2019 PIPELINES CONFERENCE

Recap/Highlights

by Bill Chavez, PUG Past-Chairman

Nashville, TN, July 21 – 24, 2019

PUG NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- This project involved construction of approximately 14.2 miles of sanitary force mains and the reconstruction and upgrade of seven pump stations.
  - Owner: City of Largo with 85,000 residents
  - The City sanitary sewer system includes 235 miles of gravity sewer spanning from Tampa Bay on the east to the Intracoastal Waterway on the west.
  - The City 54 wastewater lift stations and 143 privately maintained stations discharge through 48 miles of force main into 22 miles of interceptor sewers, 24-inch diameter and greater to the City's 12 MGD wastewater treatment facility.
  - City's sanitary sewer system regularly experience overflows following any significant wet weather event.
  - A study completed in 2000 identified improvements aimed at addressing high flows during wet weather events.
  - The Florida Department of Environmental Protection issued a consent order in April 2006 requiring the elimination of all SSOs during wet weather events less than or equivalent to a 10-year, 24-hour storm event.

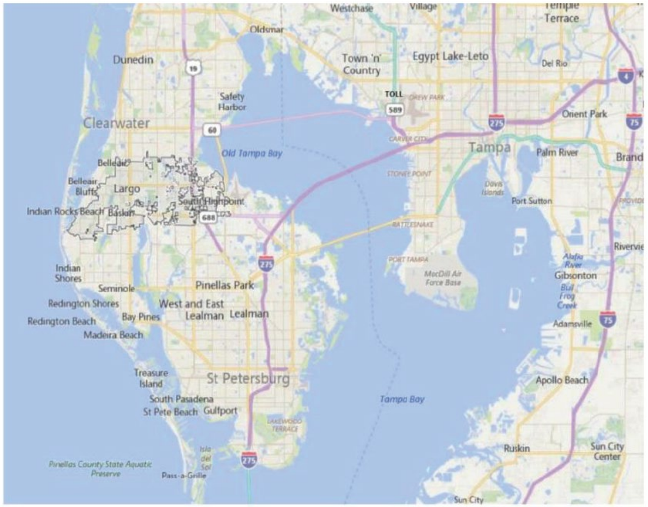

Figure 1. Map of Pinellas County, showing Largo city limits

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King Engineering Associates,
Tampa, FL

Randy Tseng,
Underground Solutions, Inc.
Poway, CA

- This City authorized Brown & Caldwell with sub-consultant King Engineering Associates to further develop the necessary improvements.
- Upon completion of preliminary investigations including in-depth study of the collection systems hydraulics and full assessment of the condition of the existing force mains the following improvements were identified:
  - Upgrades or reconstruction of seven wastewater lift stations
  - Installation of water level sensors in five locations within the gravity sewer collection system.
  - Expansion of the sanitary sewer gravity collection system by 1,400 linear feet.
  - Construction of 3 miles of 12-inch force main, 3 miles of 16-inch force main, 4 miles of 20-inch force main, and 3 miles of 30-inch force main
  - Installation of five automated motor-operated control valves to redirect flow into the new "Wet Weather Force Main" upon detection of high levels in the collection system.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- Construction of such lengths of force main in urbanized commercial and residential areas required a combination of construction methods, including open cut, trenchless horizontal directional drill, and jack and bore, see figure 2.

