# Feeder Line Replacement Infrastructure Update and Planning

April 25, 2012

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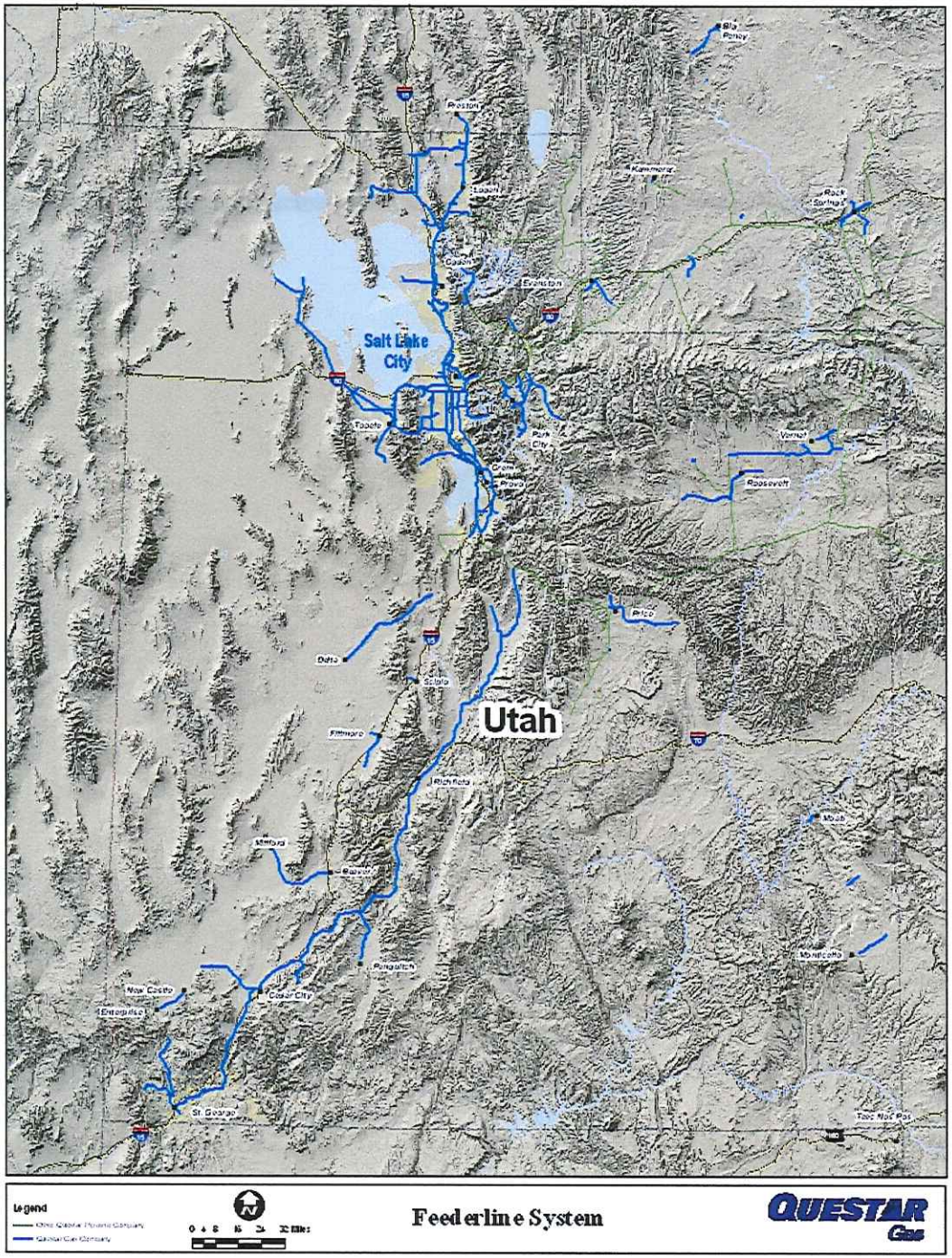
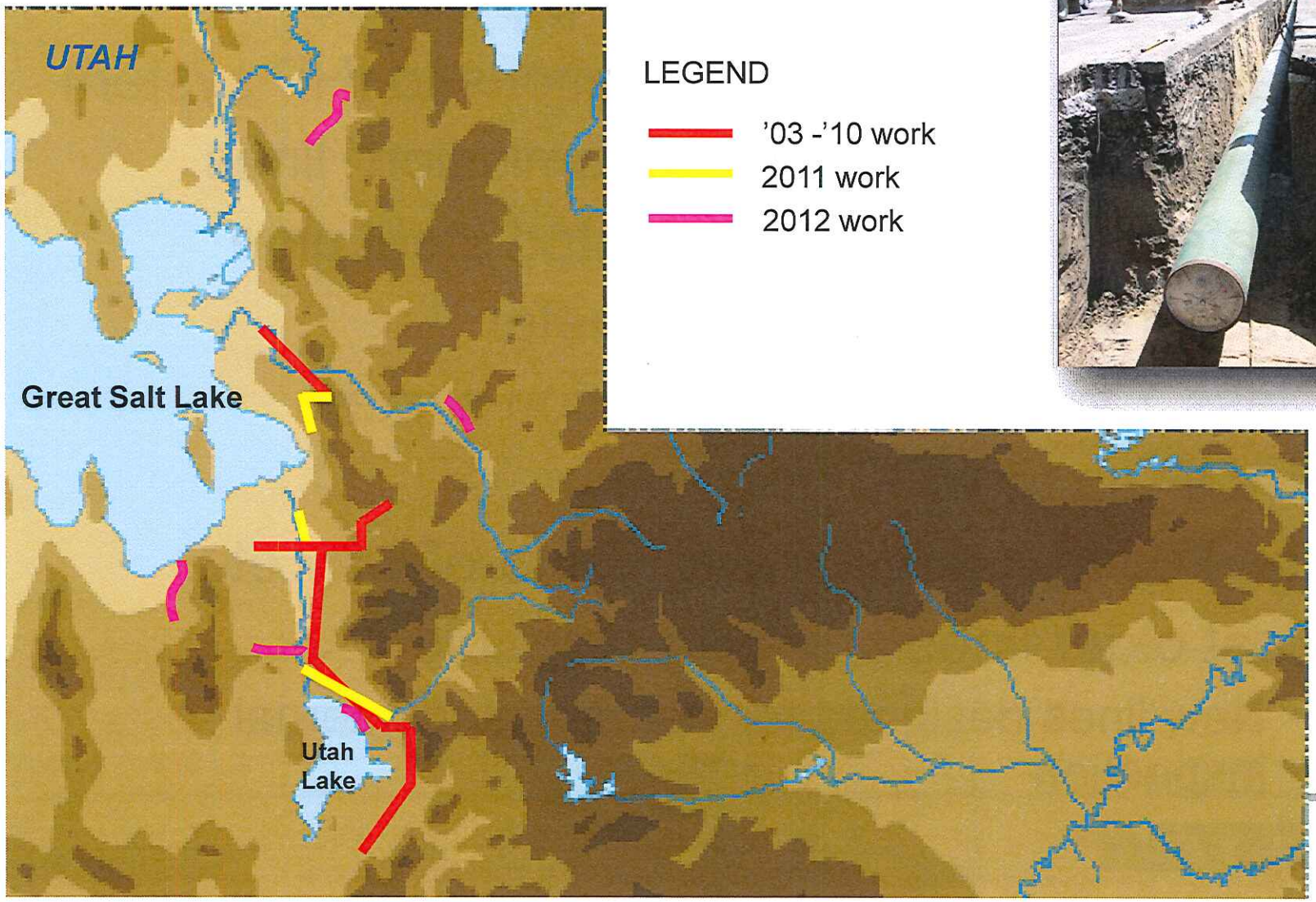



# Feeder Line Map

# Feeder Line Replacement



# Feeder Line System

- High-pressure "backbone" pipelines
  - Transport gas from gate stations to IHP system
  - Most are classified as "transmission" lines
  - Coated, cathodically-protected steel pipe
  - Sizes from 2" to 24" in diameter
  - Class 1 to 4 DOT classification system
  - MAOP up to 1000 psig
  - Located in roads, private rights-of-way etc.
  - Most older lines are "non-piggable"
    - New lines designed for instrumented internal inspection

# Historical Context - Risk Mgmt.

- Continuing capital expenditures, e.g.
  - Eliminated cast-iron / low-pressure
  - Eliminated bare steel
  - Eliminating rocket tubing (on-going)
  - Eliminating risers with anodes (on-going)
  - Feeder Line replacements (on-going)
- Driven by continuing surveillance
  - Program is adaptive over time
  - Proactive (safety can't be entirely reactive)

# §192.613 - Continuing Surveillance

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with §192.619 (a) and (b).

# Aging Feeder Lines

**(UT Mileage)**

| PRE 1940 | 1940 -1949 | 1950 -1959 | 1960 -1969 | 1970 - 1979 | 1980 - 1989 | 1990 - 1999 | 2000 - 2009 | 2010-2011 |
|---|---|---|---|---|---|---|---|---|
| 19 | 36 | 108* | 251* | 169 | 405 | 291 | 199 | 27 |

- Based on pipeline installation date
- *Includes "second tour of duty" pipelines (e.g. reconditioned 1929 vintage pipe)

# Factors in Replacing Pipelines

- Growth and system-capacity concerns
- Maintaining adequate system pressures
- Continuing surveillance (O&M history)
- Integrity management aspects (e.g. piggability)
- Public works and development projects
- Condition of ROWs
  - Unrestricted vs. impaired condition (in terms of performing required inspection, maintenance, repair and replacement activities)
- Age, construction, and manufacturing – modern v. vintage standards

# Adaptive Planning Process

- Capital Replacement Program
  - Priorities and pace of capital replacements will continue to evolve over time based on
    - Customer load growth / growth patterns
    - Operating history (e.g. leaks / failures)
    - Results of integrity assessments
    - Regulatory Compliance
- Integrated Resource Plan (IRP)
  - Updates on replacement

# Pipeline Replacement Study

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# Replacement Methodology for Vintage Pipe

We have an aggressive program to manage our vintage pipe

- We continue to refine the management of our vintage Feeder Line pipe
- We have refined our replacement methodology for vintage pipe
  - Risk = Threat x Consequence
    - → Medium threat x high consequence could be more of a concern than high threat x low consequence

