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CASE STUDY - TRI-CITY WATER RESOURCE RECOVERY FACILITY OUTFALL PROJECT

1003 MacArthur Blvd. | Grand Prairie, TX 75050 | 972-262-3600 | **thompsonpipegroup.com**

The Tri-City Water Resource Recovery Facility Outfall Project

The Tri-City Water Resource Recovery Facility Outfall Project represents one of the most innovative recent microtunneling projects in the United States. Faced with capacity limitations and regulatory challenges, Clackamas Water Environment Services (WES) partnered with Michels Construction, AECOM, Jacobs, and Thompson Pipe Group (TPG) to design and install a new 90-inch outfall beneath a constrained urban corridor terminating in the Willamette River.

This project is significant not only for its technical complexity but also for its use of Thompson Pipe Group's Flow-Crete™ FRP-lined concrete jacking pipe. This breakthrough enabled the first-ever single-pass, multi-curve microtunnel drive using a large-diameter Flow-Crete system in the USA. The successful 2,370-foot installation, completed with four curves and five intermediate jacking stations in a single drive, marks the Tri-City project as a milestone in trenchless construction and highlights TPG's leadership in advancing products for technical trenchless applications.

TECHNICAL DATA:

Year	2024 - 2025
Installation Method	TPG FRP: Open-Cut
	Flow-Crete™: Microtunelling
Pipe Diameter	TPG FRP: 90 in.
	Flow-Crete™: 90 in ID, 112in. OD.
Joint Type	TPG FRP: Reka Coupling
	Flow-Crete™: Type C - Hydraulic joint packer
Project Length	TPF FRP: 2,500 LF
	Flow-Crete™: 2,370 feet
Pipe Standard	FRP: ASTM D3262 / D3517 / D4161
	RCP: ASTM C76 / C361 / C443, ASCE 27-17 / 36-15
Project Type	Gravity
Owner	CLACKAMAS WES
Owner's Representative	Jacobs Engineering Group, Inc.
Contractor	MICHELS Construction
Engineering Firm	AECOM Technology Corp.
Project Location	Oregon City, Clackamas County, Oregon.

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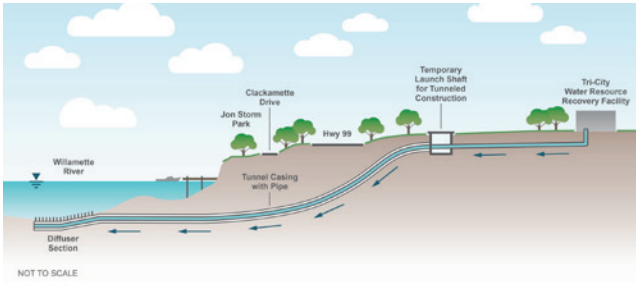
PROJECT BACKGROUND

The Tri-City Water Resource Recovery Facility treats more than ten million gallons of wastewater daily. Its original outfall, constructed in 1984, showed some infiltration and inflow issue and was nearing capacity during peak wet weather events.

To secure future service and protect water quality in the Willamette River, WES launched a new outfall project under its Capital Improvement Plan. The project expanded capacity, reduced sewer overflow risks, and improved effluent mixing and dilution to meet Oregon state water quality standards. The alignment passed under Interstate 205, the OR 99E off-ramp, and Jon Storm Park before discharging into the Willamette north of the Abernethy Bridge.



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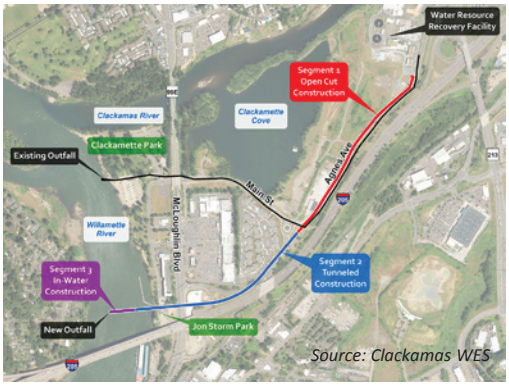
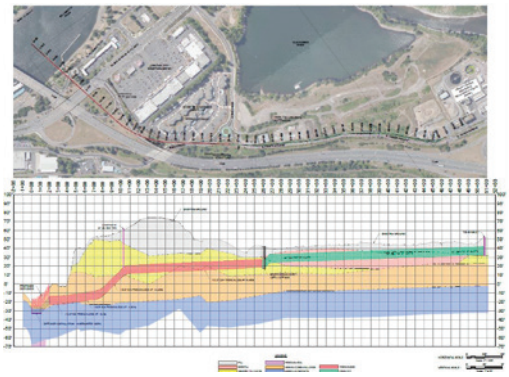
Key Challenges