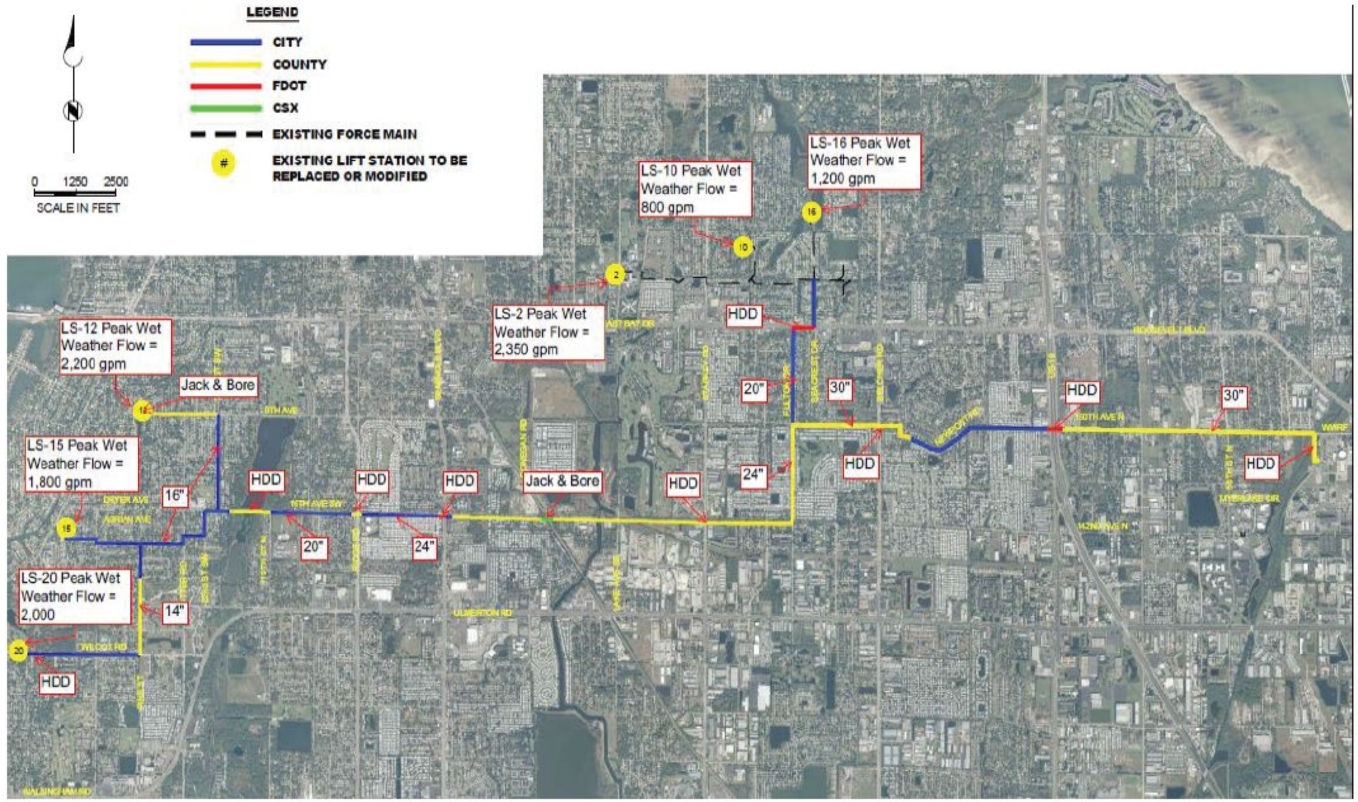

Figure 2. Project map, showing right-of-way ownership, location of trenchless installations, and pipe size

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King
Engineering
Associates,
Tampa, FL

Randy Tseng,
Underground
Solutions, Inc.
Poway, CA

- Project was awarded in 2015. Open cut construction was the preferred option for pipe installation according to the City and consulting engineers. It presented a more manageable risk, since proper subsurface utility locates could not be performed ahead of construction. Any conflicts could be better managed than with directional drill.
- The final selected route contained multiple obstacles that let to the incorporation of directional drills, including traffic impacts, restoration requirements, wetlands impacts, or costs as we are going to see next.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- Traffic Impacts and Driveway conflicts:
  - Approximate 1,500 LF of the 16-inch pipe along 8th Avenue was designed as a single directional drill to avoid impacts to sidewalks, residential driveways, and associated water and sewer services that ranged 3 to 5 feet deep.
  - As with the HDD bores, the overall length was largely determined by the availability of location for the entry and exit pits.

Figure 3. Alignment and HDD along 8th Ave. SW

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- Right-of-Way Occupancy
  - One HDD of 30-inch pipe of approximately 900 LF in length was included to cross under back yards of 11 residences that had encroached on the vacated right-of-way west of Belcher Road (see Figure 4)
  - The drill was maintained at approximately 28 feet deep to minimize the risk of surface impacts or frac-out in fenced yards.