# Our Knowledge Base

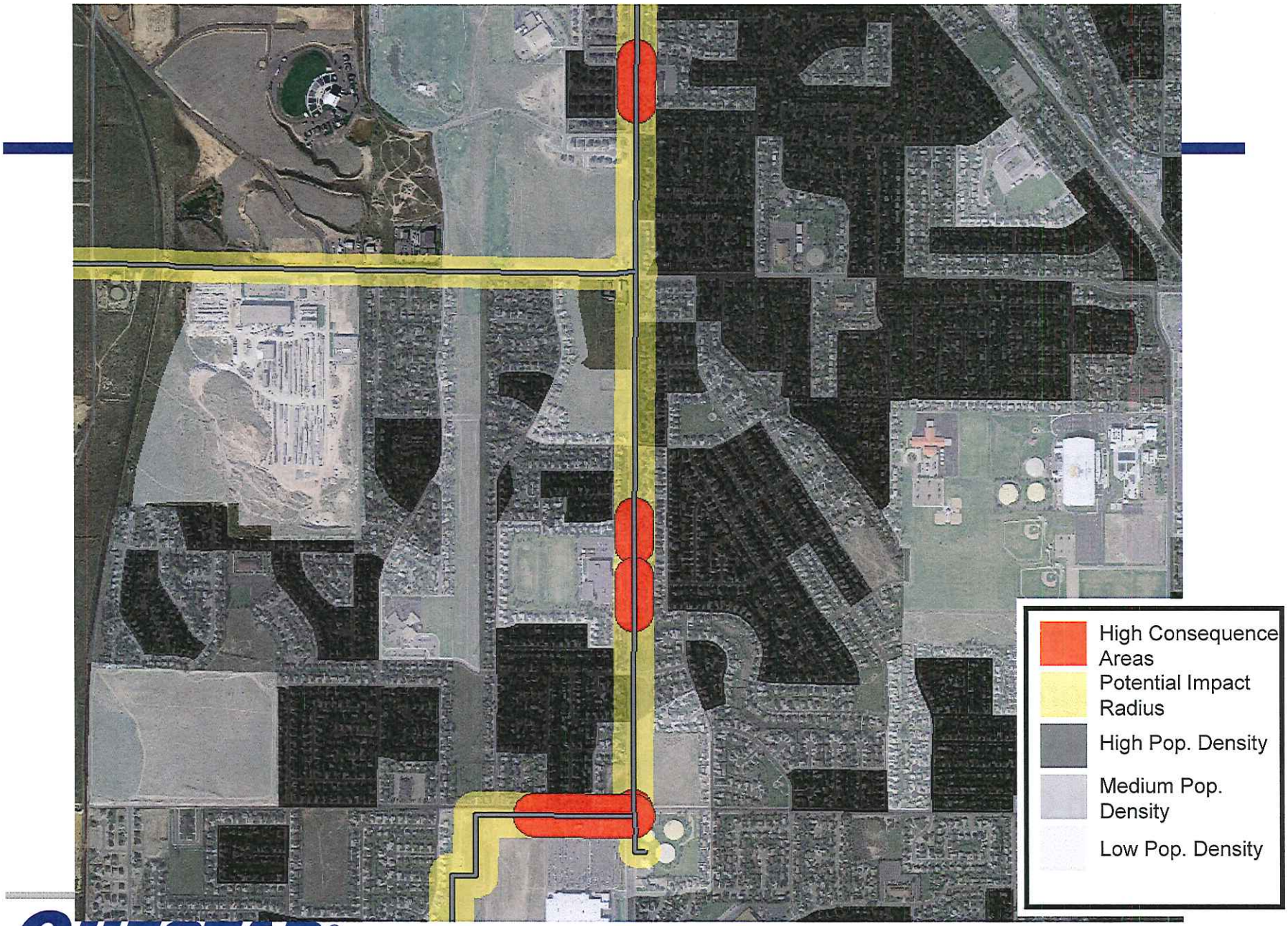
- What we know about our system
  - 80 years as an operator
  - 10 years of Integrity Management (IM)
  - Years of pipeline replacement, including 5 years of the feeder line replacement program
  - Geographic Information System (GIS) mapping tools
  - Recent MAOP validation efforts
- Industry experience
  - History of pipeline failures (e.g. pipe weld seam type failures)*
  - Publicly available data (including census data)
  - Papers and studies



* PHMSA Incident Reports

# Our Replacement Methodology Approach

- Continue to refine our replacement methodology
  - Identify key factors
  - Use simple scoring: High, Medium, Low
  - Incorporate what we have learned as an operator
  - Incorporate Subject Matter Expert (SME) inputs
  - Incorporate findings from MAOP reconciliation effort
- Data sources
  - GIS and MAOP review
  - Integrity Management dig reports and Field Activity Reports
  - Census data
  - High Consequence Areas


High Consequence Areas
Potential Impact Radius
High Pop. Density
Medium Pop. Density
Low Pop. Density

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# Factors Used in Current Methodology

- **Risk = Threat x Consequence**

- **Threats**
  - Construction
    - Pre 1955 – High Risk
    - 1955 - 11/1970 — Medium Risk
    - Post 11/1970*– Low Risk
  - Manufacturing - Pipe
    - Low Frequency Electric Resistance Weld (LF-ERW) – High Risk
    - Electric Flash Weld (EFW)– High Risk
    - Longitudinal Seam Weld Factor< 1.0 – High Risk
    - Pre 1960 – Medium Risk
      - Double Submerged Arc Weld (DSAW)
      - Submerged Arc Weld (SAW)
    - Post 1960 – Low Risk
  - Reconditioned
    - Yes – High
    - No – Low
  - Pressure Test Records
    - Not found – High Risk
  - Pipe/Equipment Condition
    - SME
- **Consequence**
  - HCAs
  - Census Data

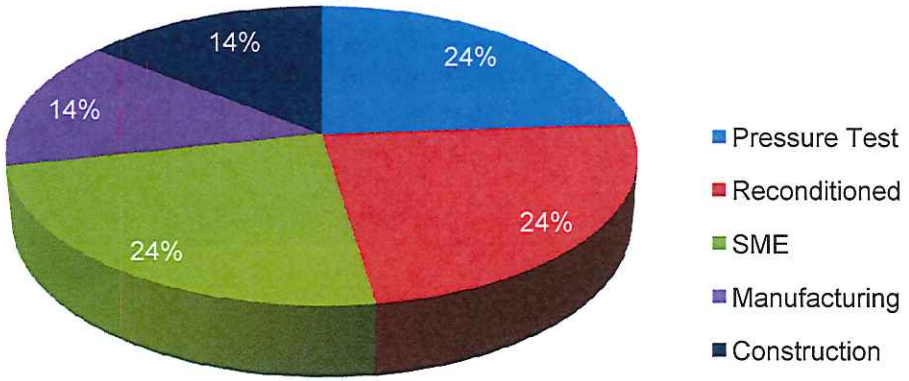


* 49 CFR Part 192 went into effect in 1970

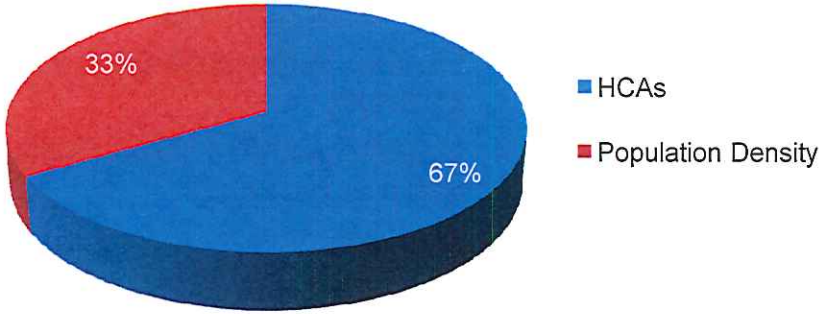
# Risk Weighting Factors

RISK = Threat x Consequence

Threat Weighting




Consequence Weighting

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# Risk Example

| Factor | Max Value | Example 1 - older pipe, lower consequence<br>Attribute | Value | Example 2 – newer pipe, higher consequence<br>Attribute | Value |
|---|---|---|---|---|---|
| Construction | 3 | Constructed in 1951 | 3 | Constructed in 1965 | 2 |
| Manufacturing | 3 | DSAW Seam Weld | 2 | LF-ERW Seam Weld | 3 |
| Reconditioned | 5 | Yes | 5 | No | 0 |
| Pressure Test | 5 | Available | 1 | Not Available | 5 |
| SME | 5 | Poor Condition | 5 | Poor Condition | 5 |
| **Total Threat** | **21** | **Total Threat** | **16** | **Total Threat** | **15** |
| HCAs | 10 | Small length in HCA | 2 | Half in HCA | 5 |
| Census Data | 5 | Low Pop density | 1 | High Pop density | 5 |
| **Total Consequence** | **15** | **Total Consequence** | **3** | **Total Consequence** | **10** |
| **Total Risk (21x15)** | **315** | **Total Risk (16x3)** | **48** | **Total Risk (15x10)** | **150** |

