Successful Application of Horizontal Directional Drilling for Long River Crossing

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Acknowledgments

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• Chris Phipps
• Bruce Wright
• David Watts
• Chris Saunders
• Kay Liu
• Victor Kibec

GHD
• Maureen Wingfield
• John Stullken
• Julianne Page
• Jeff Riling

Carsons Corp.
• Scott Murray
• Mike Perez
Outline

• Project background
• Force main alignment and community engagement
• Schedule & procurement approach and constraints
• Force main engineering & design
• Construction
• Lessons learned
• Conclusion
Project background
Anne Arundel County Sewer Service Areas

Mayo/Glebe Heights Service Area

Annapolis Service Area
Project description

• Decommission the Mayo WRF and pump all flow to the County’s 13.0 mgd Annapolis WRF
  – Annapolis WRF already upgraded for ENR and has available capacity
  – Most cost effective approach to provide ENR level treatment for Mayo SSA customers

• Requires a new regional sewage pumping station and force main from Mayo to Annapolis

• Challenge: Mayo peninsula is separated from Annapolis peninsula by the South River

Source: www.liveinannapolis.com
Force main alignment and community engagement
Alignment

Selected alignment

1. Route force main from existing Mayo WRF to Loch Haven community park
2. Cross under South River
3. Through Quiet Water Park
4. Through City of Annapolis along Bay Ridge Rd and Edgewood Dr
5. Connect to Annapolis WRF

Saves significant pipe length and cost vs. routing to existing South River Bridge crossing
**Force main** construction

- Wherever possible, forcemain to be installed using horizontal directional drilling (HDD) to minimize community impacts
- HDPE pipe per Anne Arundel County standards
- Force main will be drilled under the South River

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**PREVIOUS ANNE ARUNDEL COUNTY HDPE HDD EXPERIENCE**

<table>
<thead>
<tr>
<th>Pipeline description</th>
<th>Date installed (year)</th>
<th>Pipe diameter (inches)</th>
<th>Pipe length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marley Creek Crossing</td>
<td>1990</td>
<td>24&quot;</td>
<td>1,200</td>
</tr>
<tr>
<td>Woodland Beach FM</td>
<td>2005</td>
<td>24&quot;</td>
<td>8,400</td>
</tr>
<tr>
<td>Annapolis Junction FM</td>
<td>2004</td>
<td>15&quot; &amp; 16&quot;</td>
<td>13,800</td>
</tr>
<tr>
<td>Riva Road FM</td>
<td>2012</td>
<td>14&quot;-18&quot;</td>
<td>6,000</td>
</tr>
<tr>
<td>Mayo Influent FM</td>
<td>1998</td>
<td>16&quot;</td>
<td>8,100</td>
</tr>
<tr>
<td>Arundel Gateway FM</td>
<td>2015</td>
<td>16&quot;</td>
<td>19,500</td>
</tr>
<tr>
<td>Cayuga Farms FM</td>
<td>2004</td>
<td>16&quot;</td>
<td>15,200</td>
</tr>
</tbody>
</table>
Need for a **collaborative approach**

**Concern with construction impacts to local communities**

- Direct outreach to community, environmental leaders, and impacted business owners
- Public meetings scheduled with community associations
- Local waterman’s association engaged

**Other governmental parties also engaged**

- City of Annapolis
- County Recreation & Parks Dept.
- Critical Area Commission
Homeowner concerns

- Property access
- Traffic disruption
- School bus stops
- Trash collection
- Noise
- Working hours
- Vibration/home damage
- Contractor parking
- Stormwater management
- Community park access
- Well contamination due to frac out
- Frac out in river
Quiet Waters Park concerns

- Park access
- Loss of use of facilities
- Aesthetics
- Tree damage/removal
- Road damage
- Environmental stewardship
- Site restoration

Source: www.wslp.org
Force main engineering and design
# Force main specifications

