

# Gyroscopic Navigation In Congested Urban Areas

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THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



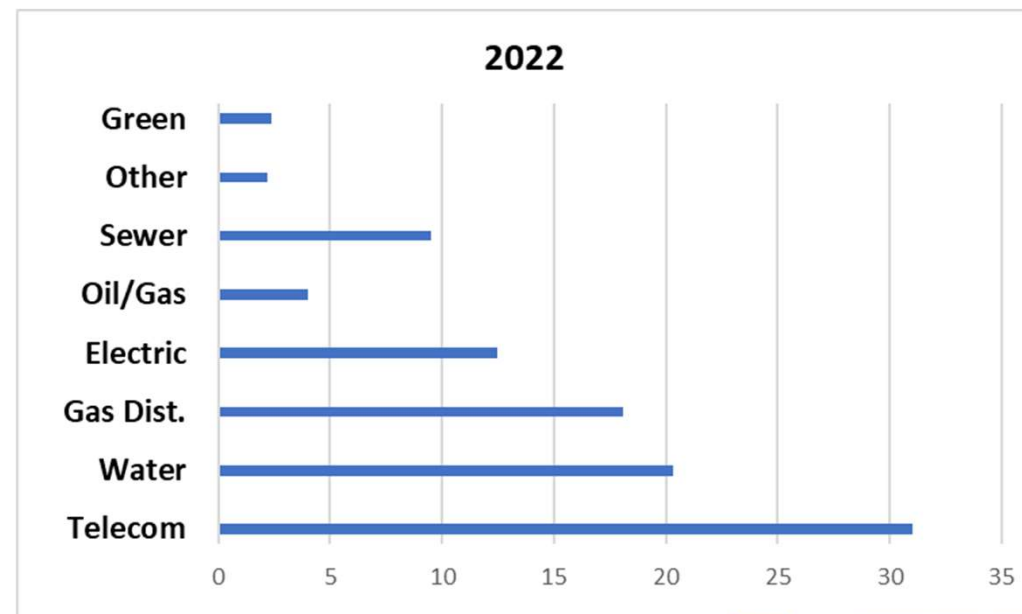
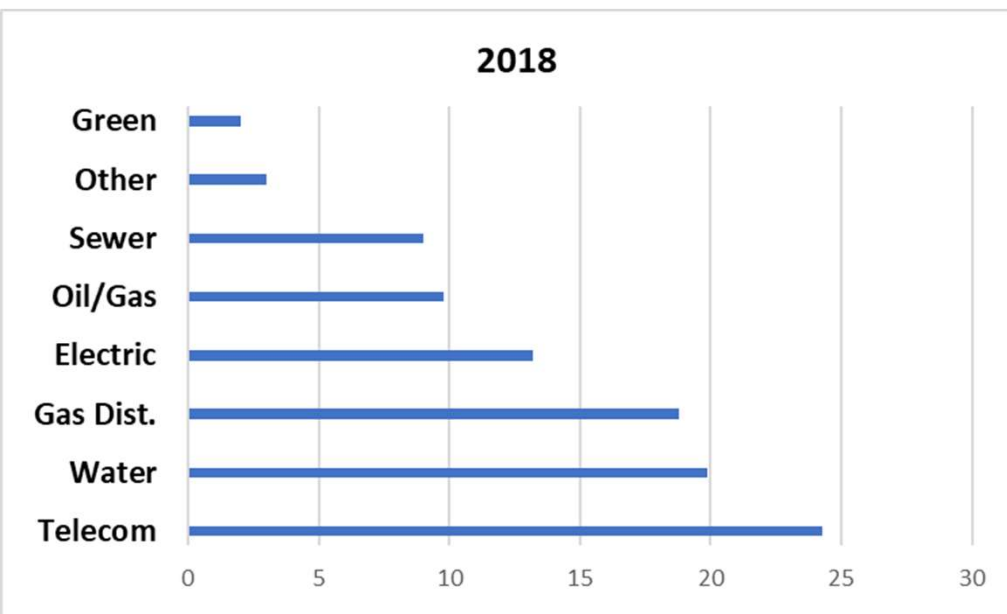
# How Did We Get Here?

