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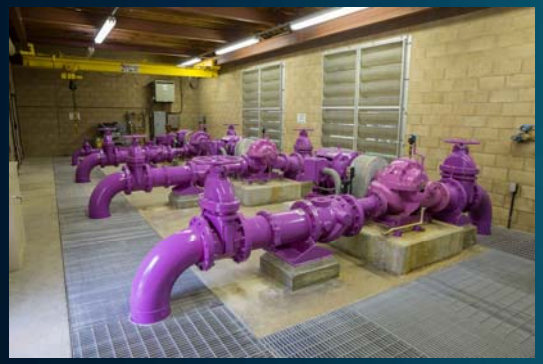
# MNWD'S Risk Assessment and Prioritization: Turning Data into Actionable Insights

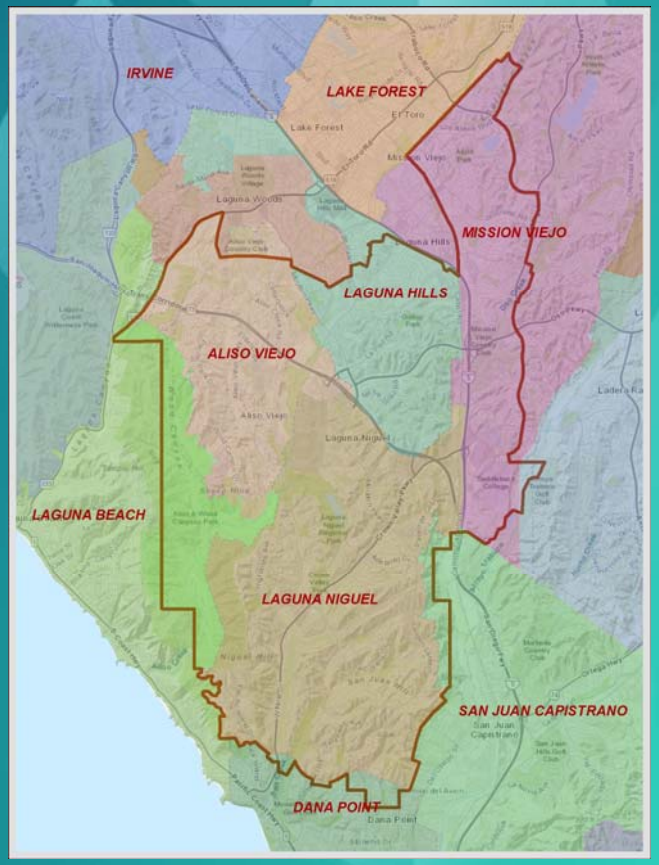
July 10, 2019

# Where is Moulton Niguel Water District?

# A Little About MNWD:

- Moulton Niguel Water District provides water, recycled water, and wastewater services to more than 170,000 customers in Laguna Niguel, Aliso Viejo, Laguna Hills, Mission Viejo, and Dana Point
- 656 miles of potable mainline
- 142 miles of recycled mainline
- 501 miles of wastewater mainline
- Approximately 56,000 service connections



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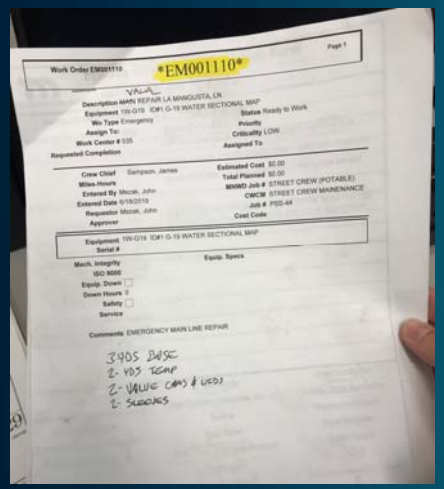
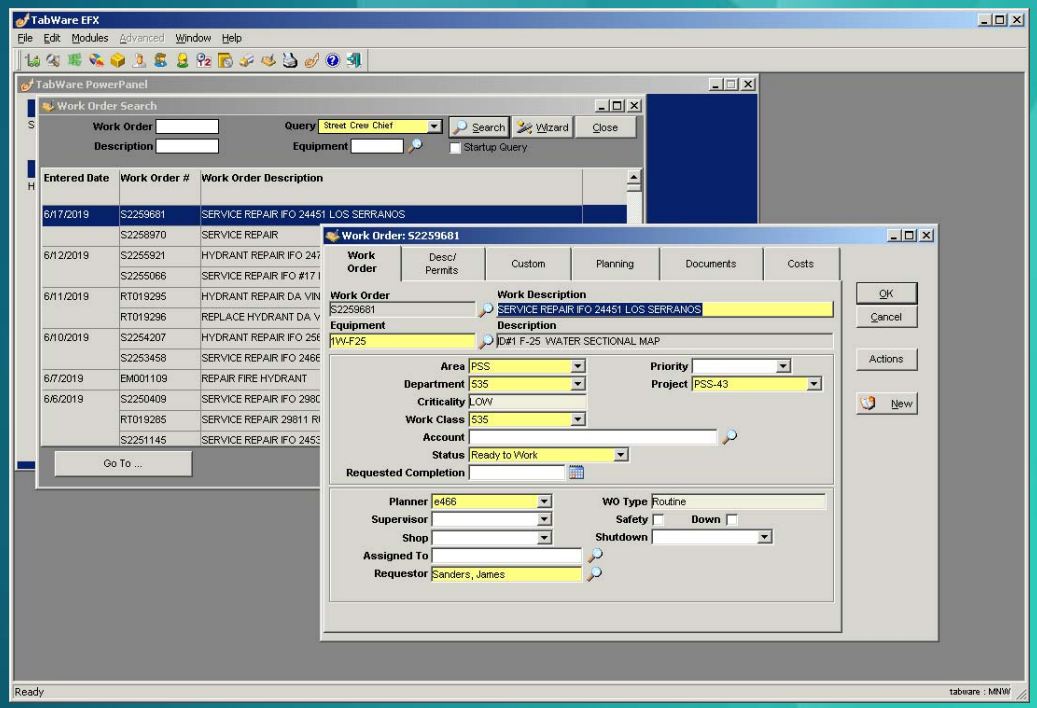
# Current Applications at MNWD