## PIPE & ALIGNMENT DESIGN CRITERIA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>25,500 ft</td>
</tr>
<tr>
<td>Individual HDD bores</td>
<td>12</td>
</tr>
<tr>
<td>Pipe material</td>
<td>HDPE DR-11 (land based HDD) HDPE DR-7.3 (South River crossing)</td>
</tr>
<tr>
<td>Pipe size</td>
<td>20 in DIPS, 24 in IPS</td>
</tr>
<tr>
<td>HDD min depth</td>
<td>25 ft BGS</td>
</tr>
<tr>
<td>HDD ave depth</td>
<td>45 ft BGS (100 ft below South River)</td>
</tr>
<tr>
<td>HDD max depth</td>
<td>100 ft BGS (125 ft below South River)</td>
</tr>
</tbody>
</table>

## OPERATIONAL DESIGN CRITERIA

<table>
<thead>
<tr>
<th>Description</th>
<th>Average</th>
<th>Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity &amp; Flowrate</td>
<td>1.1 ft/sec @ 800 gpm</td>
<td>3.4 ft/sec @ 2500 gpm</td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>45 psi</td>
<td>80 psi</td>
</tr>
<tr>
<td>Transient Pressure</td>
<td>N/A</td>
<td>100 psi</td>
</tr>
</tbody>
</table>

1. Peak Operating Pressure occurs during normal pump startup
2. Peak Transient Pressure occurs during power outage or sudden pump stoppage.
Site investigations

- Topographic and hydrographic survey
- Quality level A and B subsurface utility location
- Traffic studies
- Wetlands delineation
- Forest stand delineation
- Critical area delineation
- Geotechnical investigation

SOIL BORING SUMMARY

<table>
<thead>
<tr>
<th>Boring type</th>
<th>No. of borings</th>
<th>Approx spacing</th>
<th>Depth below surface (ft)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land boring</td>
<td>55</td>
<td>400’</td>
<td>25 – 50</td>
<td>Water monitoring wells installed at 10 sites</td>
</tr>
<tr>
<td>Water boring</td>
<td>4</td>
<td>1000’</td>
<td>61 – 136 (below water surface)</td>
<td>Additional borings added due to depth of mud observed</td>
</tr>
</tbody>
</table>
**Environmental features**

- Multiple environmental and potential disturbances in alignment
- Multiple stakeholders and permitting/regulatory reviews

**South River Crossing**

- **Force main**

**Quiet Waters Park**

- **Pipe laydown**

![Environmental Features Legend]

- Stream
- Critical Area Buffer
- Critical Area Boundary
- Wetland
- Wetland Buffer
- 100-yr Floodplain
Schedule & procurement approach and constraints
**Schedule**

NPDES permit contains provision that ENR limits take effect **January 1, 2017**

- Requests to extend deadline were not accepted

Department of Natural Resources places limit on HDD activities under the South River from **October 1 to December 15**

- Concerns with potential frack-out impacting ecosystem during sensitive periods

Funding and regulatory approval to proceed received in **Spring 2015**

- Not enough time for conventional approach for 2015 construction season

**Solution:**

- Break out South River HDD into separate contract
- Fast-track design and permitting
- Bid and award project on accelerated schedule
- Pre-purchase pipe and have shipped to site while project is bid and awarded
Procurement approach

• Pre-purchase HDPE pipe for HDD segments crossing the South River and through Quiet Waters Park and have delivered to staging area at Quiet Waters Park
  – 4,580 LF of 24” DR-7 pipe
  – 5,820 LF of 20” DR-11 pipe

• Accelerate bid for Mayo South River contract, which includes:
  – 1,770 LF HDD segment 3 (Loch Haven)
  – 4,200 LF HDD segment 4 (South River crossing)
  – 490 LF open cut segment in Quiet Waters Park
  – 2 valve vaults, odor control system, and associated site work
Bid phase challenges