- 2017: Started developing gyro navigation tool (Opti-Trac)
- First considered what's not being offered?
- Answer: smaller-diameter tool for smaller rigs
- Supported by industry trends?
- Fewer big, multi-state energy pipeline projects



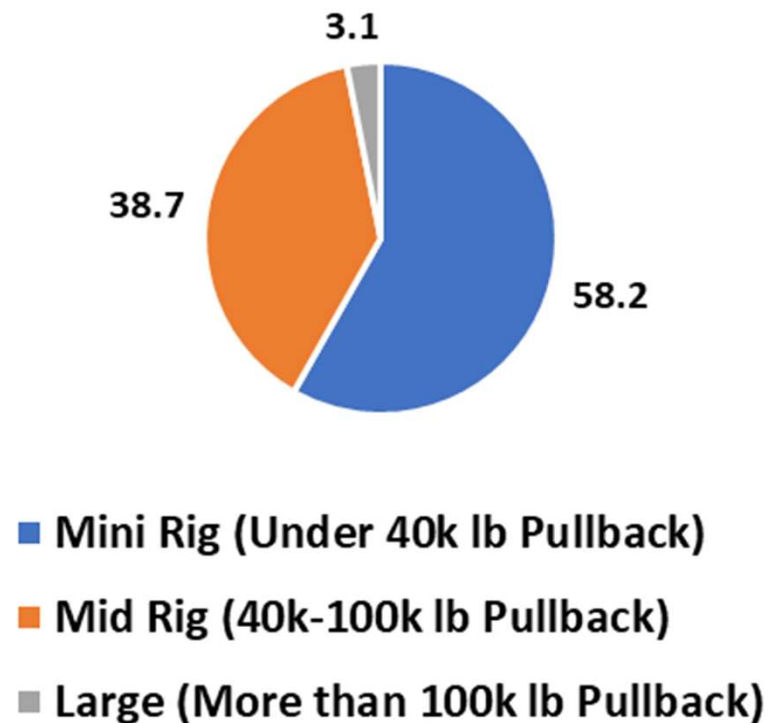
# Underground Construction's 24<sup>th</sup> Annual Directional Drilling Survey

## Job Type Trends



# Underground Construction's Drilling Survey

**Future Rig Purchases**



# Small Rig: Potential Operational Advantages

1. Decrease overall square footage
2. Equipment more fuel efficient
3. Reduce ancillary equipment
4. Cost efficiencies
5. Small crew





# Job-Site Minimum Sq Ft Setup: 60K Rig Class

Rig: 60K

Mud Mixer: 750-gallon tank

Excavator: Mid-Size

Pipe Rack: 30 pieces

Total Square Footage: 660



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# Job-Site Minimum Sq Ft Setup: 80K Rig Class

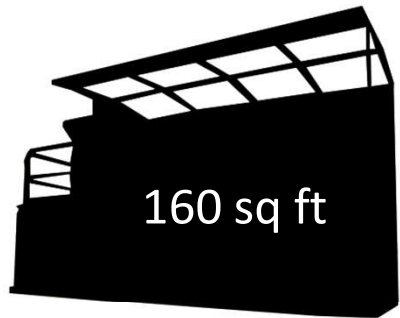
Rig: 100k

Reclaimer: 250 GPM

Excavator: Mid-Size

Pipe Rack : 9 pieces

Total Square Footage : 875



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# Job-Site Minimum Sq Ft Setup: 440 Rig Class

Rig with cabin: 550k

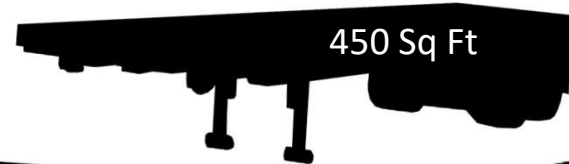
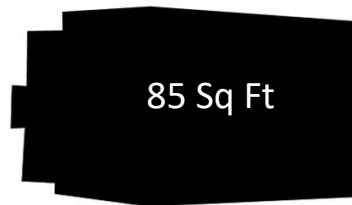
Reclaimer: 600 GPM

Mud Pump: 550 GPM Max

Excavator: Mid-Size

Trailer: 30' x 15'

Total Sq Ft : 1,910



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# Equipment Cost: 60K Rig Class