- Computerized Maintenance Management System (CMMS)
  - Current system is Tabware. Has been in use since 1999
    - Heavily used by some crews, little or not at all by others
    - No GIS integration
  - Have selected new vendor (FY 19-20 implementation)

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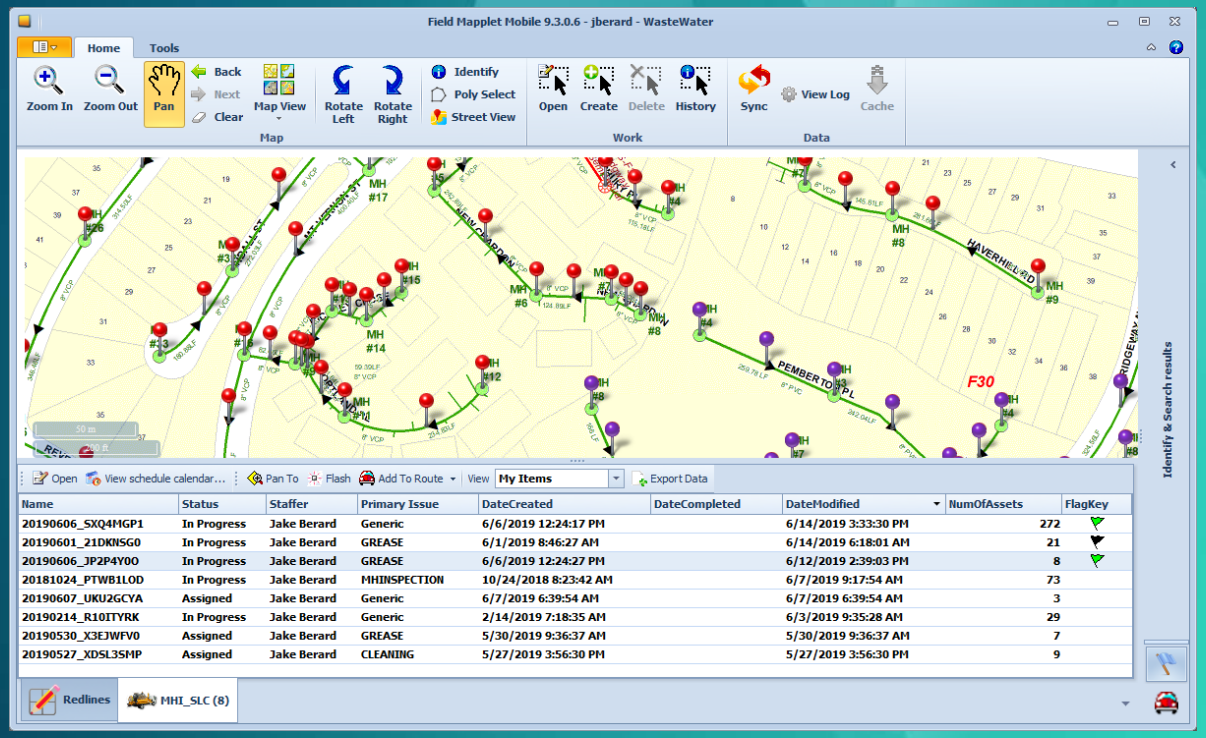
# Current Applications at MNWD

- Field Mapplet (Spatial Wave)
  - DigAlert markouts
  - Manhole inspections and sewer line cleaning

