Did You Say 36” Diameter At 275 psi?

Christopher Evans, P.E.
Aqua Pennsylvania – Neshaminy Pipeline Project

- Project Purpose
- Alignment Selection
- Design Criteria
- Standard Details
- Transient Analysis
- Cathodic Protection
- Permitting
Project Purpose

- Transmission Replacement
  - 2,600 Linear Feet
  - Existing 22” Steel
    - Corrosion Issues
    - Main Breaks
  - Existing 20” Cast Iron
  - Meet Future Demands
- Oakford, Pennsylvania
8 Surface Water Plants
70 Well Stations
100 – 140 MGD
Neshaminy Pipeline
  – 15 MGD

Southeastern Service Area Map
Project Purpose

Neshaminy Pipeline

Phase 1 - 2,600 LF
Phase 2 - 18,200 LF
Phase 3 - 20,000 LF

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Alignment Study Phase

- Special Crossings
  - Neshaminy Creek
  - CSX Railroad
  - Levee
  - 42” RCP Sewer
Alignment Study Phase

- Railroad And Stream Crossing Alternatives
  - Microtunneling
  - Horizontal Directional Drilling (HDD)
  - Pipe Jacking
  - Open Cut Trenching
- Site Geology
- Available Easements
<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Alternative</th>
<th>Total Length (feet)</th>
<th>Trenchless Length (feet)</th>
<th>Estimated Construction Cost</th>
<th>Cost / Linear Foot ($/ft)</th>
<th>Neshaminy Creek Crossing Method</th>
<th>Railroad Crossing Method</th>
<th>Levee Crossing Method</th>
<th>Raw Water Main Crossing (Y/N)</th>
<th>Finished Water Main Crossing (Y/N)</th>
<th>42&quot; RCP Sewer Crossing Location</th>
<th>Private Property Easement (Y/N)</th>
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<td>Stream Centerline</td>
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• Open Cut Creek Crossing
  – PADEP Approval
  – Poor Rock Geology
    • Rock Quality Designation
      – Very Low Percentage
    • Microtunnel crossing eliminated
### Alignment Design Phase

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Alternative</th>
<th>Total Length (feet)</th>
<th>Trenchless Length (feet)</th>
<th>Neshaminy Creek Crossing Method</th>
<th>Railroad Crossing Method</th>
<th>Levee Crossing Method</th>
<th>Raw Water Main Crossing (Y/N)</th>
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<th>Private Property Easement (Y/N)</th>
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<tr>
<td>Study</td>
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<td>2,725</td>
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<td>Design</td>
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<td>No</td>
<td>Yes</td>
<td>Stream Floodplain</td>
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</tr>
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</table>
Alignment Selection

Alternative D
Alignment Selection

Railroad Bridge Plan

• Railroad Bridge Plan
Alignment Selection

• Railroad Bridge Cross Section
Alignment Selection

- Porta-Dam
- Two Phase Crossing
Design Criteria

- **Pressure**
  - Maximum Operating Pressure = 275 psi
  - Test Factor = 1.25
  - Test Pressure = 350 psi

- **Carrier Pipe Recommendations**
  - Type 2 Laying Condition
  - 2RC Stone To Pipe Spring Line

Source: DIPRA/6-03/5M 1991
Design Criteria

- Pipe Thickness Calculations
  - HS20 Loading & Soil Depth
- Phase 1A – Inside WTP
  - Thickness Class 53
- Phase 1B – Outside WTP
  - Railroad Crossing & Levee Thickness Class 55
  - Thickness Class 53 – majority of alignment
<table>
<thead>
<tr>
<th>Wall Thickness</th>
<th>Type</th>
<th>Use</th>
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<tbody>
<tr>
<td>0.53”</td>
<td>Thickness Class 52</td>
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<tr>
<td>0.56”</td>
<td>Pressure Class 350</td>
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<tr>
<td>0.58”</td>
<td>Thickness Class 53</td>
<td>Alignment</td>
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<tr>
<td>0.68”</td>
<td>Thickness Class 55</td>
<td>Railroad &amp; Levee Crossing</td>
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</table>
### Design Criteria