Rig: 60k

Mud Mixer: 750-gallon tank

Excavator: Mid-Size

Pipe Rack: 30 pieces

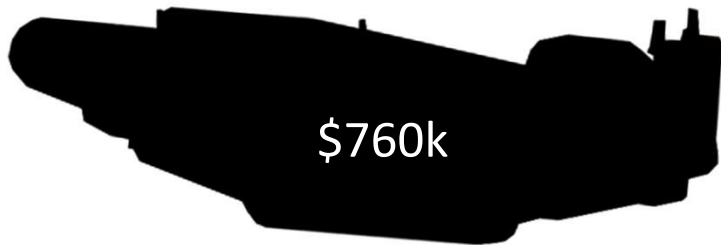
Estimated Cost: \$1,090,000



\$45k



\$5k



\$760k



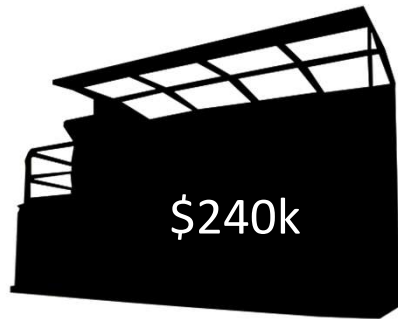
\$280k



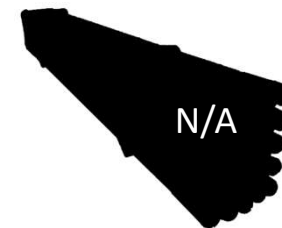
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## Estimated Cost: 80K Rig Class



Rig: 100k  
Reclaimer: 250 GPM  
Excavator Mid-Size  
Pipe Rack: 9 pieces  
Total: \$1,365,000



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# Estimated Cost: 440 Rig Class

Rig: 550k

Reclaimer: 600 GPM

Mud Pump: 550 GPM Max

Excavator: Mid-Size

Trailer: 30' x 15'

Total: \$3,646,000



\$680k



\$375k



Included  
w/ rig



\$38  
0k



\$11k



\$2,200k



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# Estimated Fuel Consumption: 60K Rig Class

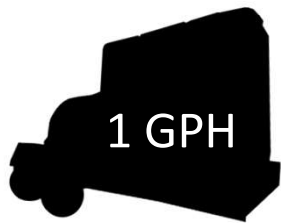
Rig: 60k

Mud Mixer: 750 Gallon Tank

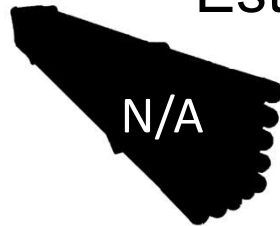
Excavator: Mid-Size

Pipe Rack: 30 Pieces

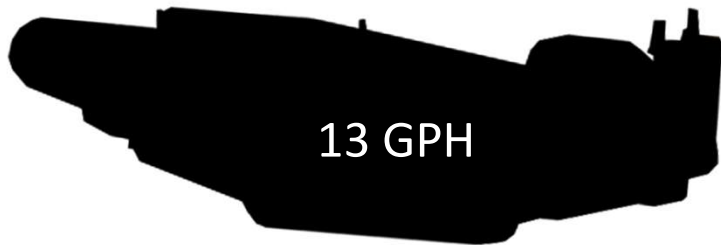
Estimated GPH: 26 GPH



1 GPH



N/A



13 GPH



12 GPH



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# Estimated Fuel Consumption: 80K Rig Class

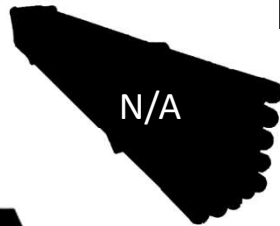
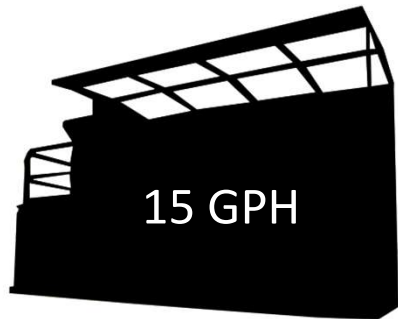
Rig: 100k

