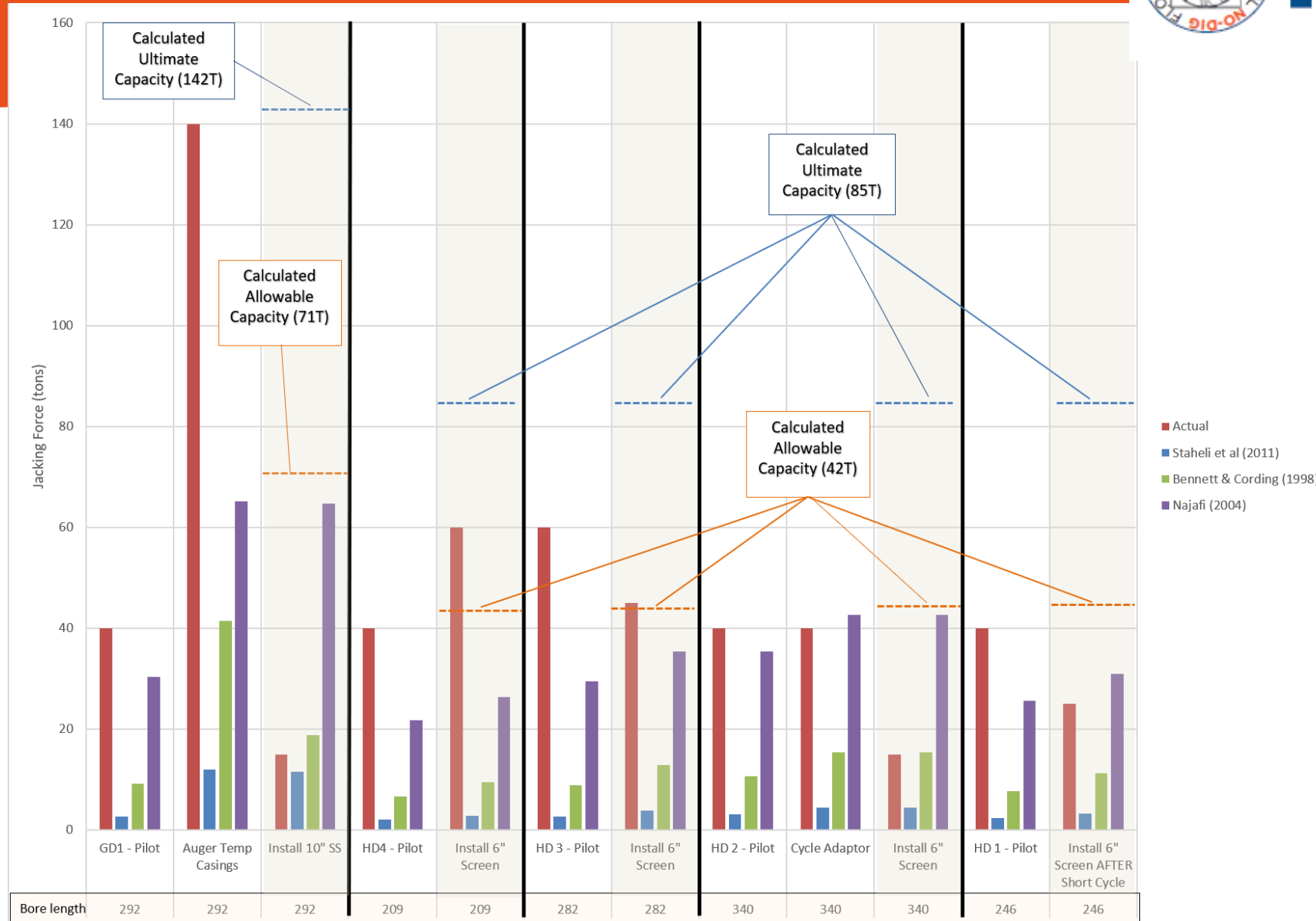
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- Cross-over adapter: Make with tool steel, not mild steel
- Shoring system: Waler placement is important
 - Caused jacking frame placement too far from the wall
 - Caused an increase in exposed drain pipe length
 - Created unforeseen lateral forces on the drain pipe, especially for the more oblique installations
- Dewatering contractor: should be required to provide drawdown curves showing the construction dewatering area of influence so the trenchless contractor can better plan for conditions

Jacking Forces



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Thank you



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