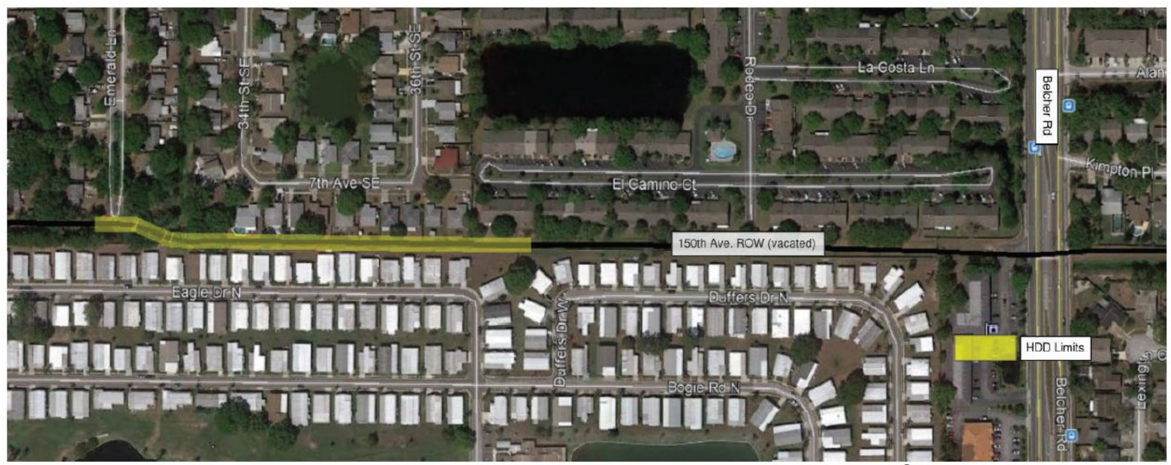

Figure 4. HDD under properties encroaching onto vacant 150th Ave (extension) right-of-way

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King
Engineering
Associates,
Tampa, FL

Randy Tseng,
Underground
Solutions, Inc.
Poway, CA

- Roadway Crossings
  - The overall pipeline routes included six major County owned or FDOT maintained roadways. Since most of the crossed roadways had six or more lanes, open cut crossings were not feasible.
  - Jack and bore crossings were evaluated in comparison to HDD crossings. In each case, jack and bore crossings were determined to be less feasible, more disruptive, or significantly more expensive.
  - This was primarily due to the large casing pipe size that would be required, the depth of other utility piping to be crossed, the resulting size and impact of the jacking pit required, the lack of available open right-of-way space to accommodate the pits. So, HDD was selected for all these crossings.

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- **Wetland and Waterbody Impacts.** Typical for this area of Florida, Largo contains numerous lakes, ponds and drainage canals. Open cut of some of the narrower waterways using coffer dams may have been feasible, but costly, and involved significant environmental impacts. The design, therefore, included a directional drill under each of the significant waterways and wetland areas crossed by the project.
  - Church Creek: A 550-ft HDD of 14-inch force main was designed to cross under Church Creek, a small waterway approximately 15 feet wide
  - Taylor Lake: the profile of the new 20-inch directionally drilled force main was designed to be 20-ft below the lake bottom, to ensure no conflict with an existing 16-inch force main would occur, as it was required to remain in service until the new construction was complete.
  - Although the lake is approximately 700 feet wide at the easement crossing, the length of the HDD crossing was increased to 1,550 LF to extend beyond a private resident's encroachment on the easement and provide a more suitable exit pit location (see Figure 5).

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King Engineering Associates,
Tampa, FL

Randy Tseng,
Underground Solutions, Inc.
Poway, CA

Figure 5. HDD of 20-inch pipe under Taylor Lake in John S. Taylor Park

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

- Cross Bayou Canal: Located at the eastern end of the project, Cross Bayou presented the final crossing before the 30-inch force main entered the wastewater treatment facility, where the new pipeline would discharge. The 610-foot bore path was designed to follow the horizontal alignment of an existing sanitary sewer crossing the canal (see Figure 6).
- To pass under the canal and provide sufficient vertical separation from the existing sanitary sewer, the pipe was drilled at a depth of 20-feet below the canal bottom.