The Tri-City Outfall alignment required both open-cut and trenchless construction. The open-cut section at Agnes Avenue was constrained by adjacent live pipelines and was installed through an old landfill. For the remainder of the route, conventional trenching was impossible as the alignment passed beneath I-205, the OR 99E off-ramp, Jon Storm Park, and nearby neighborhoods and businesses. This made tunneling essential. Additional challenges included strict in-water work windows on the Willamette River, variable ground conditions, cultural resource requirements, and the need for community approval to allow the pipeline beneath Jon Storm Park.



Source: Clackamas WES



Segment 1 – Agnes Avenue (Open-Cut Construction):

The project began with open-cut installation of 90-inch FRP pipe near the old Rosman landfill and adjacent live pipelines. Shoring and pile supports were used to protect the existing outfall and force main that remained in service.

Segment 2 – Main Street to Rive (Tunneled Construction):

The central 2,370-foot section was built by microtunneling with a 9 1/2 ft MTBM, allowing the alignment to pass beneath highways, ramps, neighborhoods, and Jon Storm Park without surface disruption. The drive was completed in a single stretch from one launch shaft, with the MTBM retrieved through a wet retrieval into the Willamette River.

Segment 3 – Willamette River (In-Water Construction):

The final portion connects the tunnel to a 150-foot diffuser installed in the river with risers and valves to maximize mixing.

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Segment 1 – Open-Cut Construction

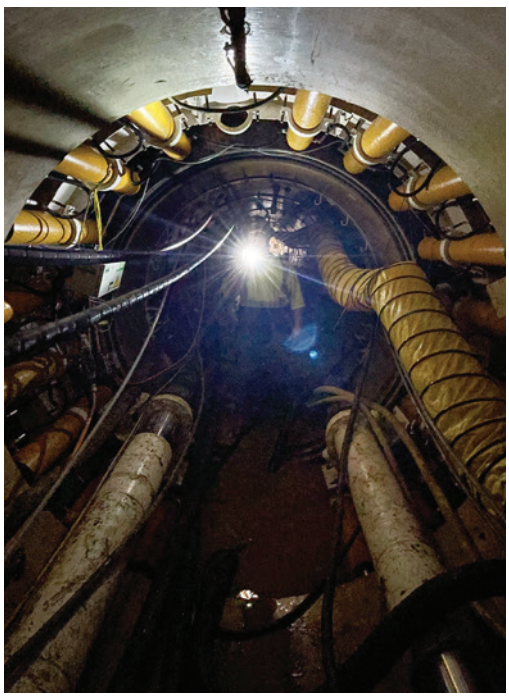
The open-cut section was completed along Agnes Avenue, where 90-inch FRP pipe was installed within a 13-foot-wide trench. Work took place next to the existing outfall and force main, both of which remained active, requiring shoring and pile supports to protect the pipelines and maintain long-term stability.

FRP by Thompson Pipe Group (TPG FRP)

- Continuously Filament wound Fiberglass Reinforced Polymer (FRP)
- **Corrosion Resistant:** Engineered for aggressive wastewater environments; single-pass solution eliminates the need for secondary lining or additional protection.
- **Lightweight, High-Strength:** High strength-to-weight Ratio.
- **Long-Term Durability:** Designed for a minimum 100-year service life.
- **Hydraulic Efficient:** Smooth interior surface. Maintains flow capacity over time due to lack of scaling or tuberculation.
- **Joint Integrity:** Leak free joints.
- Custom Fit for Complex Alignments.

Segment 2 - Tunneled Construction

The central 2,370-foot portion was constructed using microtunneling with a 9 1/2 ft diameter MTBM. This allowed the pipeline to pass beneath highways, ramps, neighborhoods, and Jon Storm Park without surface disruption. A single launch shaft and five intermediate jacking stations supported the continuous drive, and the MTBM was retrieved from the river.



Why Trenchless Technology? Why Microtunelling?

