Asset Management:
Business Risk Exposure

Thomas D. Keown, PE
GHD
Agenda

- AM Intro/Background
- How Business Risk Was Integrated Into CIP Program at Highline Water District
- Questions
Who is GHD?

- Australian-based international company with 100 offices worldwide
- 6000+ management consultants, engineers, scientists, planners, architects
- Literally, “wrote the book” on Best Practices
- Hundreds of engagements over two decades
GHD has been consulting in Asset Management for 25 years
GHD are considered one of the leading Asset Management consultants in the world
GHD’s Roger Byrne is an original principal author of the “International Infrastructure Management Manual”
  – Considered the ‘must have’ guide to AM
GHD has over 50 manuals that cover the full range of Asset Management areas
GHD have been chosen by the US EPA to conduct AM training workshops across the USA
WERF / AwwaRF commissioned GHD to create ‘SIMPLE’ – a web-based tool that enables the user to learn step-by-step on how to sustainable implement AM techniques
How AM got started

- The Australia / New Zealand beginnings
- IIMM
- PAS55
- PSAB 3150
- GASB 34
Infrastructure is the foundation to sustained quality of life
Consequences of asset failure can be severe
Changing utility business environment

- Demand to do more with existing resources
- Need to make every dollar work – to better use capital and operating budgets
- Move from *reactive* to *proactive* work environment
A paradigm shift…

- Transition from *building and operating* to *managing* assets
  - Extending asset life
  - Optimizing maintenance and renewal
  - Developing accurate long-term funding strategies
  - *Sustain long term performance!*
GHD’s Approach to Asset Management

- Mentoring and Guidance of Staff
- Step-by-Step Implementation Practices
- Knowledge Transfer
- Incorporating Change Management Practices
- Leverage Existing Organizational Knowledge
- Pilot Projects
Advanced Asset Management ("AAM") is

- a management paradigm and a body of management practices
- that is applied to the entire portfolio of infrastructure assets at all levels of the organization
- that seeks to minimize the total cost of acquiring, operating, maintaining and renewing the assets
- within an environment of limited resources
- while continuously delivering the service levels customers desire and regulators require
- at an acceptable level of business risk to the organization
- In a cultural environment that encourages maximum development and satisfaction of our human assets.
Why Start an Asset Management Program?

Benefits of AMP:

- Identify assets where rehabilitation or replacement will be cost effective.
- Understand and manage critical assets.
- Focus maintenance efforts using risk.
- Optimize its maintenance and capital needs to reduce the life cycle cost of ownership.
- Understand the long-term future renewal, rehabilitation and replacement expenditure requirements of the organization and assist in the development of plans to mitigate the various expenditure peaks.
How Business Risk was Applied at Highline Water

Business Risk Exposure:

Probability of Failure $\times$ Consequence of Failure

$\times$ Redundancy = Business Risk Exposure ($\$$)

Used data from previously completed 2002 Water System Vulnerability Study and from an internal Vulnerable Pipe Study to rank/order consequences of failure.
Level Of Service – Failure Mode

Decision Issues

- Is capacity an issue? [Yes/No]
  - Yes → Likely before other modes? [Yes/No] → Capacity
  - No → Has LOS changed from design? [Yes/No]
    - Yes → Likely before other modes? [Yes/No] → LOS
    - No → Is physical reliability an issue? [Yes/No]
      - Yes → Likely before other modes? [Yes/No] → Mortality
      - No → Is cost to operate an issue? [Yes/No]
        - Yes → Likely before other modes? [Yes/No] → Efficiency
        - No → Redo—it has to fail somehow

Redo—it has to fail somehow
# Condition Rating

<table>
<thead>
<tr>
<th>Condition Rating</th>
<th>Description</th>
<th>Maintenance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New or Excellent Condition</td>
<td>Normal PM</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Minor Defects Only</td>
<td>Normal PM, Minor CM</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Moderate Deterioration</td>
<td>Normal PM, Major CM</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Significant Deterioration</td>
<td>Major repair, rehabilitate</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Virtually Unserviceable</td>
<td>Rehab unlikely</td>
</tr>
<tr>
<td>10</td>
<td>Unserviceable</td>
<td>Replace</td>
</tr>
</tbody>
</table>