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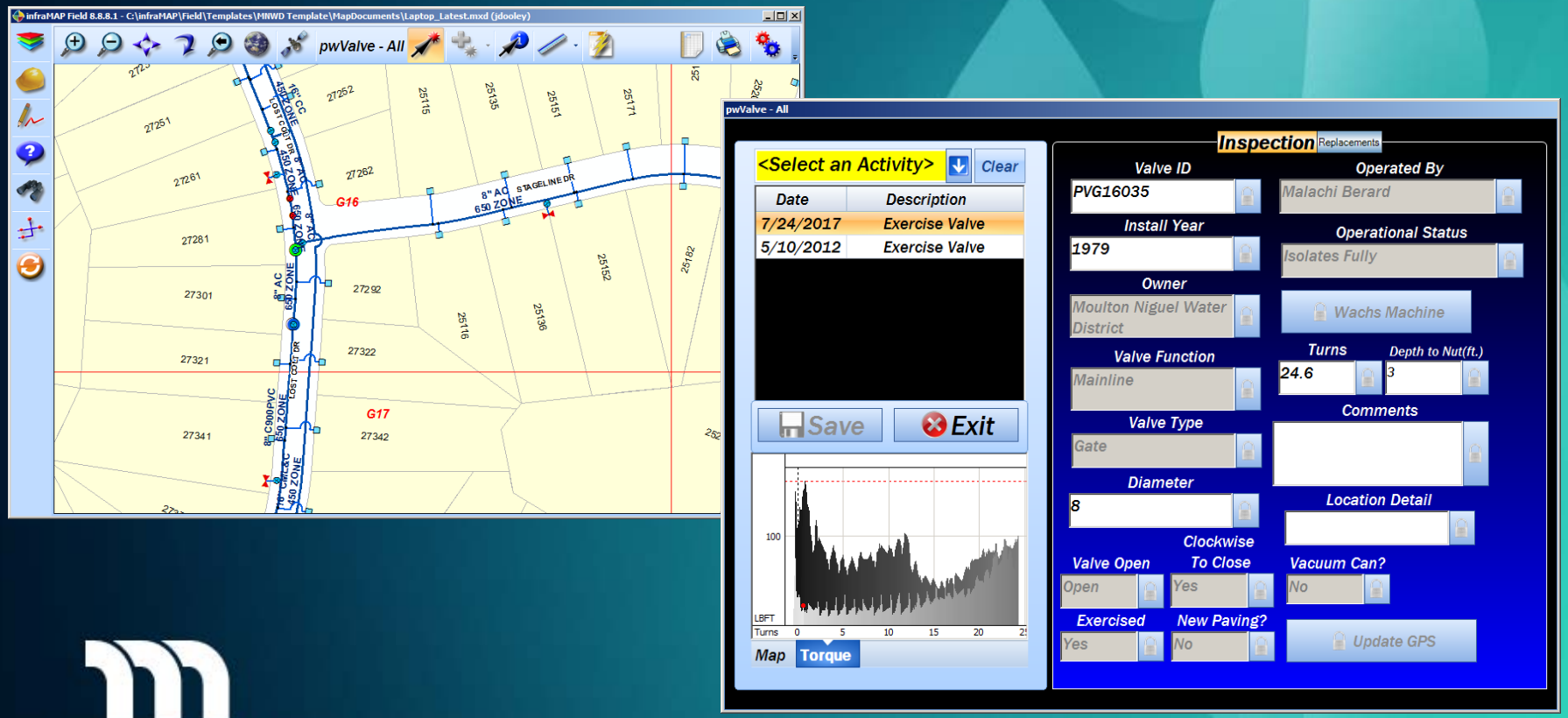
# Current Applications at MNWD