Reclaimer: 250 GPM

Excavator: Mid-Size

Pipe Rack: 9 pieces

Estimated GPH: 42





# Estimated Fuel Consumption: 440 Rig Class

Rig: 550k

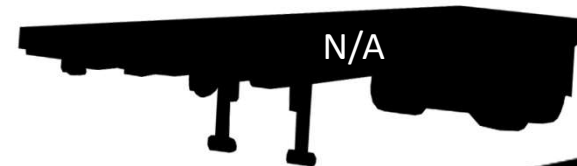
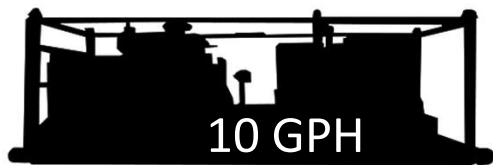
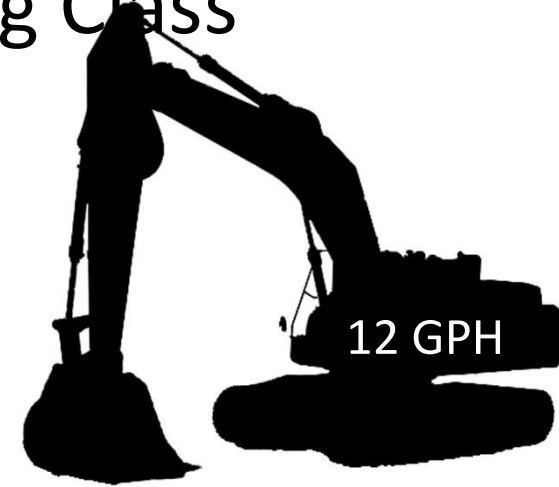
Reclaimer: 600 GPM

Mud Pump: 550 GPM Max

Excavator: Mid-Size

Trailer: 30' x 15'

Estimated GPH: 67



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## Rig Comparison Summary

	60k Rig Class	80K Rig Class	440k Rig Class
Site Set Up	660 Sq Ft	875 Sq Ft	1,910 Sq Ft
Equipment Cost	\$1,090,000	\$1,365,000	\$3,646,000
Fuel Consumption	26 GPH	42 GPH	67 GPH

# Opti-Trac Gyroscopic System

- Proprietary; specifically for bore hole
- Small OD
- Unaffected by external influences
- Highly accurate



# Opti-Trac Gyroscopic System

- Gyroscopic Module
  - 3 orthogonally aligned optical gyroscopes
  - 3 orthogonally aligned solid state accelerometers
- Independent Magnetic Module
- Integrated battery pack
- Annular Pressure Module

# Opti-Trac Gyroscopic System

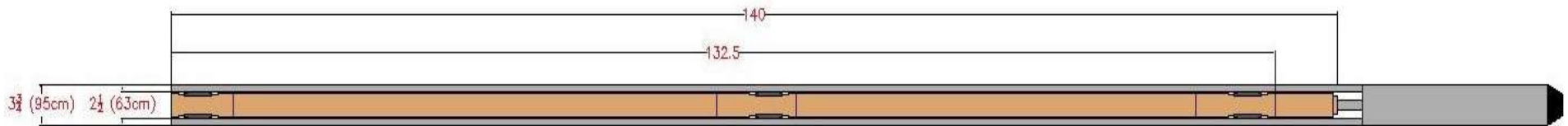
- 2 modes
  - Earth Rate Gyrocompassing
  - Continuous Inertial Navigation
- Real-time, continuous navigation
- Advanced Kalman filtering