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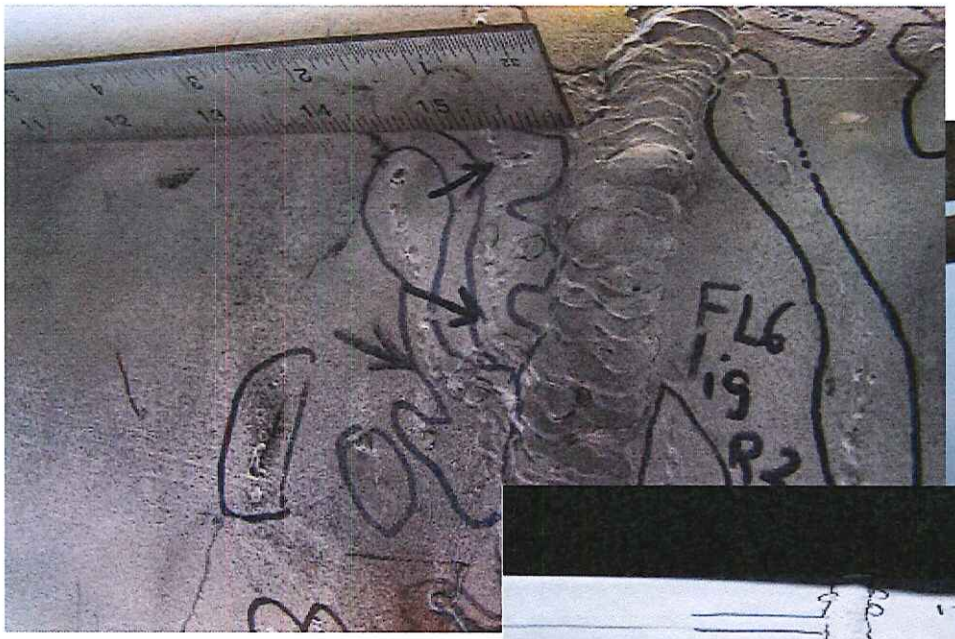
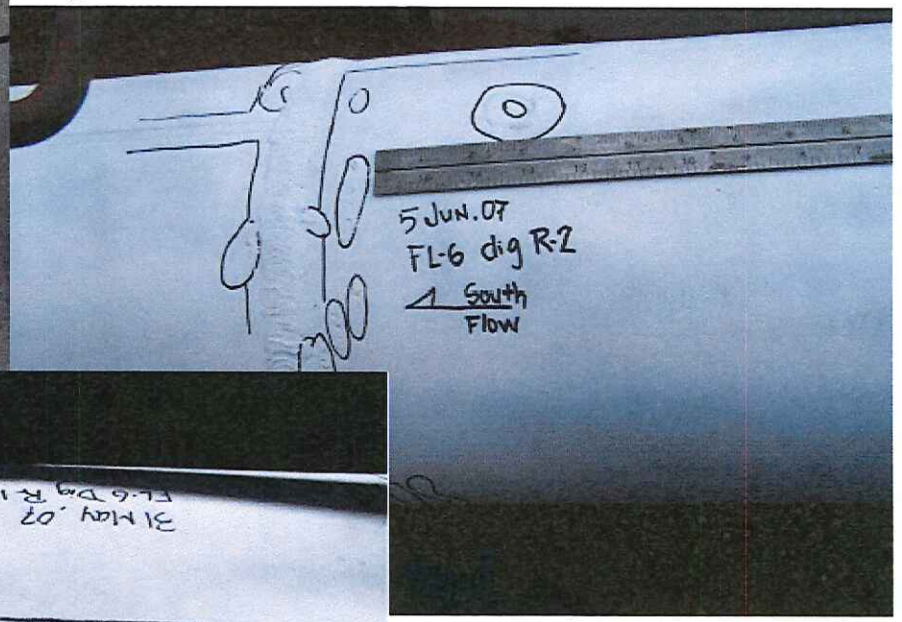
# QGC's Experience – Integrity Management

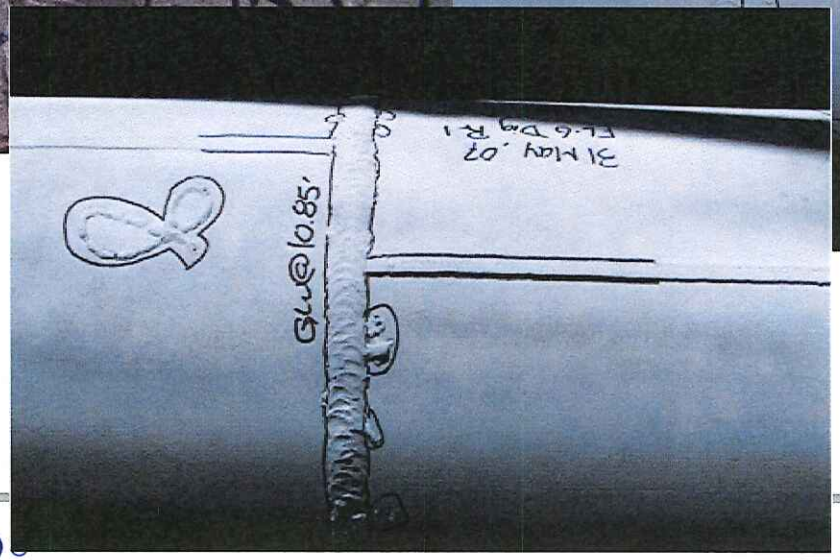
- QGC has been conducting Integrity Management assessments since 2004 per the Safety Improvement Act of 2002
- Through 2011, QGC has:
  - 169 miles of HCAs
  - Assessed all the pipe in HCAs
  - Assessed 221 miles of pipe, 52 miles outside of HCAs
  - Conducted 284 excavations and inspections
    - An average of over 1 dig per mile of assessed pipe

# Construction




46 arc strikes were found near a girth weld




Construction standards have evolved.

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# Construction (continued)

Failed “granny wrap” coating found on girth weld

Two part epoxy (2010)

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# Construction (continued)

Cobble rock in backfill can damage coating during final stages of installation

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# Construction (continued)

Current backfill practice

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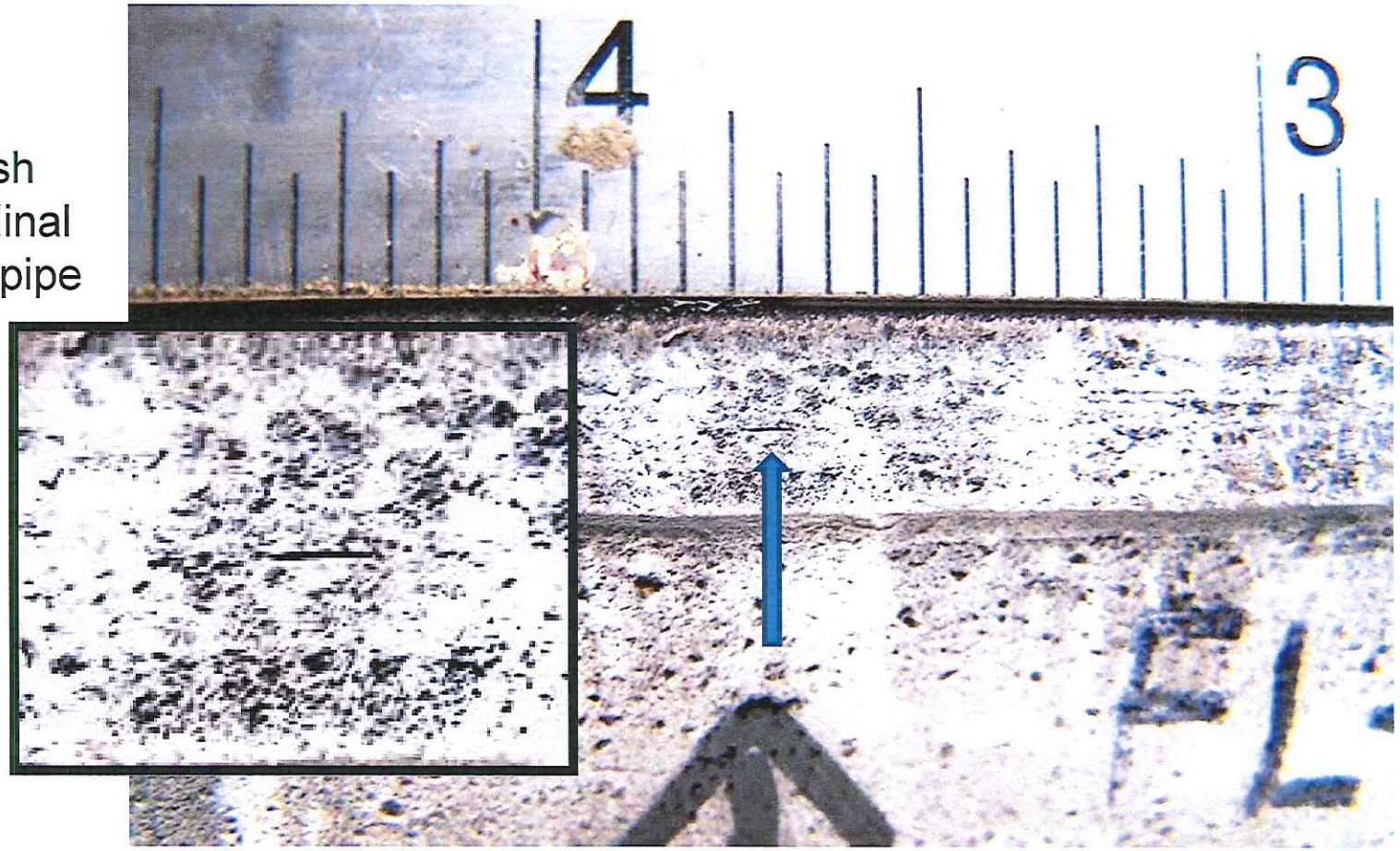
# Manufacturing

Crack-like indication in flash welded longitudinal seam of 1940s pipe

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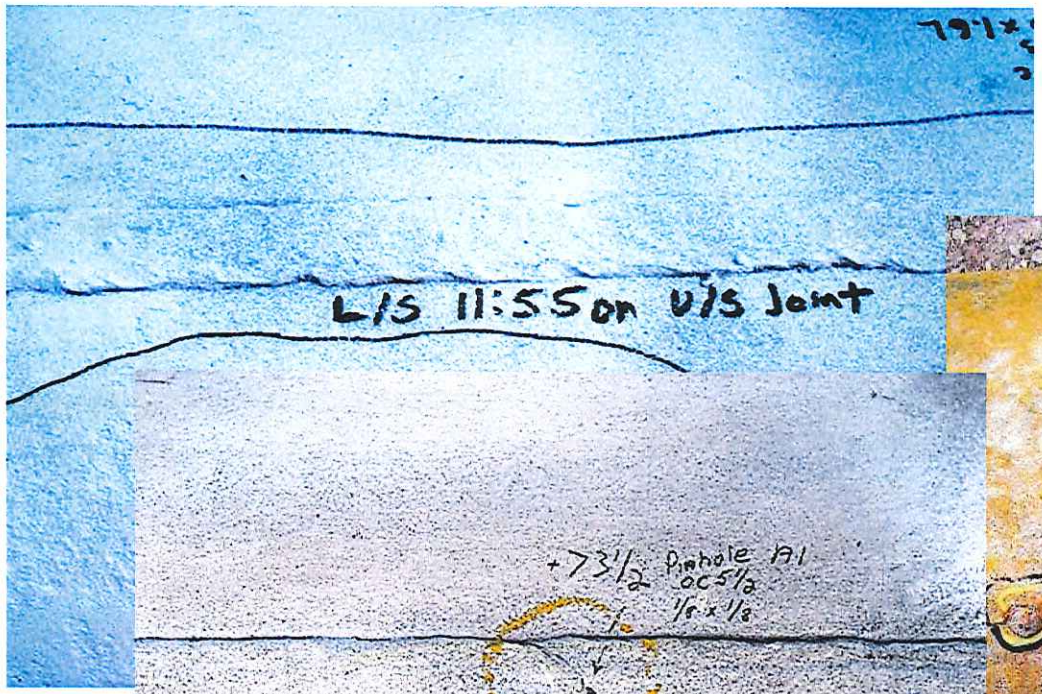
# Manufacturing (continued)