- Few pipe pre-purchase bidders due to MBE/WBE and unloading requirements
- Concern of few/no installation contract bidders due to:
  - Tight schedule with Liquidated Damages ($1,500/day)
  - High regulatory scrutiny (State and County inspectors)
  - Limited staging area and active homeowners association
  - Limited safety factor with originally specified DR-9 pipe
- Local and state permits not finalized at time of bid
- Insufficient time for formal funding agency review and approval before bid award
South River HDD contract overview

**Pipe pre-purchase**
- **Bid date:** May 26, 2015
- **Contract award:** August 21, 2015
- **Supplier:** TriCon Chemical Corp. (Forestville, MD)
- **Contract value:** $795,964 (including change to DR-7 pipe)
- **Delivery required:** 8 weeks

**Installation contract**
- **Bid date:** August 11, 2015
- **Notice to proceed:** October 9, 2015
- **Contractor:** Carsons Corp (Lafayette, NJ)
- **Contract value:** $4.2 Million
- **Contract duration:** 175 days
- **Special requirements:** Complete South River HDD by 12/15/15
Construction
Proposed HDD Equipment Setup Plan
Loch Haven staging area
**Community impact reduction**

- Sound barrier
- Park access
- Vibration monitoring
- Well testing
Well testing

- GHD subcontractor Earth Data Inc. performed well testing services

- 15 wells located within 100 ft. of the HDD path were tested for flow, pressure, and water quality prior to the start of directional drilling and again after construction has been completed.

- Laboratory water quality testing includes the following constituents:
  - Turbidity
  - Cadmium
  - Chlorides
  - Nitrates
  - Gross alpha
  - Fecal coliform
  - E. coli

- Results were provided to the homeowners
South River Crossing – Sequence of construction

1. Mobilize drill rig at Loch Haven staging area and excavators at Quiet Waters Park
South River Crossing – Sequence of construction

2. Drill 10” dia. pilot to Quiet Waters Park until daylights
South River Crossing – Sequence of construction

3. Push and pull 24” dia. reamer to Quiet Waters Park
South River Crossing – Sequence of construction

4. Push and pull 36” dia. reamer to Quiet Waters Park
5. Then swab hole with 36” barrel reamer
6. In parallel, lay-out, fuse, and test pipe in Quiet Waters Park
South River Crossing – Sequence of construction

7. Pull back 24” pipe through hole
8. Hydrostatic test pipe
South River Crossing – Sequence of construction

9 Install adjacent segments, install air release vaults, connect segments, & demobilize.
Construction

Drilling equipment

Carson utilized a magnetic wireline steering system equipped with a sensor designed to track downhole annular pressure during drilling.

1,100,000 lb. capacity Drill Rig
Construction

Pipe staging and laydown
Construction

Pipe fusing and testing
Construction

Reaming and pipe pull

Carson ballasted the pipe with water during pullback to reduce the pull forces, using tremie tubes attached to a water pump.
Success!

- Contractor mobilization on **October 21**
- Pilot drilling started on **November 2**
- Pipe pull under South River completed 11:45 pm on **December 15** – meeting DNR deadline by **15 minutes**
Construction

Site restoration
**Construction phase** issues

- Appropriate LOD for construction and protection of special trees
- Limited pipe laydown area at Quiet Waters Park (3,100 ft)
- Soft soils due to alluvial river deposits
- Two frac outs related to South River HDD (south bank of South River, woods in Quiet Waters Park)
- Wet spring slowed progress on open cut portion of force main

[South River crossing fracout - Dec 2015](image1)

[South River crossing post-fracout – Feb 2016](image2)
Project status

- HDD Segments 1 through 7 completed under 3 contracts
- HDD Segments 8 through 12 scheduled for fall/winter 2016
- Expected project completion expected early 2017
- $31.5 Million total cost
- Funded by MDE

Mayo Regional Pumping Station
Lessons learned

Engage with community stakeholders early and often
• Provide conservative estimates on project timelines and the impacts to their community

Engage with regulatory bodies early and often
• Regular communication minimizes surprises and increases trust

Foster open dialogue with contractors during bid and construction
• Different experience and perspective from contractors can lead to good approaches and outcomes
Thank you!

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