- InfraMAP (iWater) - Valve exercising, repair, and replacement

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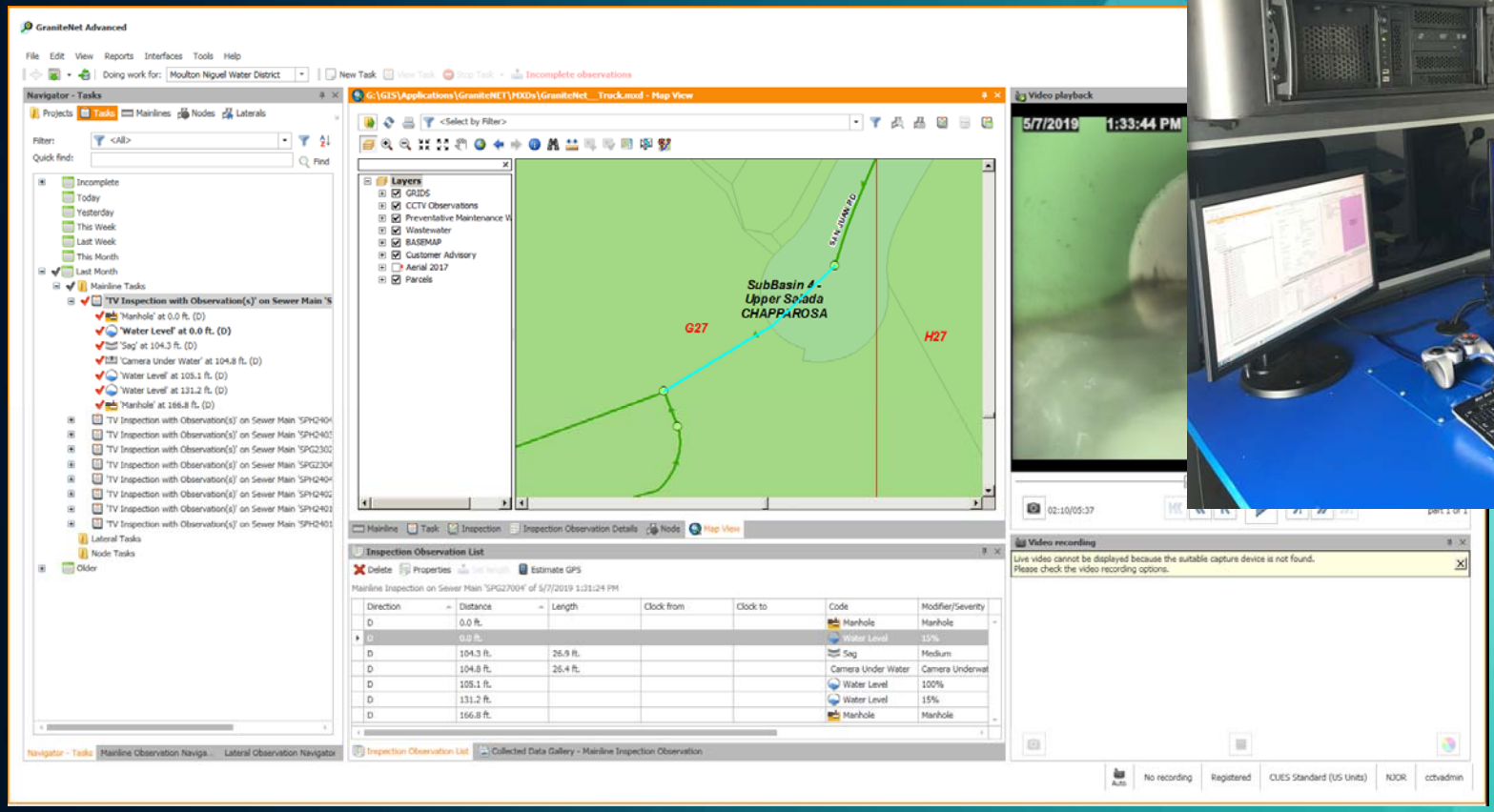
# Current Applications at MNWD