1940s Electric Flash Weld (EFW) longitudinal seam type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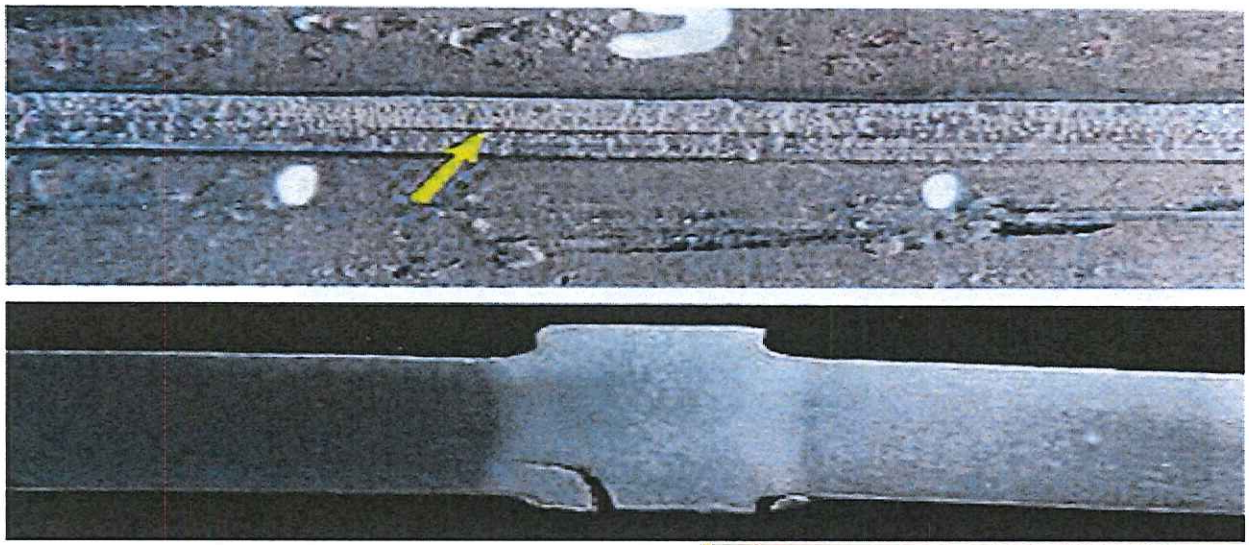
# Manufacturing (continued)

Linear indications in long seam weld

# Manufacturing (continued)



Flash weld seam flaw indications


1957 Low Frequency Electric Resistance Weld

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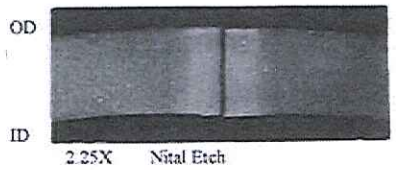
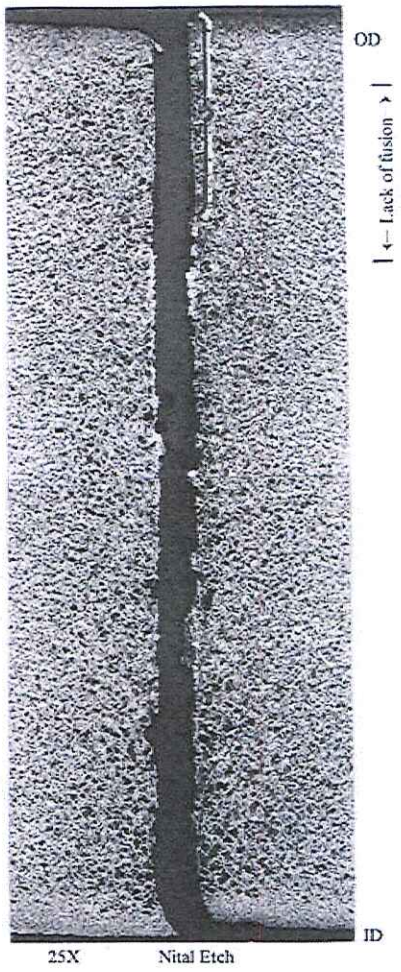
Industry Photos