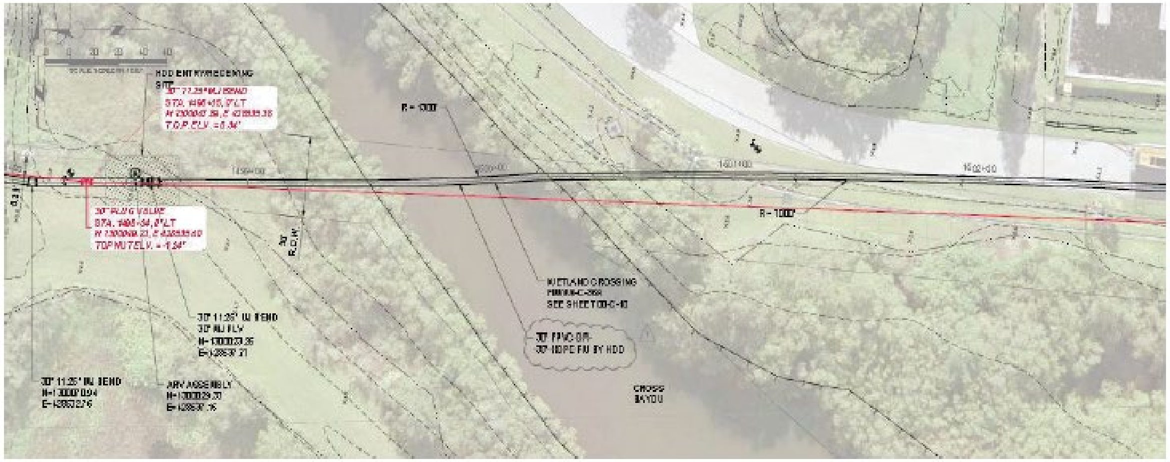

Figure 6. HDD of 30-inch force main under Cross Bayou, entering the wastewater treatment facility

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Pipe Selection

- Project was designed with approximately half of the open cut installations as ductile iron pipe. The remainder was designed as DR 18 PVC pipe. However, during the Value Engineering phase prior to construction, the Contractor presented a cost-saving proposals to substitute DR 18 PVC pipe for nearly all of the open cut ductile iron pipe. Due to cost savings, the proposal was accepted by the City.
- The design also allowed for open bidding of HDPE pipe against Fusible PVC pipe (FPVCP) for the HDDs.
- The Contractor chose to bid FPVCP, indicating that not only were material costs for the larger HDPE pipe sizes higher, but also the greater reamer sizes that would be required for the drills would significantly increase drilling costs. All of the HDD lengths were therefore completed using FPVCP.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Entry, Exit, Pullback Area

- Due to the dense residential areas associated with the project, and congested utilities in the rights of way, many of the HDDs included in the project had to be significantly lengthened beyond the width of the surface feature they were intended to cross.
- Drill entry areas required adequate space for the drilling rig, mud tank(s), mud recycler, drill rod staging, and a loader or backhoe to load drill rods into the rig – overall necessitating a minimum footprint of 100 feet by 30 feet for most of the drills.
- The pilot exit / pipe pullback side of the drill required a smaller area for equipment layout, but the 40-lengths of FPVCP, which were pre-fused into lengths of up to 1,000 LF and mounted on rollers to facilitate pullback, could not be allowed to block driveways, major roadways, or streets with no alternate egress.
- Where the unit price of HDD was significantly higher than open cut, the cost of the additional length required to reach feasible entry and exit locations had to be evaluated against the additional cost of roadway repair and maintenance of traffic required to open cut the crossing.
- However, trenchless methods were ultimately selected in all cases.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Bore path tracking