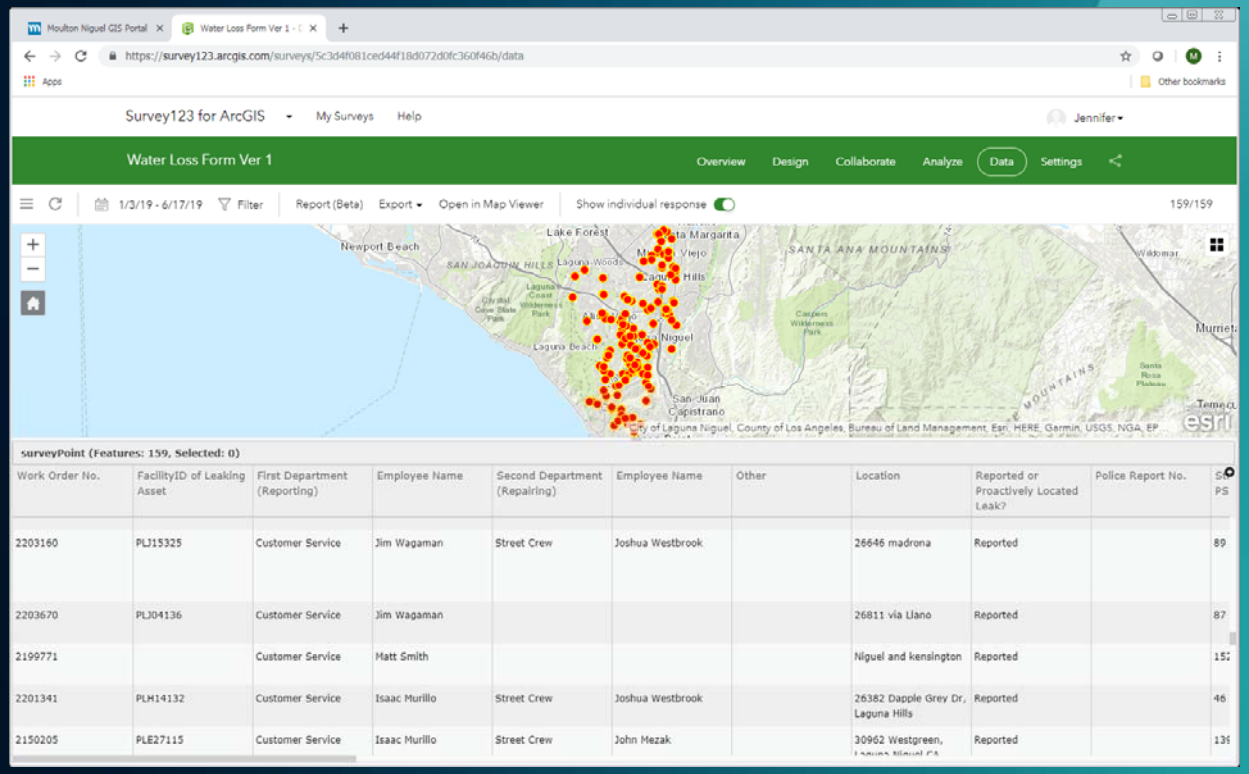
- GraniteNet for CCTV Inspections

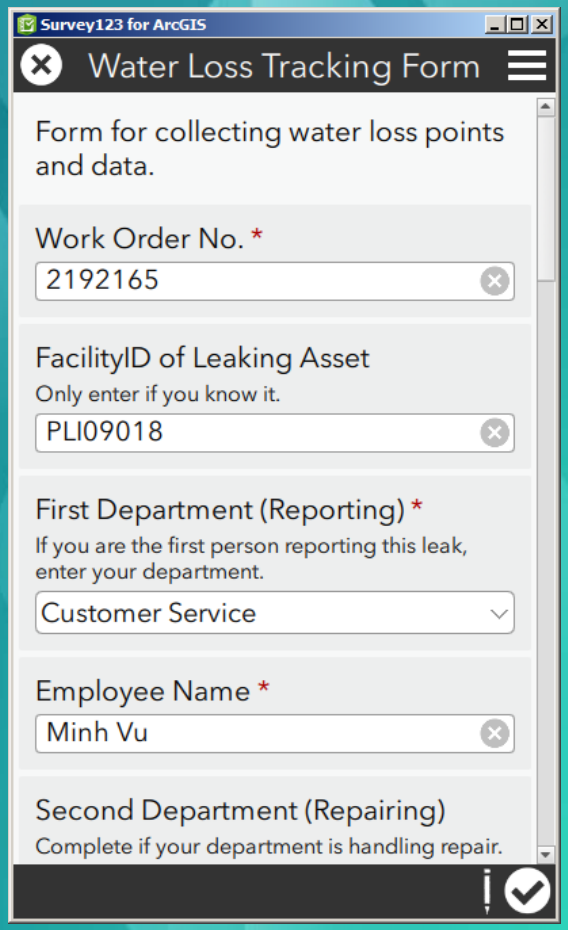
  Condition assessment via observations



# Current Applications at MNWD

- Survey123 for Water Loss Reporting



# Fundamental Goals:

- To make decisions based on insights derived from authoritative, vetted data particularly regarding repair, rehabilitation, and replacement of assets.
- First asset type – Mainlines

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# Initial Projects – 2017 Mainline Prioritizations

- Engaged Hazen & Sawyer in early 2017 to generate guidance document for the prioritization of rehabilitation and replacement of wastewater mains
- Purpose: use project as a template for R&R efforts for other asset types
- Methodology:
  - Hazen devised method to calculate Probability of Failure, Consequence of Failure, resulting overall Business Risk Exposure (BRE)
  - Mains were then ranked by BRE, highlighting pipes that need to be addressed first
- In Fall 2017, MNWD staff used structure and lessons learned in wastewater project to prioritize potable and recycled mainlines

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# Business Risk Exposure (BRE) =

Probability of Failure (PoF)

x

Consequence of Failure (CoF)

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* Photos NOT courtesy of MNWD

# Business Risk Exposure (BRE)

- PoF and CoF operate independently of each other.

| Probability of Failure (% of useful life expended) | Negligible | Low | Medium | High |
|---|---|---|---|---|
| High (>80%) | PoF: High<br>CoF: Negligible | PoF: High<br>CoF: Low | PoF: High<br>CoF: Medium | PoF: High<br>CoF: High |
| Medium (61-80%) | PoF: Medium<br>CoF: Negligible | PoF: Medium<br>CoF: Low | PoF: Medium<br>CoF: Medium | PoF: Medium<br>CoF: High |
| Low (46-60%) | PoF: Low<br>CoF: Negligible | PoF: Low<br>CoF: Low | PoF: Low<br>CoF: Medium | PoF: Low<br>CoF: High |
| Negligible (<45%) | PoF: Negligible<br>CoF: Negligible | PoF: Negligible<br>CoF: Low | PoF: Negligible<br>CoF: Medium | PoF: Negligible<br>CoF: High |

