Everyone proposed offers specific expertise AND knowledge of your facilities.

Patrick Davis, PE
Project Director

Ethan Heijn, PE
Project Manager

Guillermo Regalado, PE
Hydraulic Modeling

George Brown, PE
Asset Management/Condition Assessment

Tyler Mokris, EI
Hydraulic Modeling

Gary Bors, PE
Technical Review Committee

Janeen Wietgrefe, PE
Capital Improvement Plan
This team will provide the precision analytics and deep, Broward-specific technical experience…

Hazen’s precision analytics + Hazen’s deep Broward-specific experience = Optimized, operationally-realistic master plan for the future

…to deliver the best answers for an operationally realistic Master Master Plan.
We consider this project to be two-fold:

- **Hydraulic modeling**, analyses and risk assessment (such as likelihood and consequence of failure)

- **Risk-based prioritization/interpretation of results:**
  - Best solution
  - Real budget
  - Workable schedule
We will utilize two sets of tools for this project…

**Analytical and Modeling Tools**
- Flow Development – HazenQ
- Previous Model
- GIS Network
- Asset Condition
- As Built Drawings
- SCADA

**Decision Support Tools**
- Risk Analyses: Pipes and Pump Stations
- Alternatives Development
- Risk-based Prioritization
- CIP
Our team knows the existing regional transmission model...  
...and already converted to InfoWater.
We will **precisely** represent valve and piping characteristics within the surge analysis…

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
</tr>
</thead>
</table>
| Pumps              | Inertia (rundown time)  
                     | Station details (as-built)                                              |
| Control Valves     | Closing pattern & time                                                  |
| Check Valves       | Closing speed                                                           |
| Surge Relief Valves| Opening & closing pressure                                              |
| Pipes              | Wave Speed (pipe material & pipe thickness)  
                     | Low and High Elevations (as-built)                                     |
| Air Valves         | Location  
                     | Inlet & outlet orifice size & anti-surge orifice                         |

…because detailed data matters!
Details such as pipe age and pipe material will be input into the analysis.
For key pipelines, collection of additional data such as location of ARVs and high points, coupon samples, SmartBall results...

...will increase the precision of the risk evaluation.
Example: We have identified force mains of concern due to age and apparent lack of engineered high points.

May be candidates for additional field investigation.
Additional testing of vertical assets will improve the accuracy of the condition scores.
Testing results for pipelines and vertical assets will be incorporated into a condition assessment tool.

...and will be included in the risk prioritization analysis.
Multiple options exist for prioritizing the replacement projects...
But the results are only as good as the data going into the analysis…

Thorough review of data IN

Replace 36-inch DIP

Pipe routing options

The Optimal Solution
- Replace in year 2035
- Replace along route 2
  Risk level = low

Several risk profiles

Multiple alternatives analyzed

Proper interpretation of results OUT is essential

Data

Hydraulic Modeling

Risk Analyses: Pipes and Pump Stations

Alternatives Development

Risk-based Prioritization

CIP
The best answer balances risks against funding limits.
The presentation of the assimilated data will be displayed graphically for quick understanding.
Selecting the Hazen team ensures that the County’s end product is an operationally realistic, optimized Master Plan.
Questions?

Hazen’s precision analytics + Hazen’s deep Broward-specific experience = Workable, operationally-realistic master plan for the future
Repair Methods

Failure Mode Analysis

Public Media Notification

Flow Diversion and Bypass Pumping

Incident Command

Sanitary Sewer Overflow Response

The Hazen Emergency Response Template Covers All Elements Identified by BCWWS
What is Surge or Transient

- Fluctuations in flow and/or pressure, often sudden
- Surge can result from any change in fluid velocity
  - Pumps: Startup, normal shutdown, trips
  - Valves: Opening, closing, or other operation
  - Air/Vacuum Valves: Opening and closing
  - Rapid Flow Changes: Pipe break, fire hydrant operation, customer demands, etc.
InfoWater to InfoSurge

Surge engine is under Run Manager
Can easily switch from Standard, Fireflow analysis to Surge
Can run a “hydraulic run only” under Surge
Can start transient at anytime if you have an EPS run
Can set global wave speed
MDD Power Loss

Discharge Header and Distribution System Pressure

Moores Bridges WTP MDD Power Loss: System Pressures

- WTP discharge Pressure above 10 psi
- System Pressure below 0 psi
Hazen is incorporating predictive analytics in current projects. Example below is from Effluent project.

<table>
<thead>
<tr>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>INJECTION WELL PUMP NO.1 MOTOR WINDING RTD</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 MOTOR UPPER BEARING VIBRATION (X-AXIS)</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 MOTOR UPPER BEARING VIBRATION (Y-AXIS)</td>
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<tr>
<td>INJECTION WELL PUMP NO.1 VFD DRAWN VOLTAGE</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 VFD DRAWN CURRENT</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 VFD DRAWN POWER FACTOR</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 VFD DRAWN KW</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 VFD DRAWN KVA</td>
</tr>
<tr>
<td>INJECTION WELL PUMP NO.1 VFD OUTPUT VOLTAGE</td>
</tr>
<tr>
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Decision Support Tool
The risk-based prioritization balances the level of investment with the associated risk level to find the optimum combination.
by selecting the alternative with the lowest cost under the acceptable level of risk
for every element in the system

A Decision Support Tool is needed for complex systems.
..... however the proper tool should be selected based on the characteristics of the system. A large variety of tools are available. Avoid the “Hammer-and-Nail” paradox

- User friendly, compatibility, accurate, flexible, cost effective
- High development costs, data expensive, high maintenance cost