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### Probability of Failure

<table>
<thead>
<tr>
<th>% of Effective Life Consumed</th>
<th>PoF Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
</tr>
<tr>
<td>20%</td>
<td>3</td>
</tr>
<tr>
<td>30%</td>
<td>4</td>
</tr>
<tr>
<td>40%</td>
<td>5</td>
</tr>
<tr>
<td>50%</td>
<td>6</td>
</tr>
<tr>
<td>60%</td>
<td>7</td>
</tr>
<tr>
<td>70%</td>
<td>8</td>
</tr>
<tr>
<td>80%</td>
<td>9</td>
</tr>
<tr>
<td>90%</td>
<td>10</td>
</tr>
</tbody>
</table>

### Redundancy

<table>
<thead>
<tr>
<th>Level of Redundancy</th>
<th>Reduce PoF by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Backup</td>
<td>50%</td>
</tr>
<tr>
<td>100% Backup</td>
<td>90%</td>
</tr>
<tr>
<td>200% Secondary Backup</td>
<td>98%</td>
</tr>
</tbody>
</table>
## Consequence of Failure

<table>
<thead>
<tr>
<th>CoF Rating</th>
<th>Description</th>
<th>% Affected</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor Component Failure</td>
<td>0-25%</td>
<td>Asset</td>
</tr>
<tr>
<td>2</td>
<td>Major Component Failure</td>
<td>25-50%</td>
<td>Asset</td>
</tr>
<tr>
<td>3</td>
<td>Major Asset</td>
<td>0-25%</td>
<td>Asset</td>
</tr>
<tr>
<td>4</td>
<td>Multiple Asset Failure</td>
<td>25-50%</td>
<td>Facility / Sub-System</td>
</tr>
<tr>
<td>5</td>
<td>Major Facility Failure</td>
<td>50-100%</td>
<td>Facility</td>
</tr>
<tr>
<td>6</td>
<td>Minor System Failure</td>
<td>20-40%</td>
<td>Total System</td>
</tr>
<tr>
<td>7</td>
<td>Medium</td>
<td>40-60%</td>
<td>Total System</td>
</tr>
<tr>
<td>8</td>
<td>Intermediate</td>
<td>60-80%</td>
<td>Total System</td>
</tr>
<tr>
<td>9</td>
<td>Significant</td>
<td>80-90%</td>
<td>Total System</td>
</tr>
<tr>
<td>10</td>
<td>Total</td>
<td>90-100%</td>
<td>Total System</td>
</tr>
</tbody>
</table>
### Simple Approach

*Business Risk Exposure*

<table>
<thead>
<tr>
<th>PoF / Likelihood</th>
<th>CoF / Consequence of Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

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Managing Risk: Risk Reduction Options

Management Treatment Options

- Reduce Probability
  - Add Redundancy
  - Refocus / Increase O&M
  - Refurbish/Replace

- Reduce Consequence
  - Manage Post Failure Impacts
  - Insure
  - Influence Customer Expectations
CLR is confidence level rating, BRE is business risk exposure, LCC is life cycle cost, CIP is capital improvements program.
## Confidence Level Ratings