# Manufacturing (continued)

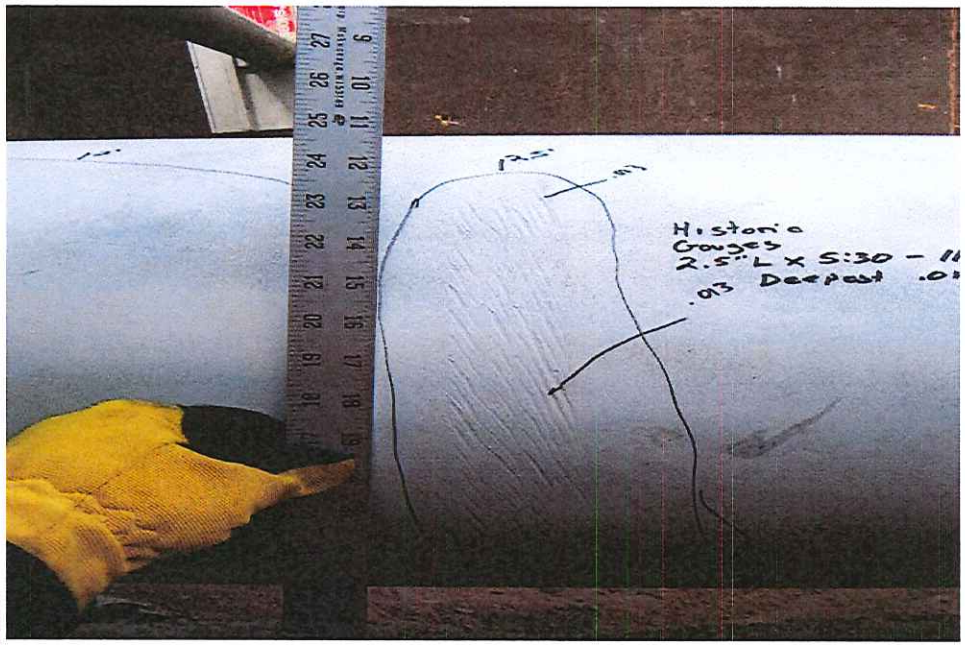


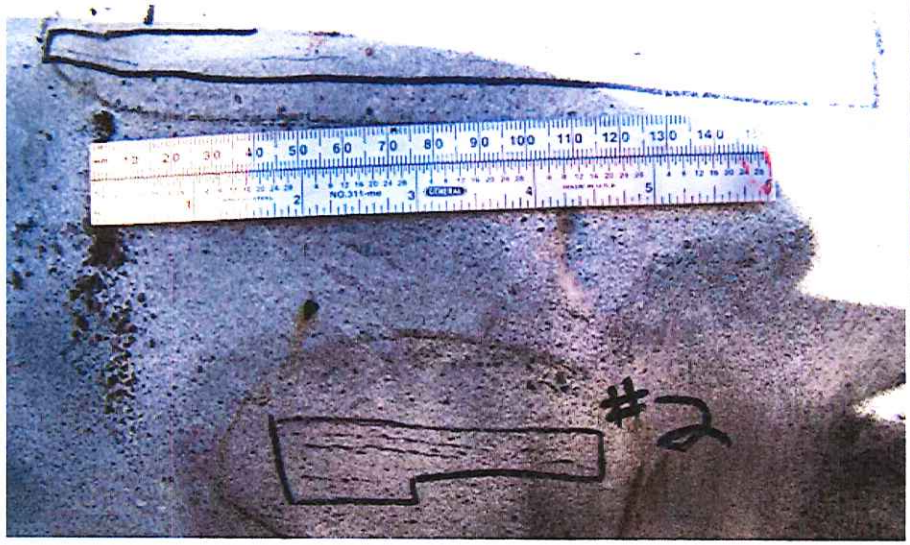




Lack of fusion (cold weld)
along Low-Frequency
Welded ERW bond

# Manufacturing (continued)

Gouge-like defects from manufacturing process found under coating




Linear indications from manufacturing process

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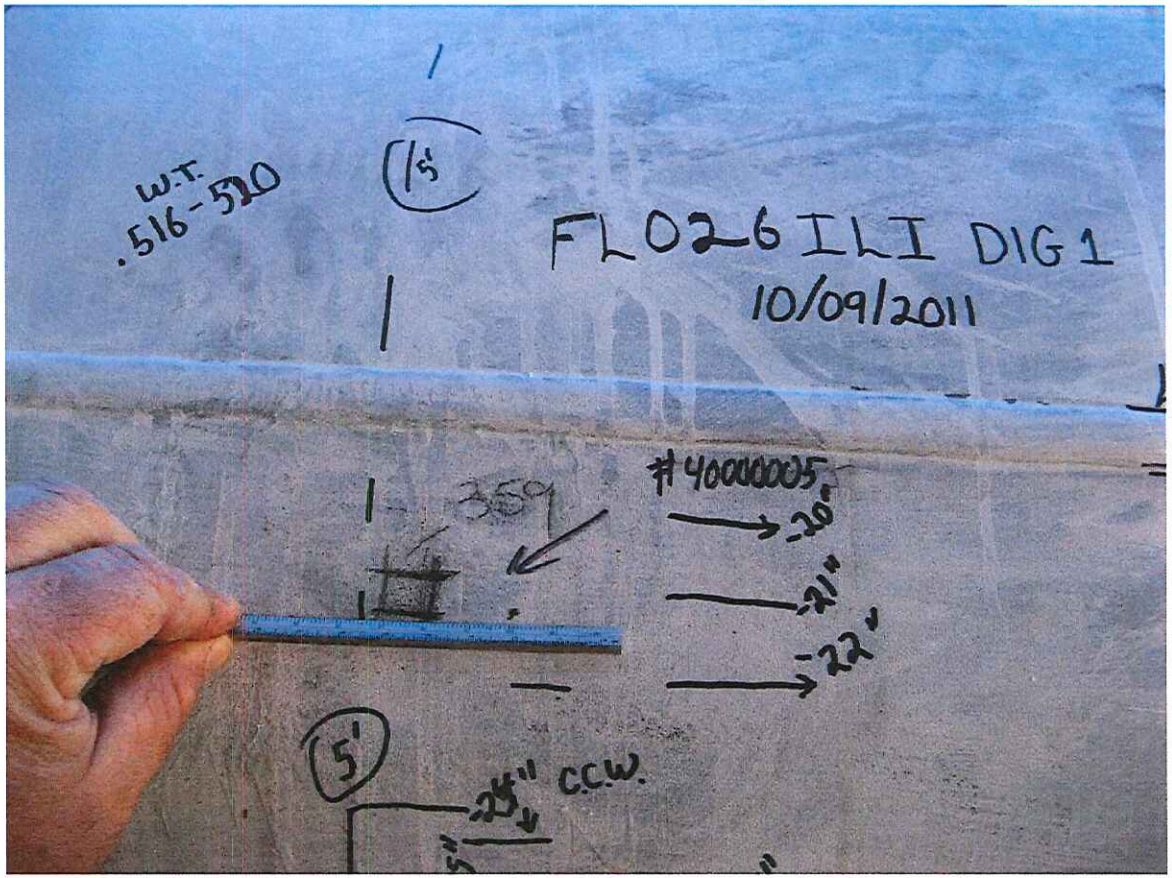
# Manufacturing (continued)




Doubled Submerged Arc Weld
2002

# Our Replacement Methodology

| | |
|---|---|
| Step 1 | Form a team of Subject Matter Experts |
| Step 2 | Pre-screen pipe 1970 and older and some post 1970 Utah Gas Pipe |
| Step 3 | Develop risk algorithm – threat and consequence |
| Step 4 | Some scoring using mapping approach |
| Step 5 | Use Subject Matter Experts to adjust |
| Step 6 | Refine algorithms |
| Step 7 | Get input from other QGC stakeholders |

# Preliminary Schedule

| Line (Segment) | City/County | Miles | Diameter | Scheduled | Notes |
|---|---|---|---|---|---|
| FL23 | Logan/Cache | .57 | 12 | 2012 | 1 |
| FL25 | Lehi/Utah | 13.45 | 12 | 2012 | 1 |
| FL35(a) | Riverton/Salt Lake | 8.55 | 16 | 2012 | 1 |
| FL50 | Croyden/Summit | 5.24 | 6 | 2012 | 1 |
| FL14 | Tooele/Tooele | 14.90 | 12 | 2012 | 1 |
| FL41(a) | Tooele/Tooele | 2.88 | 16 | 2013 | 1 |
| FL36(a) | Riverton/Salt Lake | 3.70 | 8 | 2013 | 1 |
| FL36(b) | Riverton/Salt Lake | 6.33 | 8 | 2013 | 1 |
| FL38(a) | Tooele/Tooele | 10.13 | 8 | 2013 | 1 |
| FL21-50(a) | Centerville/Davis | 0.19 | 20 | 2013 | 1 |
| FL20 | Ogden/Weber | 1.17 | 14 | 2013 | 1 |
| FL8(a) | West Jordan/Salt Lake | 2.37 | 6 | 2013 | 1 |
| FL8(b) | West Jordan/Salt Lake | 1.90 | 6 | 2013 | 1 |
| FL22 | Ogden/Weber | 11.10 | 20 | 2013-2014 | 1 |
| FL6 | Sandy/Salt Lake | 13.41 | 10 | 2014 | |
| FL24 | Pleasant Grove/Utah | 18.28 | 10 | 2014 | |
| FL21-5 | North Salt Lake/Davis | 3.68 | 14 | 2014 | |
| FL21-50(b) | North Salt Lake/Davis | 24.51 | 20 | 2015 | |
| FL21-4 | Salt Lake City/Salt Lake | 2.41 | 10 | 2015 | |
| FL11 | Salt Lake City/Salt Lake | 0.30 | 12 | 2015 | |
| FL26 | American Fork/Utah | 11.55 | 20 | 2016 | |
| FL29 | Brigham City/Box Elder | 19.32 | 10 | 2016 | |
| FL21-13 | Bountiful/Davis | 1.64 | 6 | 2016 | |
| FL47 | Clearfield/Davis | 1.37 | 12 | 2016 | |
| FL21-20 | Bountiful/Davis | 1.05 | 6 | 2016 | |
| FL11-1(a) | Magna/Salt Lake | 4.87 | 12 | 2016 | |
| FL33 | Salt Lake City/Salt Lake | 5.09 | 20 | 2016 | |

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1- Preliminary planning and analysis already completed.

*This schedule is subject to revision based on ongoing risk, constructability, availability of materials, construction moratoriums, competing (co-located) civil projects and system constraints analyses.

# Feeder Lines Under Consideration

- Questar is continuing to evaluate additional pre-1970s pipelines
  - Approximately 250 miles from 40 to 45 Feeder Lines

# The Next Step - Improve the Process

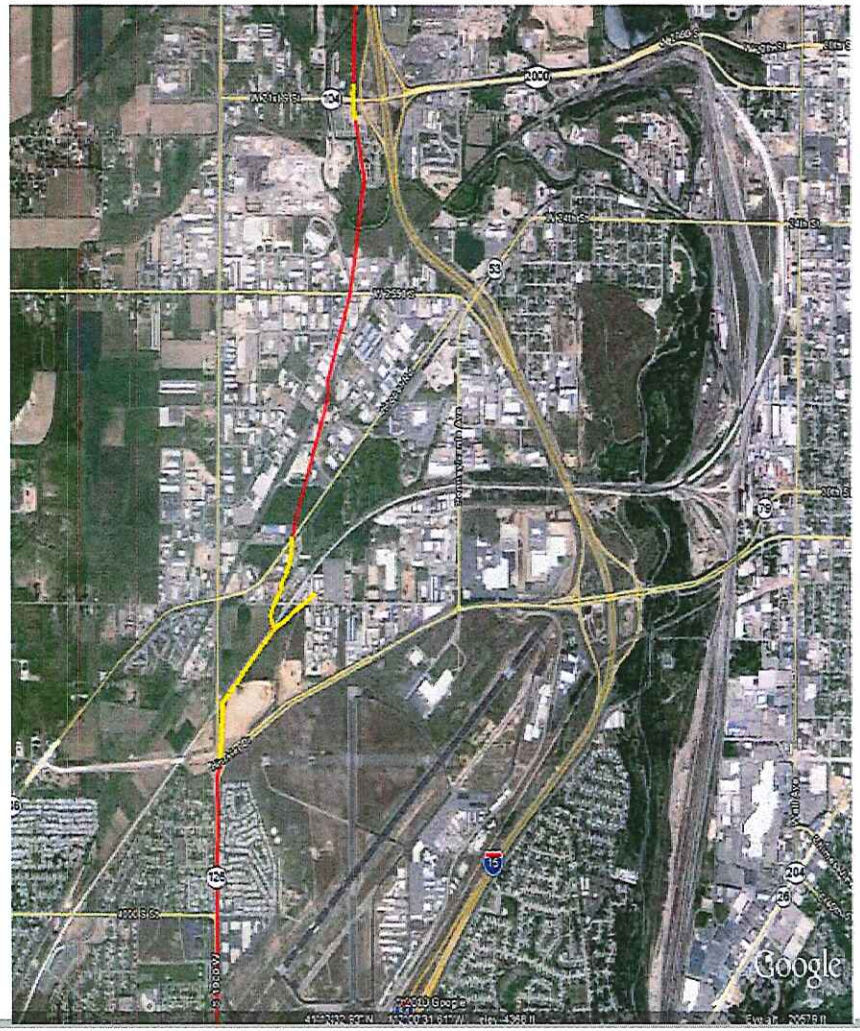
Replacement methodology is an adaptive process

- Consider more threats and consequences
- Pull in more data (including MAOP reconciliation effort)
- Gather additional pipe information when pipe is exposed, removed, or abandoned
- May include sending pipe to test labs
  - Gather and/or validate pipe data
  - Establish Fitness For Service
- Continue to refine algorithms

# 2011 Projects

| Project | 2011 Budget | 2011 Costs | Variance |
|---|---|---|---|
| FL19 | $500,000 | $52,629 | $-447,371 |
| FL12 | $15,566,000 | $17,237,671 | $1,671,671 |
| FL18 | $1,420,000 | $2,087,573 | $667,573 |
| FL17 | $4,180,000 | $5,844,103 | $1,664,103 |
| FL25/7 | $20,000,000 | $24,047,593 | $4,047,593 |

# Feederline 19




- Sunset Station to Harrisville Station
- Carryover costs in 2011
- 20" Welded Steel Pipe
- 2011 Budget $500,000
- 2011 Costs $52,629