In Segment 2, trenchless construction was the only feasible option. Open-cut excavation would have disrupted I-205, 99E, and Jon Storm Park, while tunneling allowed the pipeline to pass deep below surface obstructions with minimal impact. Microtunneling was chosen for its precision in navigating the tight corridor and maintaining line and grade for the large-diameter gravity outfall.

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Initial Plan – Two-Pass Microtunnel

The original plan proposed a two-pass microtunnel, first installing a casing, then inserting the FRP carrier pipe, and finally grouting the annular space. While feasible, this approach conflicted with the I-205 Abernethy Bridge widening, project and the general contractor's (Kiewit) staging area, and would have required multiple shafts, creating major disruption in an already congested corridor.

Revised Plan – Single-Pass Microtunnel

To eliminate these conflicts, the team shifted to a single-pass method using Thompson Pipe Group's Flow-Crete™ FRP-lined jacking pipe. This eliminated the need for a casing, as the FRP carrier pipe itself is cast into the concrete jacking pipe.

Final Design

The final design called for a continuous 2,370-foot drive executed from a single launch shaft. The alignment included 1 horizontal curve and 3 vertical curves with radii as tight as 1,000 feet. The drive terminated in the Willamette River, where the microtunnel boring machine was retrieved underwater in a wet recovery operation. By avoiding multiple shafts and reducing surface disruption, the single-pass solution not only resolved the conflicts created by the initial plan but also demonstrated the structural capabilities of Flow-Crete™ in a very challenging tunnel environment.

Installing the Integral IJS Pipe into pipe string

Lowering the MTBM named "Whack-A-Mole" lowered into launch shaft

WES inspecting Flow-Crete™ delivered to tite

Key Features of the Final Drive:

- A single continuous push of 2,370 LF
- One launch shaft with no intermediate shafts
- Three vertical curves and one horizontal curve (radius 1,000 - 1,100 ft each), making it one of the few U.S. microtunnel drives to successfully combine both horizontal and vertical curves
- Five intermediate jacking stations (IJS) to manage thrust forces
- "Wet retrieval" of the microtunnel boring machine in the Willamette River

Pipe Innovation – Flow-Crete™ FRP Jacking Pipe

Flow-Crete™ represents a major advancement over traditional RCP or steel casing systems. By integrating a structurally independent fiberglass-reinforced polymer (FRP) liner with the concrete jacking pipe, the system eliminated the need for post-installation protection or secondary lining.

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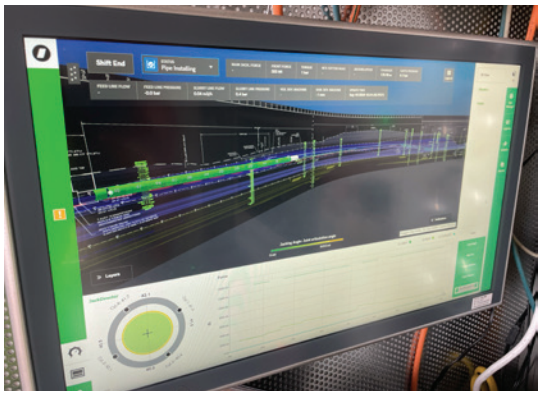
Open Cut FRP and Flow-Crete™ staging area



Installation Progress tracked in real time

Final Inspection of installed pipe before flooding tunnel

Advantages

- No casing pipe required; reducing schedule and cost by eliminating grouting, the time and labor associated with a second pass , and often reducing required machine and excavation diameter.
- ASTM-conforming FRP liner and joint system
- Independent structural resistance to groundwater pressure without relying on adhesion to the concrete shell
- Fully structural liners compared to other non-structural liners on the market

Project Outcomes and Significance

This project represents a landmark achievement in U.S. pipeline construction, both trenchless and open-cut. It also marked the first U.S. installation of FRP-lined RCP jacking pipe, Flow-Crete, in a single-pass, multi-curved microtunnel.

Key Partners

- **Owner:** Clackamas Water Environment Services (WES)
- **Owner's Representative Engineer:** Jacobs
- **Progressive Design Build Team:** AECOM, Michels Construction
- **Pipe Supplier:** Thompson Pipe Group – Flow-Crete™ and TPG FRP
- **Agencies:** Oregon DEQ, ODOT, U.S. Army Corps of Engineers, Oregon Department of Fish & Wildlife,