### LEVEL 2: Overall Confidence Levels BUSINESS EFFICIENCY CIP Project

<table>
<thead>
<tr>
<th>No.</th>
<th>Quality Element</th>
<th>Project Value Chain</th>
<th>Process Effectiveness</th>
<th>Data &amp; Knowledge Quality</th>
<th>Process Effectiveness</th>
<th>Data Quality</th>
<th>Element Quality Rating</th>
<th>Project Confidence Level</th>
<th>The CLR Rating Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Understanding of Existing Service</td>
<td>4%</td>
<td>Consultant Report on LOS</td>
<td>Data Prepared at Asset Level - CMMS Data</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>17</td>
<td>Understanding of Existing Service</td>
<td>18%</td>
<td>Consultant Report on LOS</td>
<td>Data Prepared at Asset Level - CMMS Data</td>
<td>90%</td>
<td>80%</td>
<td>80%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>19</td>
<td>Service Failures</td>
<td>5%</td>
<td>Consultant Report on LOS</td>
<td>Data Prepared at Asset Level - CMMS Data</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>21</td>
<td>Service Failures</td>
<td>3%</td>
<td>Consultant Report on LOS</td>
<td>Data Prepared at Asset Level - CMMS Data</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>23</td>
<td>Analysis Approach</td>
<td>20%</td>
<td>Consultant Report on LOS</td>
<td>Data Prepared at Asset Level - CMMS Data</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>25</td>
<td>Appropriateness of Methods Used to Maintain Business Efficiency Measures</td>
<td>0%</td>
<td>No Process</td>
<td>No notation</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>27</td>
<td>Appropriateness of Budget for Staging Plan</td>
<td>0%</td>
<td>Current Practice</td>
<td>Based on Example</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>29</td>
<td>Appropriateness of Assessed Solutions</td>
<td>0%</td>
<td>Simple Analysis Done</td>
<td>Data as per Current Practice</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>31</td>
<td>Appropriateness of Economic Evaluation</td>
<td>7%</td>
<td>Other (Description Attached)</td>
<td>Other (Details Attached)</td>
<td>28%</td>
<td>28%</td>
<td>28%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>33</td>
<td>Appropriateness of Economic Evaluation</td>
<td>12%</td>
<td>Other (Description Attached)</td>
<td>Other (Details Attached)</td>
<td>28%</td>
<td>28%</td>
<td>28%</td>
<td>2%</td>
<td>6%</td>
</tr>
</tbody>
</table>

**Note:** Please adjust the value chart to suit the type of asset most pertinent to the project by choosing the relevant one in the drop down menu (DR). Please select the following data to review the Chart of CLR gaps. It shows the gap for each of the Secondary Quality Elements.
Confidence Level Ratings

Business Efficiency Weighted GAP

- Existing Standards of Service
- Knowledge of Existing Infrastructure and Resources Providing Service
- Current Demands for Service
- Future Demands for Service
- Prediction of How (Asset (Service) Will Fail
- Timing of Failure
- Consequence of Service Failure

Quality Elements

- Appropriateness of Methods Used to Maintain Business Efficiency Measures
- Appropriateness of Budget for Staffing Plan
- Appropriateness of Assessed Solutions
- Assessment of Financial Investment Estimates
- Assessment Used to Determine Risk Reduction and/or Benefits
- Appropriateness of Economic Evaluation
### Consequence of Failure

#### Business Risk Exposure Tool - BRE 3.0 Model Version 1.0

**Licensed Client**: Highline Water District

**2008/2009 CIP Validation Program**

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Project No.</th>
<th>Assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date (MM/DD/YYYY):</th>
<th>2/23/2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration:</td>
<td>Total</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>Failures:</td>
<td>1</td>
</tr>
<tr>
<td>Failure Mode:</td>
<td>Localized Service</td>
</tr>
</tbody>
</table>