Consequence of Failure

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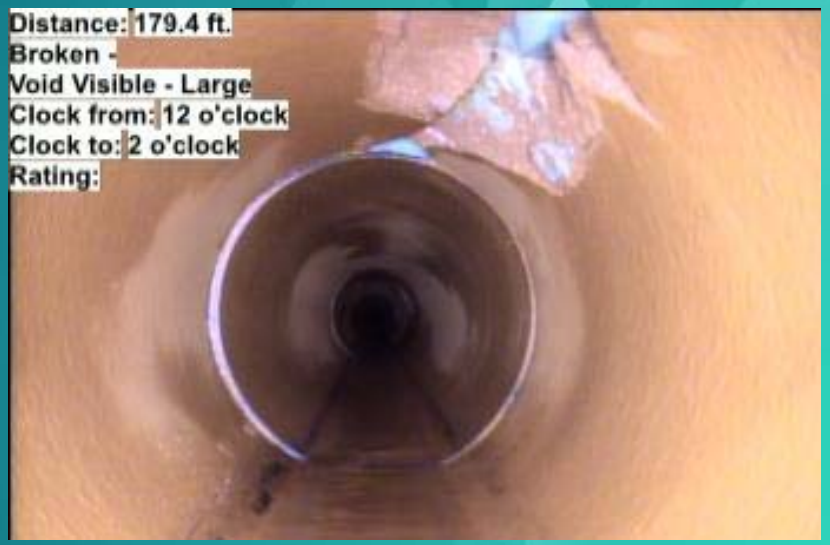
# Probability of Failure - PoF

- PoF is expressed as a percentage of useful life expended.
  - It is NOT a prediction of when a pipe will fail; it is a tool to approximate where assets are in their lifecycle.
  - A score of .60 means *"This pipe has expended 60% of its useful life."*

- Currently, PoF is primarily based on age / material type, but can be modified by other factors such as:
  - Leak history
  - Corrosive soil conditions
  - Observed defects → →

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# Probability of Failure (PoF) – How is it calculated?

- Age / Material Type-Based PoF
  - Age-based PoF percentage calculated by dividing age of pipe by corresponding useful life depending on material type.

    Example: 60 year-old VCP pipe with a useful life of 80 years

    = 75% consumed - *(60/80 = .75)*

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# Probability of Failure (PoF) – How is it calculated?

- Additional Factors – accounted for by increasing aged-based PoF by a multiplier. The effect is that % of useful life consumed is increased.
  - Example: A 240 ft-long 30-year-old CML&C steel pipe with a useful life of 65 years has one recorded leak.
    - Age based PoF = 46% consumed *(30/65 = .46)*
    - Multiplier for one leak for pipes <250 ft = 1.3
    - Overall PoF is then 46% * 1.3 = 60%

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# Consequence of Failure - CoF

- CoF – is the outcome of an asset failure expressed either qualitatively or quantitatively…AKA “If this pipe does fail, what are the ramifications?”
  - Example: Line break in a commercial area would have a higher CoF than one in an open space area.
- Often referred to in terms of “triple bottom line” factors of financial, social, and environmental impacts.

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# Consequence of Failure (CoF) Criteria:

- Each pipe is scored on a scale of 1-5 for the following factors, (score of 5 being most serious):
  - Flow
  - Land Use
  - Capital Cost
  - Public Impact
  - Proximity to Water Bodies
  - Proximity to Major Intersections
  - Proximity to Major Utilities
  - Pressure – potable and recycled only
  - Number of Services Out of Water – potable and recycled only
  - Number of Hydrants Out of Water – potable only

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# Consequence of Failure (CoF) Criteria Weighting:

| Factor | PW | RW | WW |
|---|---|---|---|
| Flow | 15 | 19 | 25 |
| Land Use | 10 | 19 | 19 |
| Public Impact | 15 | 19 | 19 |
| Proximity to Water Bodies | 1 | 10 | 19 |
| Accessibility | 5 | 5 | 5 |
| Capital Cost | 4 | 5 | 10 |
| Proximity to Major Utilities | 5 | 5 | 3 |
| No of Services Out of Water | 25 | 15 | - |
| No of Hydrants Out of Water | 17 | 0 | - |
| Pressure | 3 | 3 | - |
| Total | 100 | 100 | 100 |

Overall CoF for each segment is calculated based on sum of weighted average of CoF factor scores.

Ex: (3*0.15)+(4*0.1)+(4*0.15)+(1*0.01)+(1*0.05)+(1*0.04)+(2*0.05)+(1*0.03)+(3*0.03) = 1.77

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# Bringing it All Together—How BRE is Calculated:

PoF (percentage) x CoF (sum of weighted factors on 1-5 scale) = Overall BRE

Examples:

| PoF | | CoF | | BRE |
|---|---|---|---|---|
| | | | | |
| 50% | x | 2.5 | = | 1.25 |
| 70% | x | 1.5 | = | 1.05 |
| 30% | x | 3 | = | 0.9 |
| 50% | x | 4 | = | 2 |
| 80% | x | 4 | = | 3.2 |

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# How BRE is Categorized:

PoF (percentage) x CoF (sum of weighted factors on 1-5 scale) = Overall BRE

Overall Business Risk Exposure (BRE):