**Nomograph Draft Hydraulic Thrust Calculation**

<table>
<thead>
<tr>
<th>Operating Condition</th>
<th>Pipe Pressure</th>
<th>Rounded Pressure</th>
<th>90 Degree Bend Thrust</th>
<th>45 Degree Bend Thrust</th>
<th>22.5 Degree Bend Thrust</th>
<th>11.25 Degree Bend Thrust</th>
<th>End Thrust</th>
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</thead>
<tbody>
<tr>
<td>Maximum Operating Pressure (MOP)</td>
<td>275 (psi)</td>
<td>275 (psi)</td>
<td>450 (kips)</td>
<td>220 (kips)</td>
<td>110 (kips)</td>
<td>56 (kips)</td>
<td>280 (kips)</td>
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<tr>
<td>Test Press. = 1.25 x MOP</td>
<td>343.75 (psi)</td>
<td>350 (psi)</td>
<td>500 (kips)</td>
<td>280 (kips)</td>
<td>140 (kips)</td>
<td>72 (kips)</td>
<td>360 (kips)</td>
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<tr>
<td>Test Press. = 1.50 x MOP</td>
<td>412.5 (psi)</td>
<td>420 (psi)</td>
<td>600 (kips)</td>
<td>325 (kips)</td>
<td>165 (kips)</td>
<td>85 (kips)</td>
<td>425 (kips)</td>
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</tbody>
</table>

**Restrained Joint Pipe Required**
<table>
<thead>
<tr>
<th>Vendor</th>
<th>Design Location</th>
<th>Pressure Rating</th>
<th>Proof of Design Test</th>
<th>Maximum Operating Pressure (MOP)</th>
<th>Safety Factor</th>
<th>36&quot; Diameter Joint Deflection</th>
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<tbody>
<tr>
<td>A</td>
<td>Fitting</td>
<td>350</td>
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<td>2.5</td>
<td>2.0</td>
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<td>B</td>
<td>Pipe Joint</td>
<td>250</td>
<td>550</td>
<td>275</td>
<td>2.0</td>
<td>2.0</td>
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</tbody>
</table>

Vendor B Lower SF For Project
Pipe Selection

- 3rd Party - Proof of Design Testing

Source: US Pipe
Pipe Selection

- Proof of Design Testing
  - US Pipe HP LOK Selected
- Material – Ductile Iron Pipe
- Joint – Fully Restrained Joint Alignment

Source: US Pipe
Air Release Assembly Upgrade

- Threaded Joint to Restrained & Flange Joint
- 2” Copper to 6” Ductile
- 2” Curb Stop to 6” FL Butterfly Valve
- Low Stack Height

Standard

Neshaminy
• **Blow Off Assembly Upgrade**
  » Mechanical Joint to Restrained & Flange Joint
  » 4” Galvanized to 6” Ductile
  » 4” MJ Gate Valve to 6” RJ Gate Valve
Standard Details

- Horizontal Valve Detail
  - PADEP Every 1500 LF
  - Air Release Assembly
  - FL x RJ Spool
  - FL Butterfly Valve (350 psi)
  - Blow Off Assembly
  - ~ 20 LF in Length
• Wet Taps
  – 22” Steel
  – 20” Cast Iron
  – Sequencing
  – “Used & Useful”
• Transfer Station
  – Plant Service Water Provide - 1050 gpm
  – Pressure Reducing Valves From 275 psi To 80 psi

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• Valve Insertions
• Construction Sequencing
Transient Analysis

- Hydraulic model transient analysis - 40,800 linear feet
Cathodic Protection

- Corrpro Companies
- Investigation
  - Soil Resistivity
  - Bacteria Corrosion
  - Stray Current
- Design
  - Polyethylene Exterior Coating

Source: Liberty Coating Company - Pritec

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• Corrpro Companies

• Design (Continued)
  – Linear Anode
  – Joint Bonding

Source: Corrpro Companies
• 6 Month Schedule

  – Pennsylvania State Programmatic General Permit 4 (PASPGP-4)
    • PADEP
    • U.S. Army Corp of Engineers
  – CSX Railroad
  – Soil Conservation District
    • Erosion & Sediment Control
    • NPDES
• Thank You Aqua Pennsylvania
  – Den Mahoney
  – Bill Zahn
  – Rob MacNamara
  – Al D'Ercole
  – Mike Staerk
  – Steve Pizzi
  – Tom Walton
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