#### Consequence of Failure (CoF)

<table>
<thead>
<tr>
<th>Triple Bottom Line</th>
<th>Consequence of Failure</th>
<th>Calculation</th>
<th>Economic Value ($)</th>
<th>CoF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>Damage to Failed WPD Assets</td>
<td>Cost of Repair</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Damage to Adjacent WPD Assets</td>
<td>Total Damage</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Damage to Raw WPD Assets</td>
<td>Total Damage</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Length of WPD Service</td>
<td>Number of Valuations</td>
<td>2003,000.00</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water Lost from WPD Service</td>
<td>Duration (Days)</td>
<td>1</td>
<td>219,300.00</td>
</tr>
<tr>
<td></td>
<td>WPD Legal Costs</td>
<td>Total Costs</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td>Number of Violations</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class A (In)</td>
<td>Number of Days</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class B (In)</td>
<td>Number of Days</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL VIOLATIONS</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WPD</td>
<td>TYPE OF VIOLATION</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visit Days (Byltp Day)</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length of WPD Public Service</td>
<td>Hours</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td>Water Service Pipe</td>
<td>Total Cost</td>
<td>0</td>
<td>23,000.00</td>
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<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td>$2,608,200.00</td>
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## Probability of Failure Before CIP Project (PoF_B)

<table>
<thead>
<tr>
<th>Years to Expected Failure</th>
<th>Redundancy</th>
<th>PoF_B</th>
<th>BRE_B</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Years</td>
<td>25%</td>
<td>50%</td>
<td>13%</td>
</tr>
</tbody>
</table>

## Probability of Failure After Project (PoF_A) and Total Business Risk Reduction (BRE_B - BRE_A)

<table>
<thead>
<tr>
<th>Project Option</th>
<th>Years to Expected Failure</th>
<th>Redundancy</th>
<th>PoF_A</th>
<th>BRE_A</th>
<th>Total Business Risk Reduction (BRE_B - BRE_A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alternative Supply</td>
<td>21 - 50 Years</td>
<td>3%</td>
<td>50% Backup</td>
<td>50%</td>
<td>2%</td>
</tr>
<tr>
<td>2. HWID Well</td>
<td>21 - 50 Years</td>
<td>3%</td>
<td>No Backup</td>
<td>100%</td>
<td>3%</td>
</tr>
<tr>
<td>3.</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
</tr>
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<td>4.</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
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<td>5.</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
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<td>6.</td>
<td>N/A</td>
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<td>-</td>
<td>N/A</td>
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<td>7.</td>
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<td>-</td>
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<td>N/A</td>
<td>-</td>
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<td>-</td>
<td>N/A</td>
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<td>9.</td>
<td>N/A</td>
<td>-</td>
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<td>10.</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Life Cycle Cost Comparison – New Source of Supply

<table>
<thead>
<tr>
<th>Option</th>
<th>Business Risk Exposure ($)</th>
<th>Capital ($)</th>
<th>Annual Operation ($)</th>
<th>Annual Maintenance ($)</th>
<th>PV of Benefits ($)</th>
<th>NPV</th>
<th>Adjusted Annualized PV</th>
<th>Benefit Cost Ratio</th>
<th>Pay Back Period (years)</th>
<th>Total PV/CLR ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maintain Status Quo</td>
<td>0</td>
<td>0</td>
<td>461,160</td>
<td>0</td>
<td>0</td>
<td>-12,576,152</td>
<td>-503,046</td>
<td>0</td>
<td>0</td>
<td>-20,960,254</td>
</tr>
<tr>
<td>2. Renegotiate Seattle Public Utility Supply Contract</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-6,081,669</td>
</tr>
<tr>
<td>3. Augment Sources of Supply – Lakehaven Utility District</td>
<td>533,500</td>
<td>1,000,000</td>
<td>8,800</td>
<td>12,000</td>
<td>13,713,933</td>
<td>11,053,026</td>
<td>442,121</td>
<td>5.2</td>
<td>0</td>
<td>18,421,710</td>
</tr>
<tr>
<td>4. Augment Sources of Supply – New Well</td>
<td>460,750</td>
<td>3,000,000</td>
<td>100,000</td>
<td>0</td>
<td>13,354,371</td>
<td>8,778,638</td>
<td>292,621</td>
<td>2.9</td>
<td>5</td>
<td>14,631,064</td>
</tr>
</tbody>
</table>

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Finalize CIP Validation Process

- Complete Initial LCC Assessment
- Organize and submit Business Case to Validation Committee
- Re-score Confidence Level Rating (if additional resources were needed/used)
- CIP Validation Committee has a reproducible method to assess whether project is the right decision, at the right time, at the right costs and for the right reasons.
- Budget and book the project and move on to the next.
Highline’s AM Lessons Learned