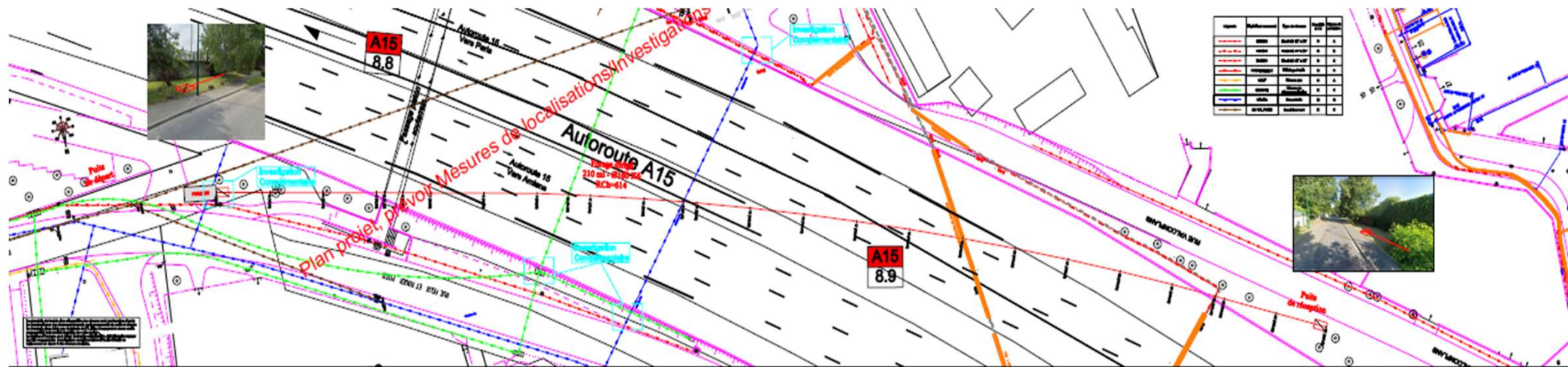
# Opti-Trac Gyroscopic System

- Standard customer-supplied drill collar
- No special tooling
- Standard non-mag drill collar 4-3/4"-plus
- Adjustable rubber fin centralization for any ID
- 3-3/4" custom drill collar



# Case Study 1: Sannois, France

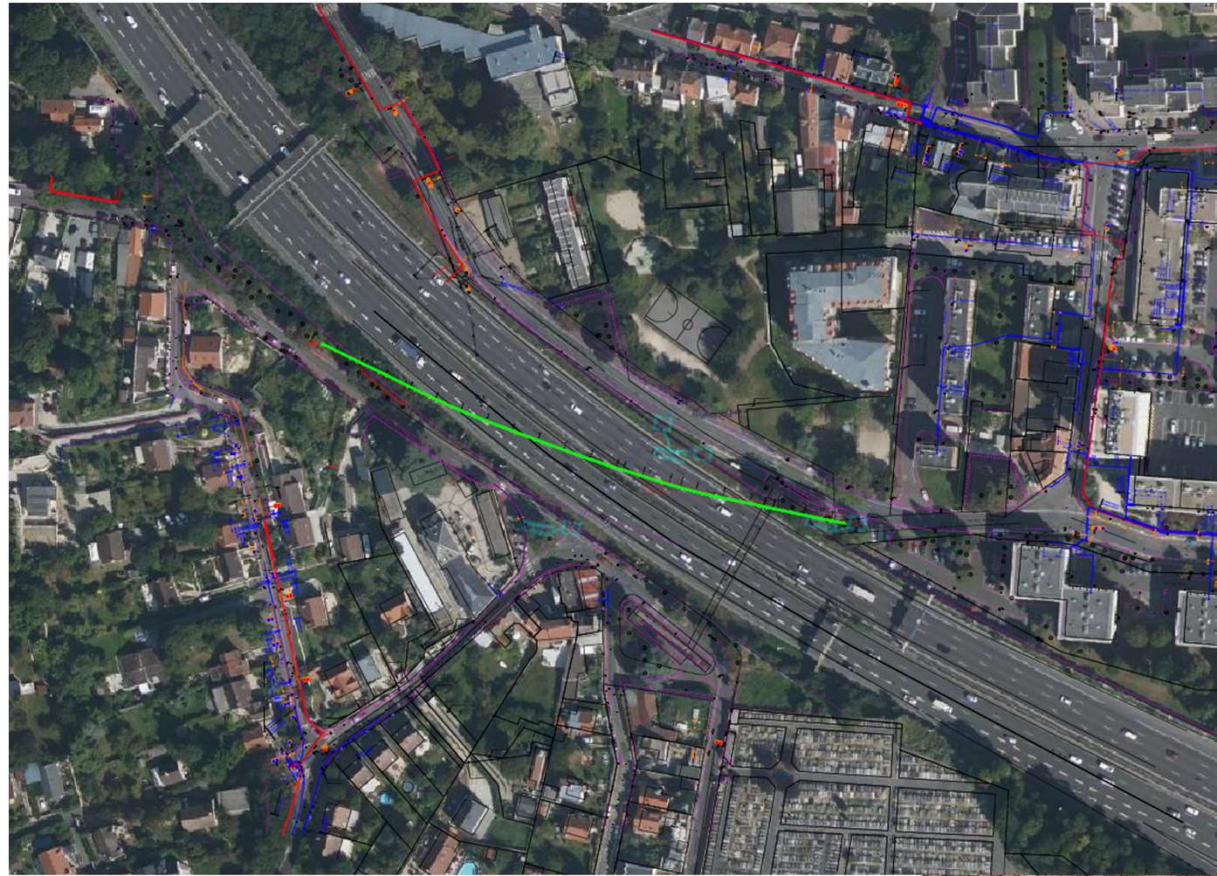
- Walkover or surface coil not possible
- Under very busy highway
- Lateral curve: 15 degrees, 600' radius
- Punch out in exit pit
- Length: 1,000'