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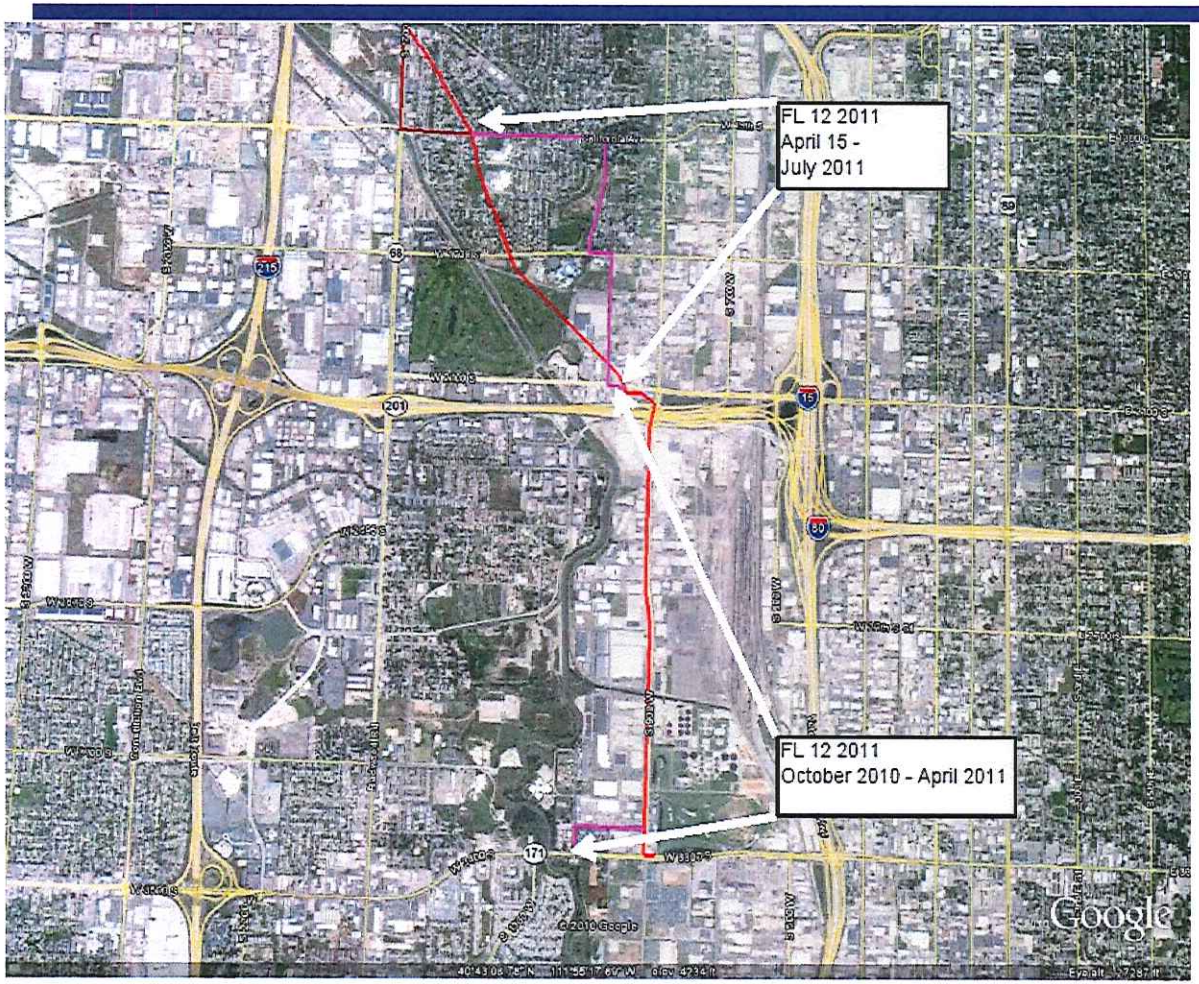
# Feederline 12




- 3300 S and 1100 W to California Ave and Redwood Rd to Orange St in Salt Lake
- 24" Welded Steel Pipe
- 2011 Budget $15,566,000
- 2011 Costs $17,237,671

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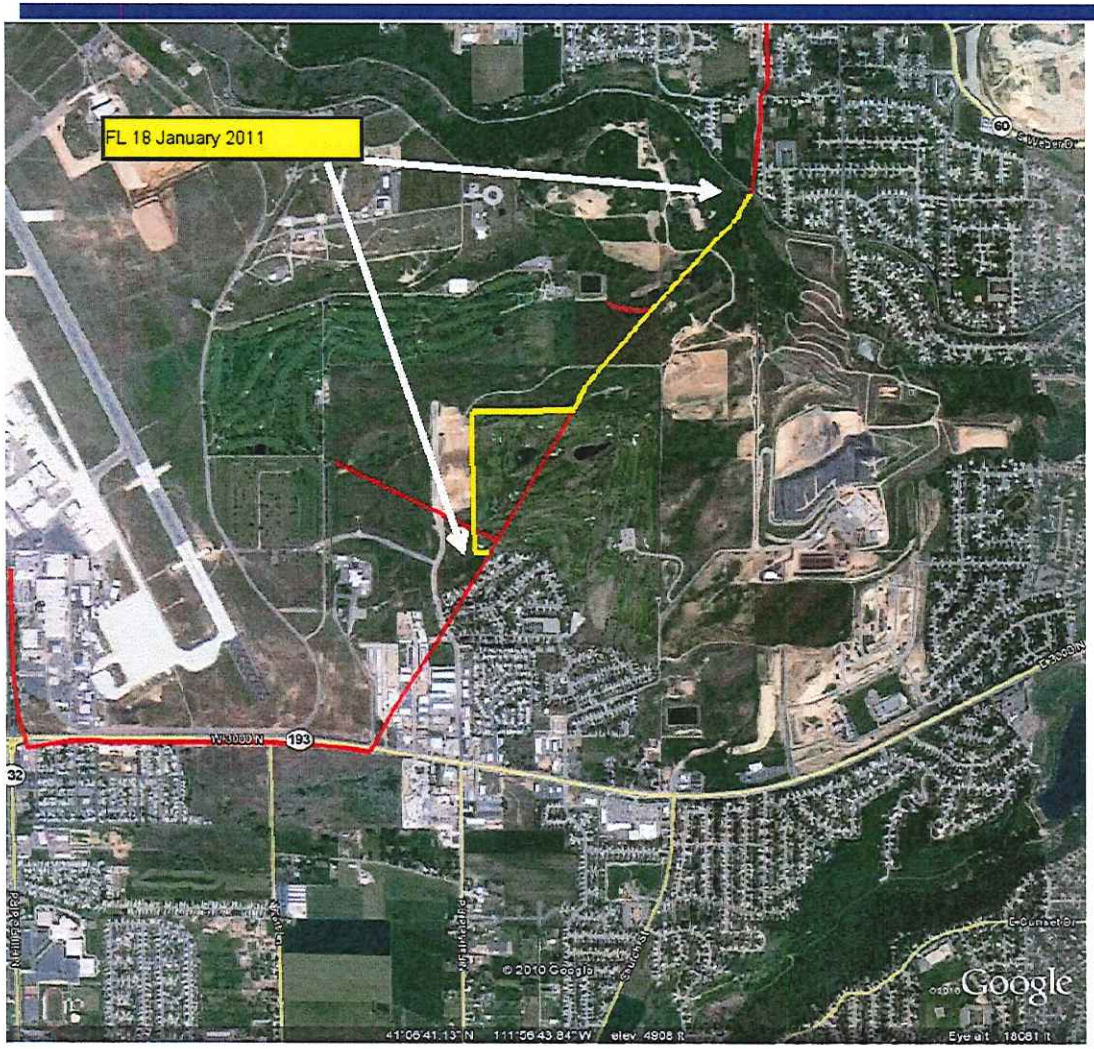
# Budget Overage Feederline 12

- High levels of precipitation resulted in unusually high groundwater and complicated construction.
- High water levels also resulted in shallower than anticipated pipe installation depths, increased utility crossings, and slower construction.
- Salt Lake City's uncertainty regarding the location of its utilities resulted in re-routing and increased costs.
- Re-routed some sections in order to minimize impacts on two local schools.

# Feederline 18




- Sunhill golf course to Davis-Weber canal in Davis County
- 12" Welded Steel Pipe
- 2011 Budget $1,420,000
- 2011 Costs $2,087,573

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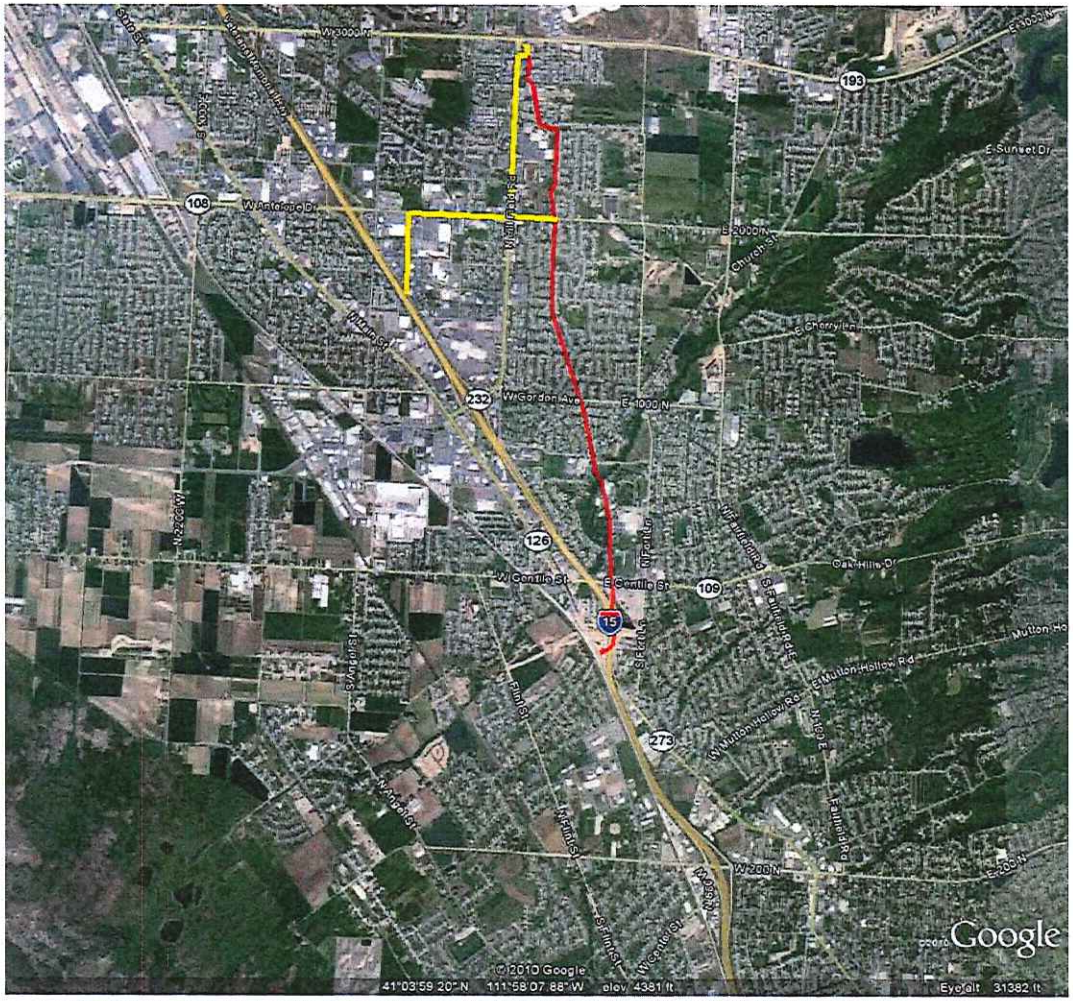
# Budget Overage Feederline 18

- Unusually cold weather limited Questar Gas' ability to take certain sections out of service, resulting in delays and costs associated with mobilizing and demobilizing.
- Decommissioning of the old pipeline was more expensive than anticipated.