High: >2.8

Medium: 1.5-2.8

Low: <1.5

| | A | Q | R | AE | AF | AG | AH | AI |
|---|---|---|---|---|---|---|---|---|
| 1 | FacilityID | FinalPoF | PoFLevel | FinalCoF | CoFLevel | RiskMatrix | BREScore | BRELevel |
| 8486 | PPE21009 | 55% | Low PoF | 2.41 | Low CoF | 5-2 | 1.32 | Low Risk |
| 8487 | PPE21010 | 48% | Low PoF | 2.25 | Low CoF | 5-2 | 1.09 | Low Risk |
| 8488 | PPE21011 | 55% | Low PoF | 1.75 | Negligible CoF | 5-2 | 0.96 | Low Risk |
| 8489 | PPE21013 | 78% | Medium PoF | 1.81 | Negligible CoF | 8-2 | 1.42 | Low Risk |
| 8490 | PPE21014 | 82% | High PoF | 1.89 | Negligible CoF | 8-2 | 1.56 | Medium Risk |
| 8491 | PPE21015 | 50% | Low PoF | 1.93 | Negligible CoF | 5-2 | 0.97 | Low Risk |
| 8492 | PPE21016 | 48% | Low PoF | 2.45 | Low CoF | 5-2 | 1.19 | Low Risk |
| 8493 | PPE21017 | 82% | High PoF | 2.09 | Low CoF | 8-2 | 1.72 | Medium Risk |
| 8494 | PPE21018 | 50% | Low PoF | 1.89 | Negligible CoF | 5-2 | 0.95 | Low Risk |
| 8495 | PPE21019 | 50% | Low PoF | 1.26 | Negligible CoF | 5-1 | 0.63 | Low Risk |
| 8496 | PPE21020 | 50% | Low PoF | 1.87 | Negligible CoF | 5-2 | 0.94 | Low Risk |
| 8497 | PPE21021 | 46% | Low PoF | 2.55 | Medium CoF | 5-3 | 1.18 | Low Risk |
| 8498 | PPE21022 | 78% | Medium PoF | 2.15 | Low CoF | 8-2 | 1.69 | Medium Risk |
| 8499 | PPE21023 | 63% | Medium PoF | 1.66 | Negligible CoF | 6-2 | 1.04 | Low Risk |
| 8500 | PPE21024 | 63% | Medium PoF | 1.66 | Negligible CoF | 6-2 | 1.04 | Low Risk |
| 8501 | PPE21025 | 63% | Medium PoF | 1.66 | Negligible CoF | 6-2 | 1.04 | Low Risk |

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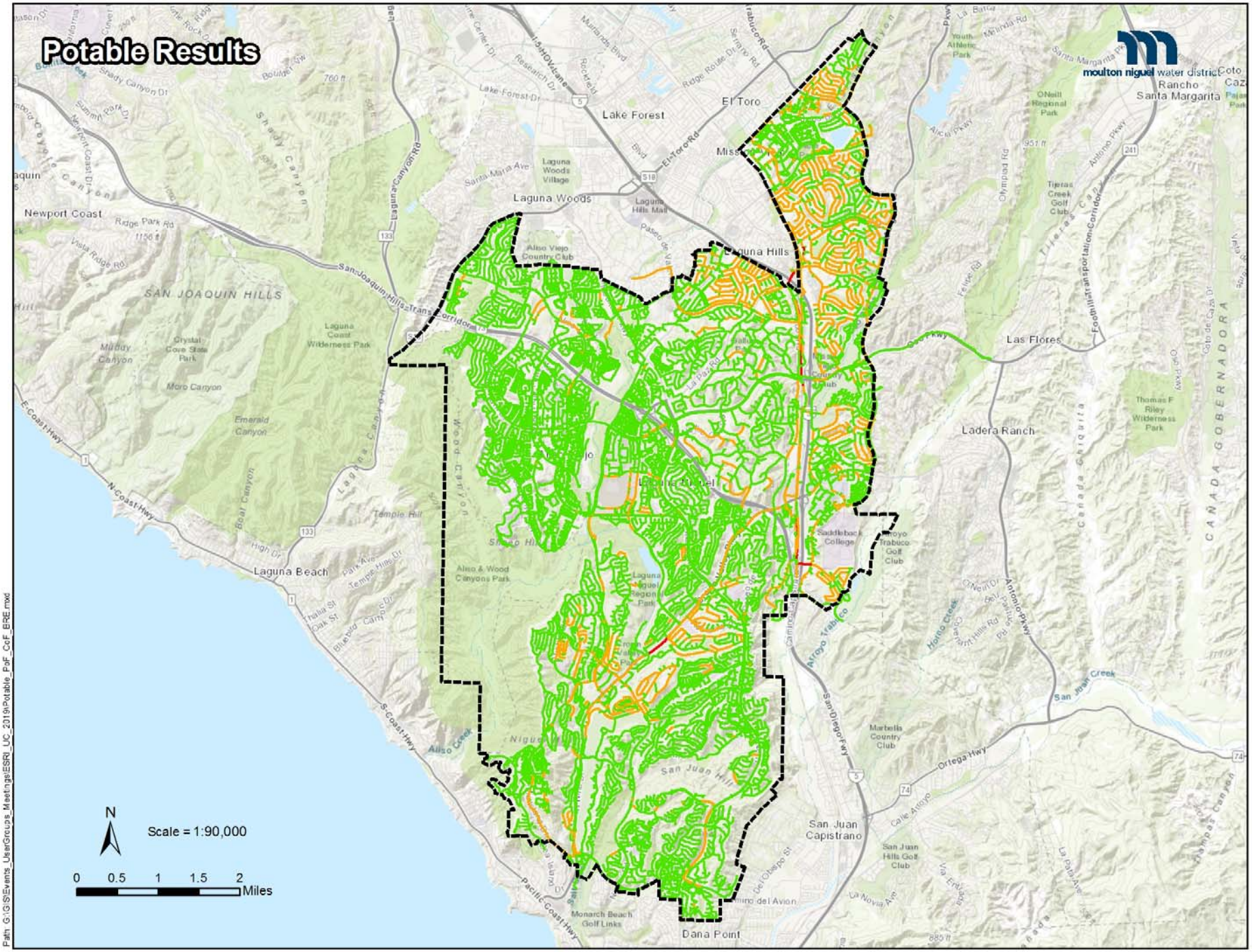
# Potable Results