Successes To Date:
1. Management can see how different management strategies impact risk of business operations
2. Risks can be explained to different audience targets
3. Better Understanding of Funding Needs

Improvements In Progress:
1. Need champions to continue the process
2. Need better tools for staff to assess remaining useful life
3. Need additional “exercising” of AM in the organization to change the culture
Questions?
Creating an Asset Management Plan
Investment Decision Making Process

Current State of our Assets?
Required Sustained Level Of Service?
Which Assets are Critical to Sustained Performance?

Management Strategies for the Assets
Best Long-Term funding strategy

Develop Asset Register
Failure Modes:
• Capacity
• Physical Mortality
• Level of Service
• Financial Efficiency
Determine Physical & Economic Residual Lives
Collect Historic Costs & Determine Current Replacement Cost
Set Current & Future Levels of Service

Establish Risk Ratings (Relative Criticality)
Develop Appropriate Maintenance & Operations Plans
Develop Appropriate CIP Program
Future Funding Requirements
Build the AMP

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How to Get Started?

- Using your available data, whether on paper or spreadsheet or database you can develop an asset management plan (AMP).
- When starting, just focus on a small asset group as a pilot project.
- The AMP will need to eventually include incorporate existing and projected operational efforts and capital projects, prioritized based on condition, level of service, and risk.
Step 1 - Develop Asset Register

- Need to establish an asset hierarchy, a definition of the maintenance managed item (MMI) and the data attributes required to support the asset management decision-making process.

- Develop an asset register for a pilot asset group, consolidating all inventories available. The asset register will contain an asset hierarchy and asset attributes, defined by a data framework specifying data attributes required to support asset management decisions.

- Confirm asset data gaps based on the agreed asset hierarchy structure by reviewing existing asset information held in asset registers. Gaps of missing or incomplete data can then be identified.
Step 2 - Establish Condition

- Estimate install date, rehabilitation dates, remaining useful life, and projected replacement dates for major equipment, if data is not already available.
- Review the existing asset condition assessment protocols and make recommendations for improvement.
- Finalize the condition assessments for the pilot asset group. Condition ratings for all assets can be loaded into TeamPlan2™.
You can’t judge a book by its cover.

It’s what’s on the inside that counts.
Step 3 - Residual Life Estimates

- Need to estimate the residual life for all assets. The residual life estimates will be based on identifying the four failure modes and selecting the imminent failure mode.

- If good data is not available, the residual life will default to the remaining original design life using the original installation date.
How Much Residual Life is Left?

Name the Movie: Planes, Trains and Automobiles (a Hughes Entertainment Production)
Name the Year: 1987
Residual Life Estimates

Determine Residual Life for Parks and Recreation

Maximum Potential Life: [ ]
Effective Economic Life: [ ]

Asset Lives

Maximum Potential Life

Effective Economic Life

Effective Physical Life

Probability of Failure: Undefined
Consequence of Failure: Undefined
Mitigation Factor: Undefined

Capacity Residual Life: Undefined
Level of Service Residual Life: Undefined
Physical Mortality Residual Life: Undefined
Financial Efficiency Residual Life: Undefined

Save Changes
Step 4 - Replacement Cost Valuation

- Develop protocols for estimating replacement costs for all asset types.
- Enables valuing assets based on current replacement cost (rather than a historical cost) basis.
- Protocols will identify both top down and bottom up approaches to determining replacement costs.
Step 4 - Replacement Cost Valuation
Step 4 - Replacement Cost Valuation

Determine Life Cycle & Replacement Costs for Sewer Pumping Stations

- Historical Cost: 0
- Lump Sum Replacement Cost: 0
- Unit Price: 0
- Total Unit Cost: 0
- Total Replacement Cost: 0
- Rehab Cost Fraction: 0
- Maximum Number of Rehabs: 0
- Number of Rehabs to Date: 0
- Date of Last Renewal (YYYY-MM-DD): 
- Comments: 