# Case Study 1:Sannois, France

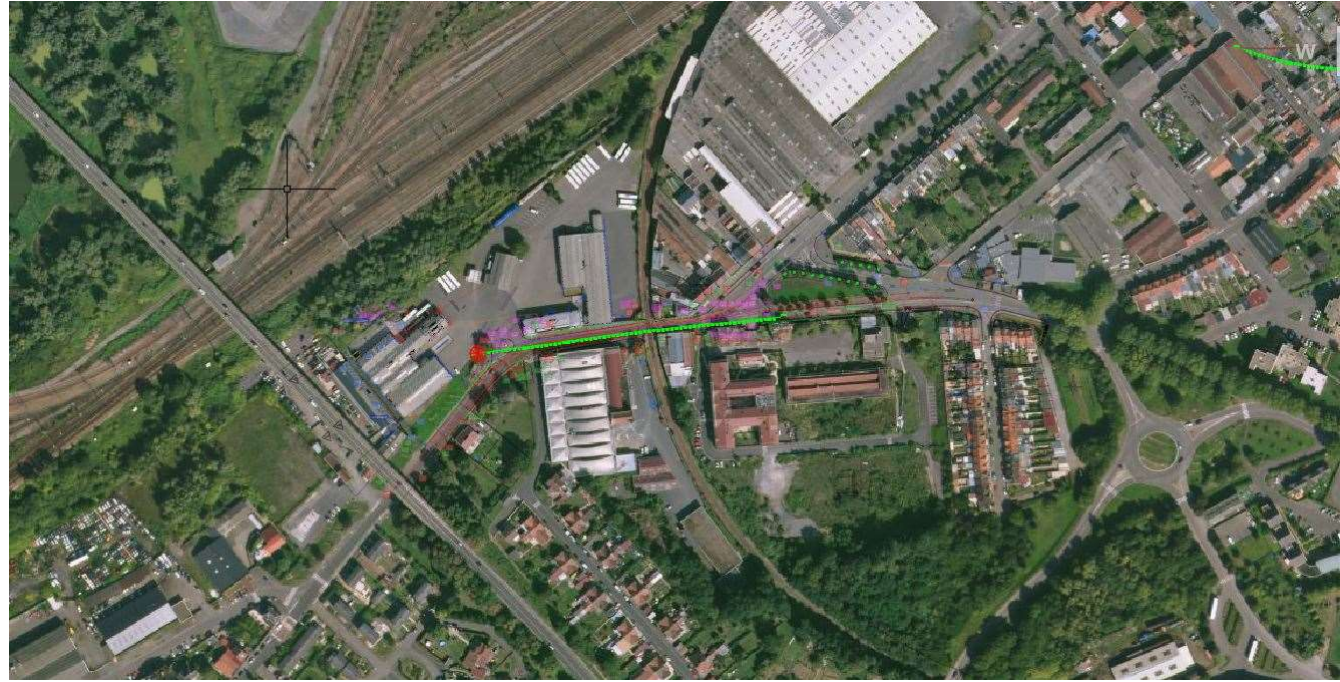
- Rig: Tracto 28N (28 ton)
- 3-3/4" custom assembly
- 3-1/2" motor
- 5-1/2" bit





## Case Study 2: Saint-Quenin, France

- Initially used walkover
- Unsuccessful; too many services
- Length: approx. 660'



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## Case Study 2: Saint-Quenin, France

- Rig: Tracto 28N
- Hard clay
- Bit: 5½" tri-hawk
- 3¾" assembly



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# Questions?

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Downhole Products & Services



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