# Feederline 17




- Gentile Street to HAFB South Gate in Layton
- 12" Welded Steel Pipe
- 2011 Budget $4,180,000
- 2011 Costs $5,844,103

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# Budget Overage Feederline 17

- Layton City requirements and difficulty locating other utilities resulted in reroutes and realignments.
- Canal company required directional drilling instead of trenching, increasing costs.
- Additional measures in tight working areas were required to maintain service to Hill Air Force Base.

# Feederlines 25/7


- Utah County line to Pleasant Grove
- 12” Welded Steel Pipe
- 2011 Budget $20,000,000
- 2011 Costs $24,047,593
- Required re-routes added 17,000 feet to the project

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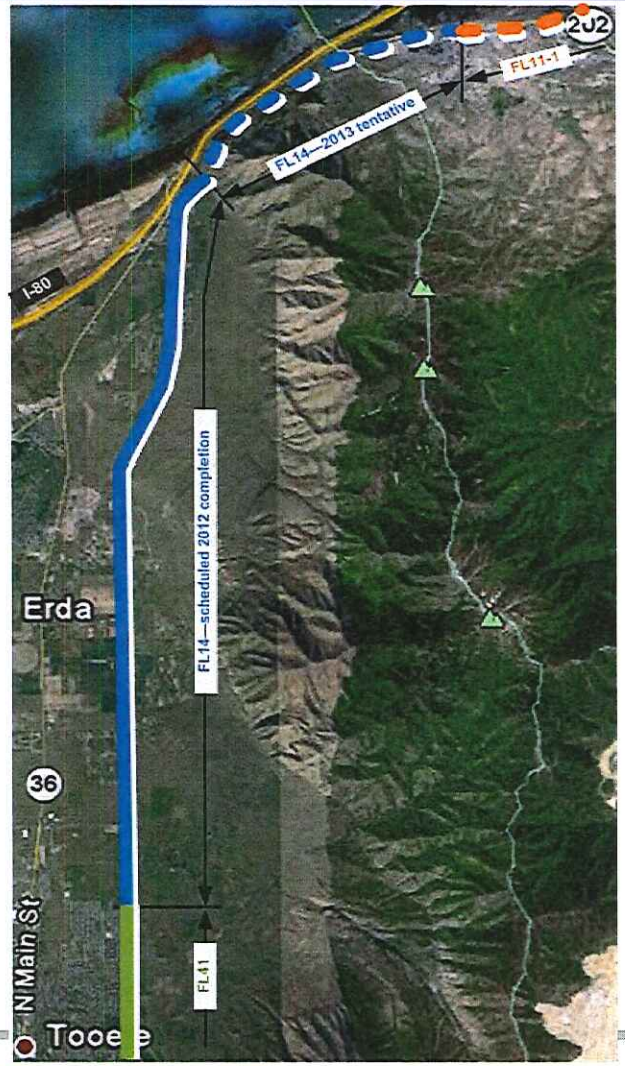
# Budget Overage Feederline 25/7

- DOT and Lehi City required significant reroutes.
- Utah County road construction resulted in need for additional traffic control.
- High ground water complicated trenching, trench shoring and construction.
- The I-15 Core construction project greatly impacted project trucking costs to haul and dispose of trench spoil material and supply fill material.
- UDOT required that Questar Gas bore across roads, instead of the planned open-trench construction, increasing costs.

# 2012 Projects

| Project | 2012 Budget |
|---|---|
| FL14 – Droubay Rd in Tooele | $16,500,000 |
| FL23 – 800 N and 200 W in Logan | $2,500,000 |
| FL25 – 100 E and State St in Lehi | $4,500,000 |
| FL35 – 13400 S in Herriman & Riverton | $27,000,000 |
| FL50 – Hwy 65 in Henefer | $2,000,000 |
| Other | $2,000,000 |
| **Total 2012 Budget** | **$57,000,000** |

# Feederline 14




- Droubay Rd in Tooele
- 75,000 ft of 20" pipe
- Total Project cost $21,552,000
- 2012 Budget $16,500,000

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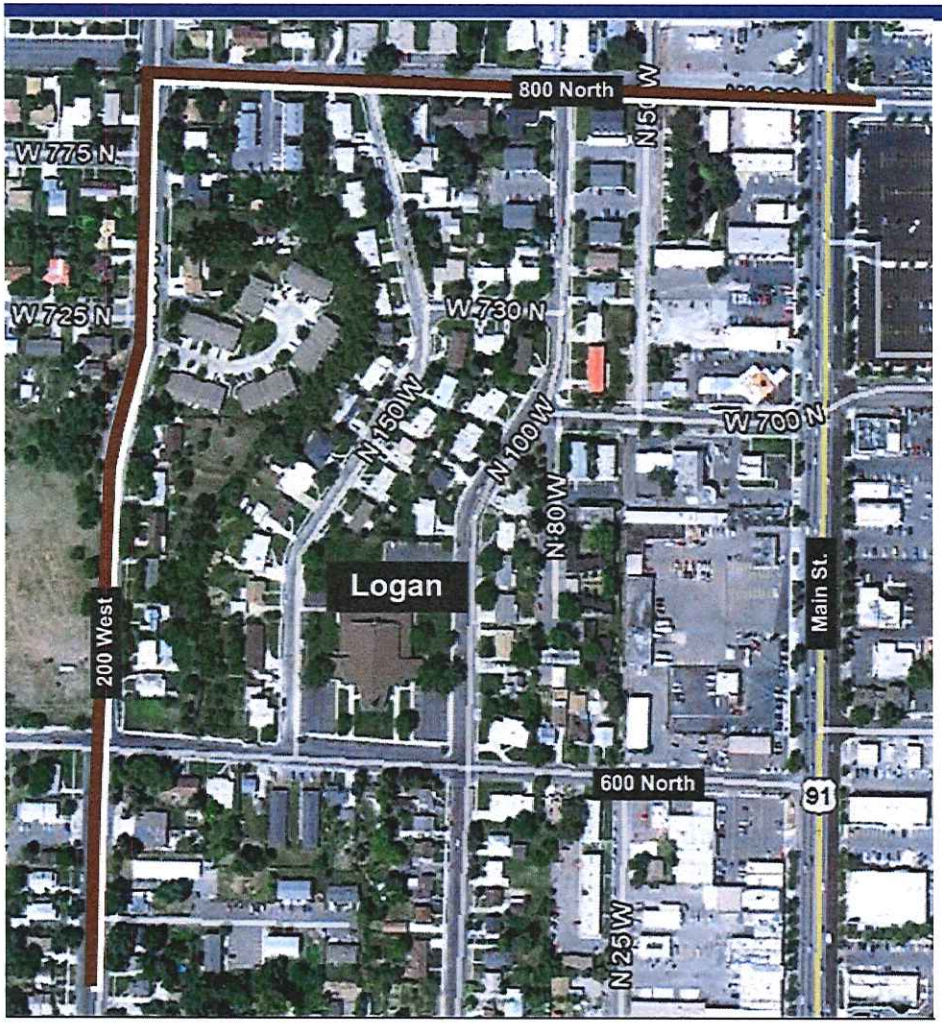
# Feederline 23




- 800 N and 200 W in Logan
- 3,000 Ft of 12" pipe
- Total Project Cost $2,500,000
- 2012 Budget $2,500,000

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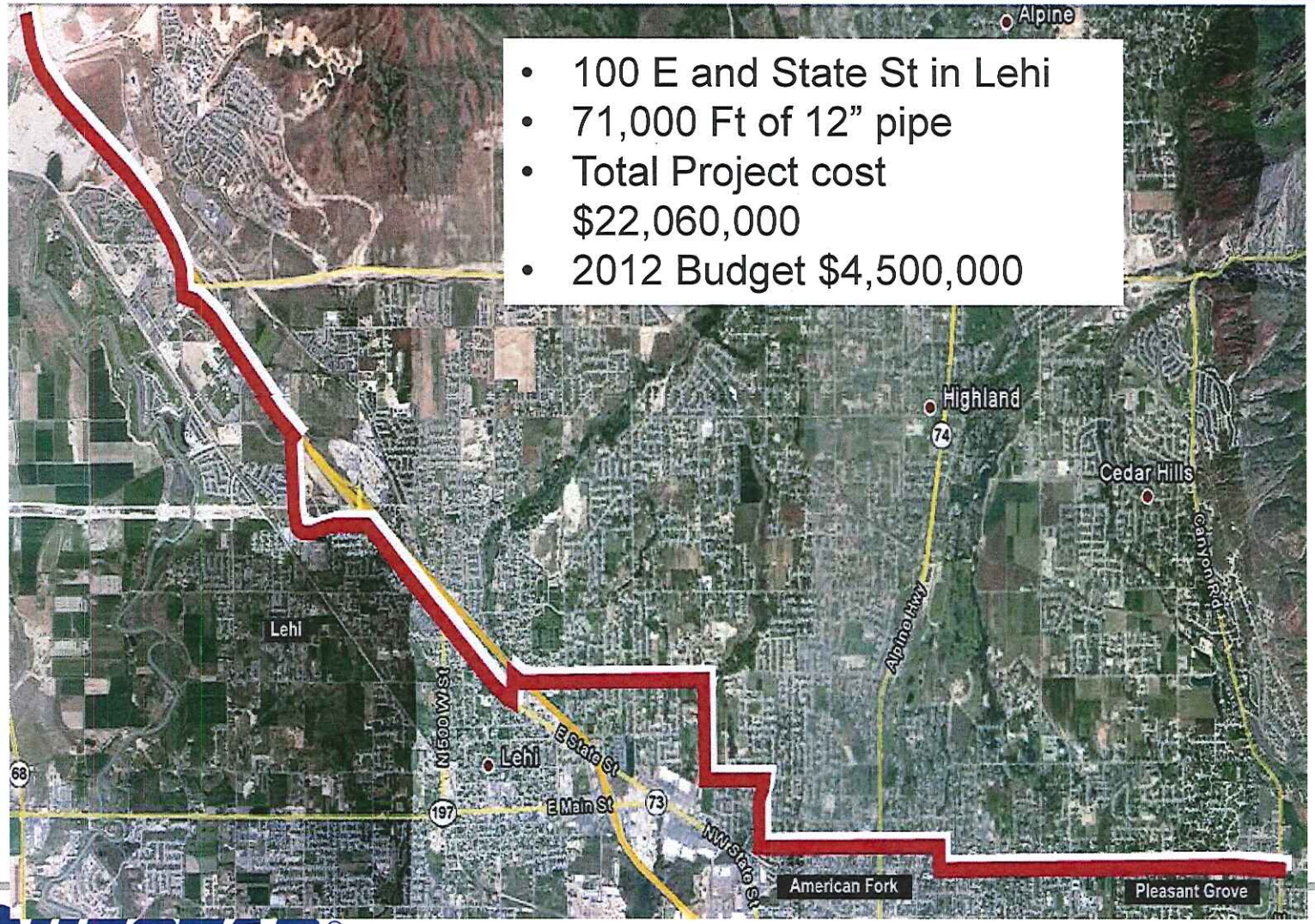
# Feederline 25