Probability of Failure: Undefined
Consequence of Failure: Undefined
Raw Risk Score: Undefined
Mitigation Factor: 0
BRE: 

Capacity Residual Life: Undefined
Level of Service Residual Life: Undefined
Physical Mortality Residual Life: Undefined
Financial Efficiency Residual Life: Undefined
Imminent Failure Mode: Undefined

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Step 5- Review of Levels of Service (LOS)

- Develop current and future LOS criteria for the assets
- LOS statements typically include measurable service levels, such as number of odor complaints or overflows per year.
# Levels of Service (LOS)

<table>
<thead>
<tr>
<th>Community Outcome</th>
<th>Core Value</th>
<th>Activity Strategic Outcomes</th>
<th>Customer Levels of Service (CLOS)</th>
<th>Proposed Target (2012)</th>
<th>Technical Levels of Service (TLOS)</th>
<th>Proposed Target (2012)</th>
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<tr>
<td>Water sources are protected.</td>
<td>Water Quality</td>
<td>Protect water quality</td>
<td>Meet DOH requirements, and coordinate with local land use councils.</td>
<td>As per current</td>
<td>Well head program - time of travel zones are inspected biannually by staff looking for potential sources of contamination</td>
<td>As per current</td>
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<tr>
<td>The drinking water is safe.</td>
<td>Water Quality</td>
<td>Water quality is safe for drinking</td>
<td>75% of customers believe the drinking water is safe to drink 70% of customers believe the drinking water has a good taste</td>
<td>80% of customers believe the drinking water is safe to drink 75% of customers believe the drinking water has a good taste</td>
<td>Comply with 100% of DOH WAC 246.290 monitoring requirements. Maintain fluoride concentration between 0.8 – 1.3 mg/L in distribution system. Maintain pH concentration between 7.6 and 8.3 in distribution system.</td>
<td>As per current</td>
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Step 5 - Levels of Service (LOS)

Set Target Levels of Service (LOS) for Sewer Pumping Stations

Design Capacity:

Actual Performance:

Issues:

Probability of Failure: Undefined
Consequence of Failure: Undefined
Raw Risk Score: Undefined
Mitigation Factor: BPE: Undefined
Capacity Residual Life: Undefined
Level of Service Residual Life: Undefined
Physical Mortality Residual Life: Undefined
Financial Efficiency Residual Life: Undefined
Imminent Failure Mode: Undefined
Step 6 - Evaluate Business Risk Exposure (BRE)

- Dust off Hazard Mitigation Plans!
- Review Consequences of Failure and Probability of Failure metrics.

- Develop BRE scores for all assets within a pilot asset group.
- BRE scores will serve as the basis for subsequent asset inspection prioritization and will be used for the renewal cost forecasting.
Determine Business Risk ("Criticality") for Sewer Pumping Stations

- Probability of Failure: Undefined
- Consequences of Failure:
  - Social: Undefined
  - Economic: Undefined
  - Environmental: Undefined
- Business Risk Mitigation Factors (Asset Resiliency):
  - Asset Redundancy:
  - Containment:
  - Failure Response:
  - Facility Bypass:
  - Monitoring:
- Comments:

Other Sections:
- WHISKEY BOTTOM
  - 12" Valve
- Pressure Regulating Valve
  - College Ave.
  - GORMAN RD
  - 12" Valve
  - Hollifield
  - Hunt Club Rd.
  - 10" Valve
- HUNTINGTON EAST
- MAIN ST. (ELKRIDGE)
  - MAIN ST. (ELLIOTT CITY)
- MEADOWRIDGE
  - 10" Valve
- RIVER ROAD
  - 10" Valve
- SARAH'S LANE
- WHISKEY BOTTOM
  - 12" Valve
- Sewer Master Meters
- Sewer Odor Stations
- Sewer Pumping Stations
- Shared Septic Systems
- TEST
- Water Master Meters

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Step 7 - Management Strategies

- Need to review and document the current operation and maintenance practices. The information will then be used to make recommendations for updating current business processes to optimize asset management decisions.