- The path of the pilot bore is important in every HDD, but close monitoring and control of the bore was especially critical on this project, where easements were as narrow as 10 feet, and the elevation of subsurface utilities were either unknown or deep.
- Installation of air release valves at high points is critical. A poorly-controlled HDD bore path with high points along the profile in excess of approximately 25% of the pipe diameter were not acceptable.
- This project specified a bore path tracking system combining downhole wireline and a walkover system for bores on which the full length of the drill could be accessed from the surface.
- For bores that were not fully accessible from the surface, such as the long water crossing of Taylor Lake, a surface wireline system that functioned by triangulating the borehead position relative to the wire grid was required.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King Engineering Associates,
Tampa, FL

Randy Tseng,
Underground Solutions, Inc.
Poway, CA

Geotechnical

- The geotechnical investigations performed during design confirmed sandy conditions along the intended alignment.
- Bore profiles were adjusted to be above the layer of limestone, typically found between 35- and 50-foot depths.

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Construction

- NTP was issue early 2015. The drilling subcontractor generally progressed using two separate drill crews throughout most of the project. The 25th and final HDD was completed in September 2016.
- The typical sequence of the fast paced drill operation was as follows:

1. Pipe layout & fusing: 3 days to 1 week
2. Survey and subsurface utility locates: 1 to 2 days
3. Rig site preparation, setup, and tracking wire layout (where necessary): 3 days to a week
4. Pilot bore: 1 to 2 days
5. Engineer approval of pilot bore log: 1 to 3 days
6. Reaming: 1 to 3 days (up to 2 weeks where significant subsurface rock was encountered)
7. Pullback: 1 to 2 days
8. Mandrel test: 1 day
9. Pigging: 1 to 2 days
10. Pressure test: 1 day
11. Demobilization and cleanup: 3 to 5 days

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Lessons Learned

- **Drill plan and pre-drill field meeting**: Multiple submittals were specified for review by the Engineer prior to drilling activity. However, many of these requirements were satisfied using standard, non-specific informational sheets. A more comprehensive, location specific plan is recommended which identifies the specific drilling rigs, equipment layouts, tracking systems, and most importantly, contingency plans for frac-outs or failures during each stage of the drilling operation, for each individual drill location.
- Field meeting with the contractor, drilling subcontractor, “mud engineer”, Engineer of Record, field inspector, and owner should be specified.
- Meetings should be repeated for each drill where new conditions, drilling operations or tracking systems are present.

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage,
King Engineering Associates,
Tampa, FL

Randy Tseng,
Underground Solutions, Inc.
Poway, CA

Lessons Learned

- **Frac-outs and surface impacts:** Of the twenty-five HDDs completed on the project, seventeen experienced frac-outs of varying degrees. Most of the frac-outs were small and manageable, occurring in the right-of-way in locations where the surface had been disrupted in some way (i.e., at the bases of utility poles, edge of sidewalks, utility boxes), providing a path of least resistance to the mud.
- Taking a slow pace during drilling operations often dramatically improves both the accuracy of the drill path as well as limits the occurrence of frac-outs and surface failures.
- Equally as important is the regular testing and maintenance of proper drilling mud viscosities and return flows.

NORTHERN CALIFORNIA PIPE USERS GROUP

Over 5 miles of Horizontal Directional Drills of Sanitary Force Main in Largo, Florida

Ben Turnage, King Engineering Associates, Tampa, FL

Randy Tseng, Underground Solutions, Inc. Poway, CA

Conclusion

- Due in part to the issues above, the portion of the project schedule attributed to trenchless pipe installation extended from an optimistic 180 days in the baseline schedule to 300 days at project completion. However, since the drilling operations were completed concurrent to the open cut portions, the overall project schedule was not affected.
- Despite these setbacks, the installation of the pipeline was completed successfully and will serve to reduce sanitary sewer overflows in the City of Largo for many years to come.
- The incorporation of horizontal directional drilling allowed the project to be completed with significantly less impact to the community and environment than open-cut options would have provided.

NORTHERN CALIFORNIA PIPE USERS GROUP

THANK YOU!

All papers can be obtained through the ASCE website