- 100 E and State St in Lehi
- 71,000 Ft of 12" pipe
- Total Project cost $22,060,000
- 2012 Budget $4,500,000

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# Feederline 35

- 13400 S in Herriman and Riverton
- 75,000 Ft of 20" pipe
- Total Project cost $30,737,000
- 2012 Budget $27,000,000


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# Feederline 50


- Hwy 65 in Henefer
- 28,000 ft of 6" pipe
- Total Project cost $4,500,000
- 2012 Budget $4,500,000

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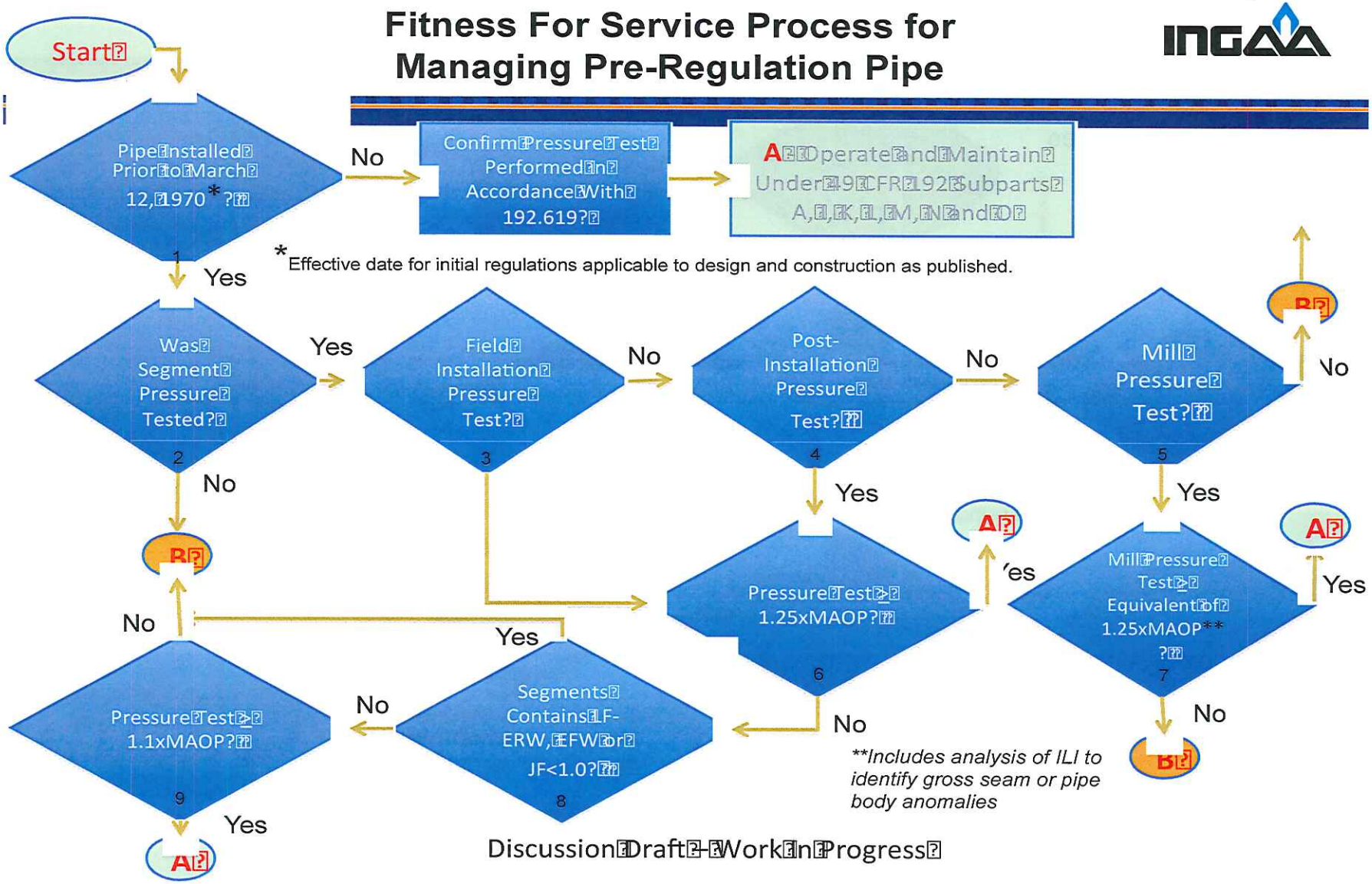
# Questions

Jan 12, 2012

# Fitness For Service Process for Managing Pre-Regulation Pipe




Discussion Draft – Work in Progress

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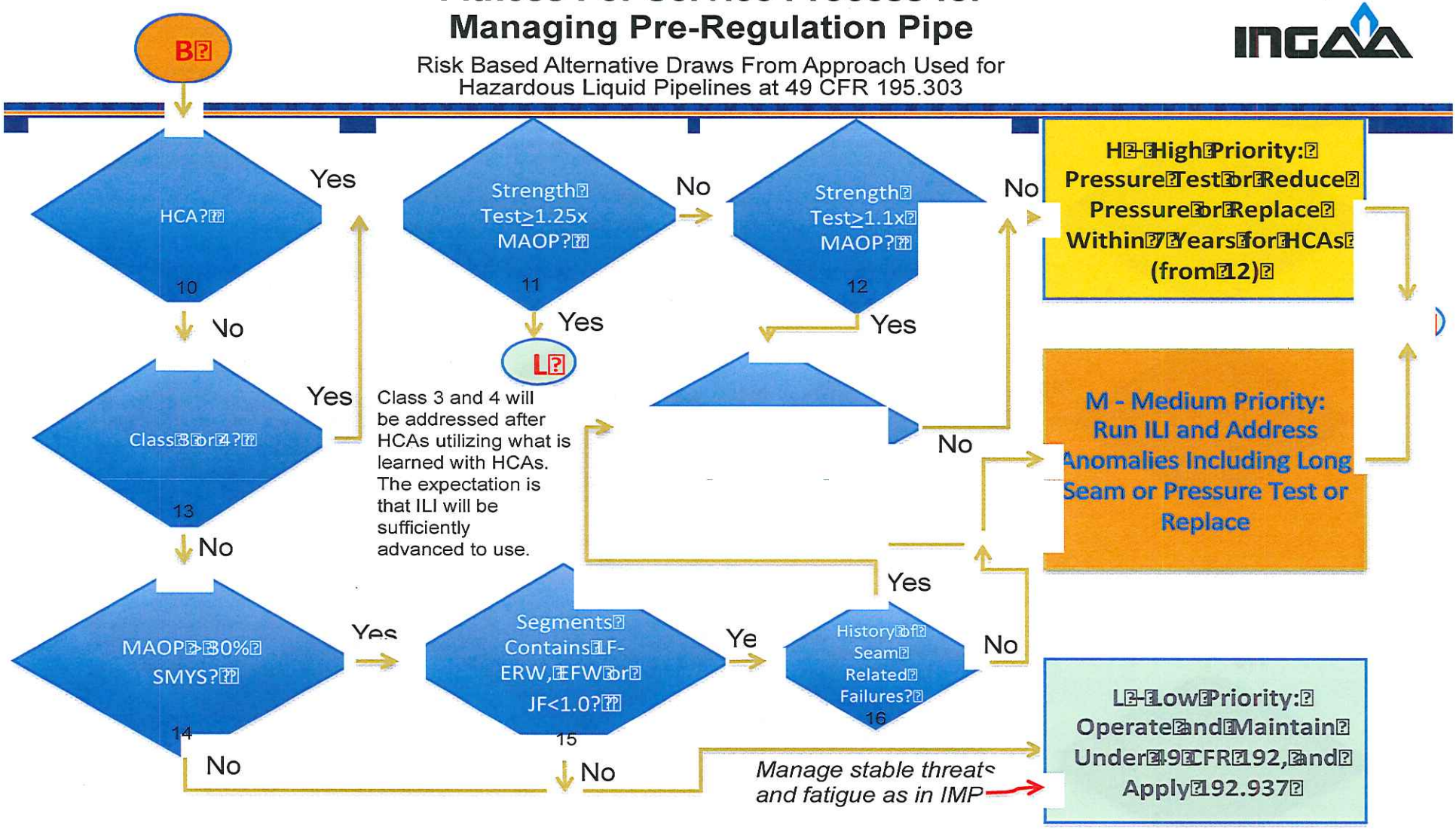
# Fitness For Service Process for Managing Pre-Regulation Pipe

Jan 12, 2012

Risk Based Alternative Draws From Approach Used for Hazardous Liquid Pipelines at 49 CFR 195.303




LF-ERW is low frequency electric resistance welded; EFW is electric fusion or flash welded; and JF is joint factor as defined at 49 CFR 192.113

Discussion Draft - Work In Progress

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