- Standards can then be developed for:
  - Evaluating maintenance requirements, and tracking maintenance costs by individual asset
  - Recording time, materials, and plant costs associated with maintaining individual assets
  - Assigning maintenance costs to an individual asset
  - Developing and implementing consistent failure codes assigned to an asset every time a reactive maintenance visit is made
Example Management Strategies:

- **Pipe**
  - PVC/HDPE/DI – 100 years
  - AC – 70 years
    - Small Diameter AC – 60 years
  - CI – 80 years
    - Small Diameter CI – 70 years

- **Note:** No effective rehab for pressurized water mains.

- **Hydrants**
  - Pre-1970 Hydrants not efficient to operate/rehab, so MS is 35 years of useful life.
  - Post-1970: Rehab every 10 years. Max Life = 50 years

- **Meters**
  - Large Meters (>1”) – Minor PM every 2 years, Major PM every 20 years. Max Life = 60 years
  - Small Meters (1” and smaller) – 15 years, then toss.
Management Strategies

GHD T.E.A.M.

Forecast Operations, Maintenance, and Administrative Costs for Sewer Pumping Stations

Estimated Annual Current Operations Cost: 

Projected Annual Operations Cost Trend:

Estimated Annual Current Maintenance Cost: 

Projected Annual Maintenance Cost Trend:

Comments (O&M):

Estimated Annual Current Administration Cost: 

Projected Annual Administration Cost Trend:

Comments (Administration):

Probability of Failure: Undefined
Consequence of Failure: Undefined
Raw Risk Score: Undefined
Mitigation Factor: 0
EREI:

Capacity Residual Life: Undefined
Level of Service Residual Life: Undefined
Physical Mortality Residual Life: Undefined
Financial Efficiency Residual Life: Undefined
Imminent Failure Mode: Undefined

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Step 8 - Identification of CIP projects

- Need to recommend, prioritize and estimate costs for capital improvements of assets in the pilot asset group to provide any required asset life extensions.
- Then develop procedures where business cases are to be prepared for the CIP projects.
- The business cases require a Jurisdiction’s staff to have an understanding of:
  - Current and future demands
  - Operational and maintenance requirements of the asset
  - Asset condition, imminent failure mode, and estimated residual life
  - Business risk exposure
  - Renewal cost and
  - Life cycle costs
Identification of CIP projects

### Determine Capital Investment for Sewer Pumping Stations

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Step 9 - Life Cycle Cost Projections

- Determine the lowest life cycle cost for assets in the pilot asset group, based on the best time for renewal or replacement of assets.
  - A 100-year time period can be used for modeling to support replacement of all assets in the pilot asset group at least once during the planning period.
- Current valuation tables and graphs (not historic values) will be used to understand the current state of the assets.
  - These graphs provide details on the replacement, depreciated values, and asset counts detailed by key systems and major asset classes.
- Graphs are based on the current replacement cost, estimated book value, and the maximum potential life of assets and asset classifications.
  - The graphs present the District’s future investment estimate. The graphs build the total predicted cash flow by summing the following:
    - Estimated rehabilitation and replacement cost
    - Cost estimates for new levels of service and growth
    - Operations and maintenance costs
Develop a detailed outline of the asset management plan (AMP) for the pilot asset group.

- The asset management plan will be based on the current level of knowledge and information held by staff and information collected from the assessment process.

A sample outline for an AMP is as follows:
Use of Asset Management Plan

- Sell and Tell Your System’s Story!
- Determine Lowest Life-Cycle Cost to Operate Your System at the Lowest Acceptable Risk……
- While Meeting the Needs of Your:
  1. Customers
  2. Regulators
  3. Electeds
  4. Management
  5. Staff
Getting AM Program Started

Questions?