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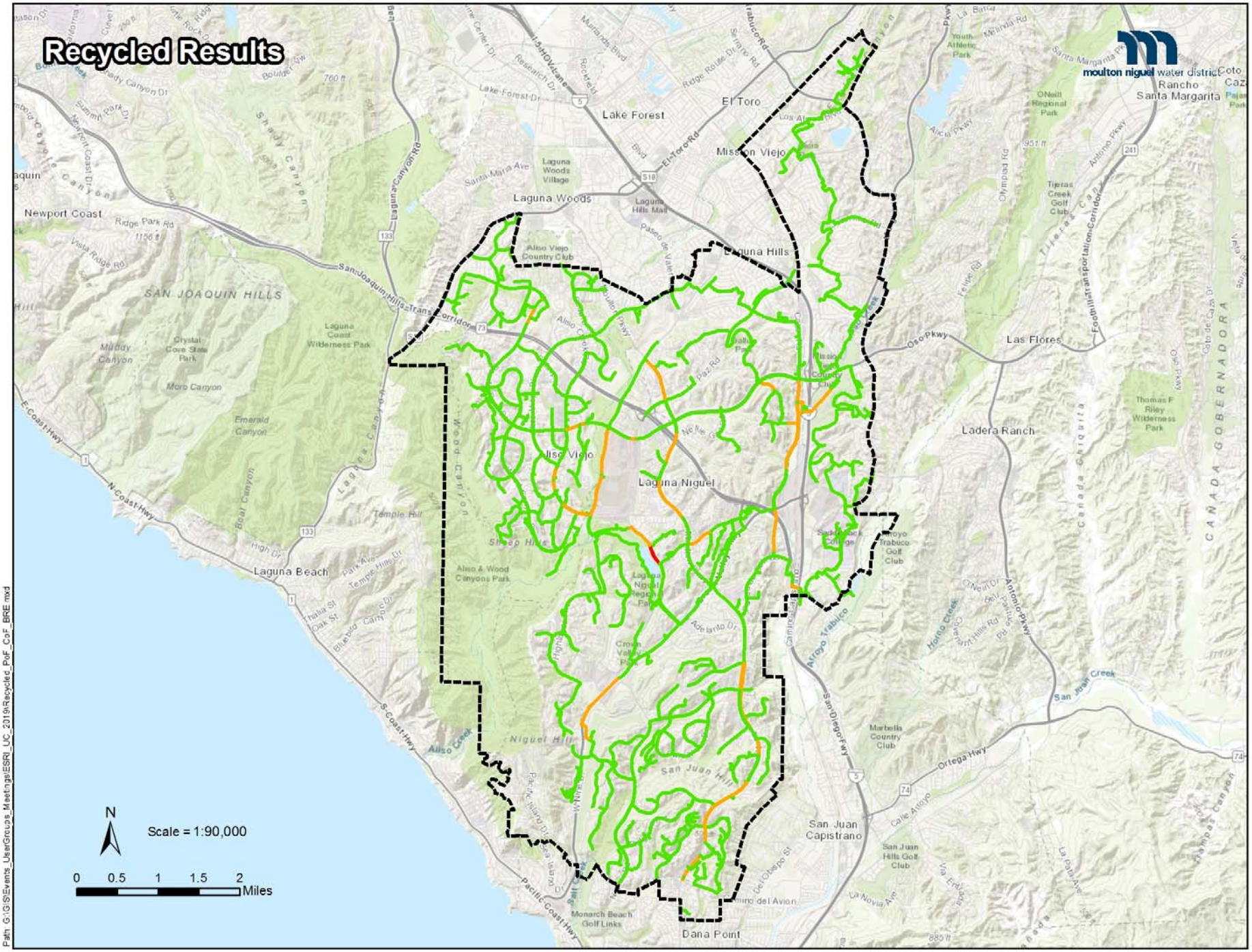
# Recycled Results

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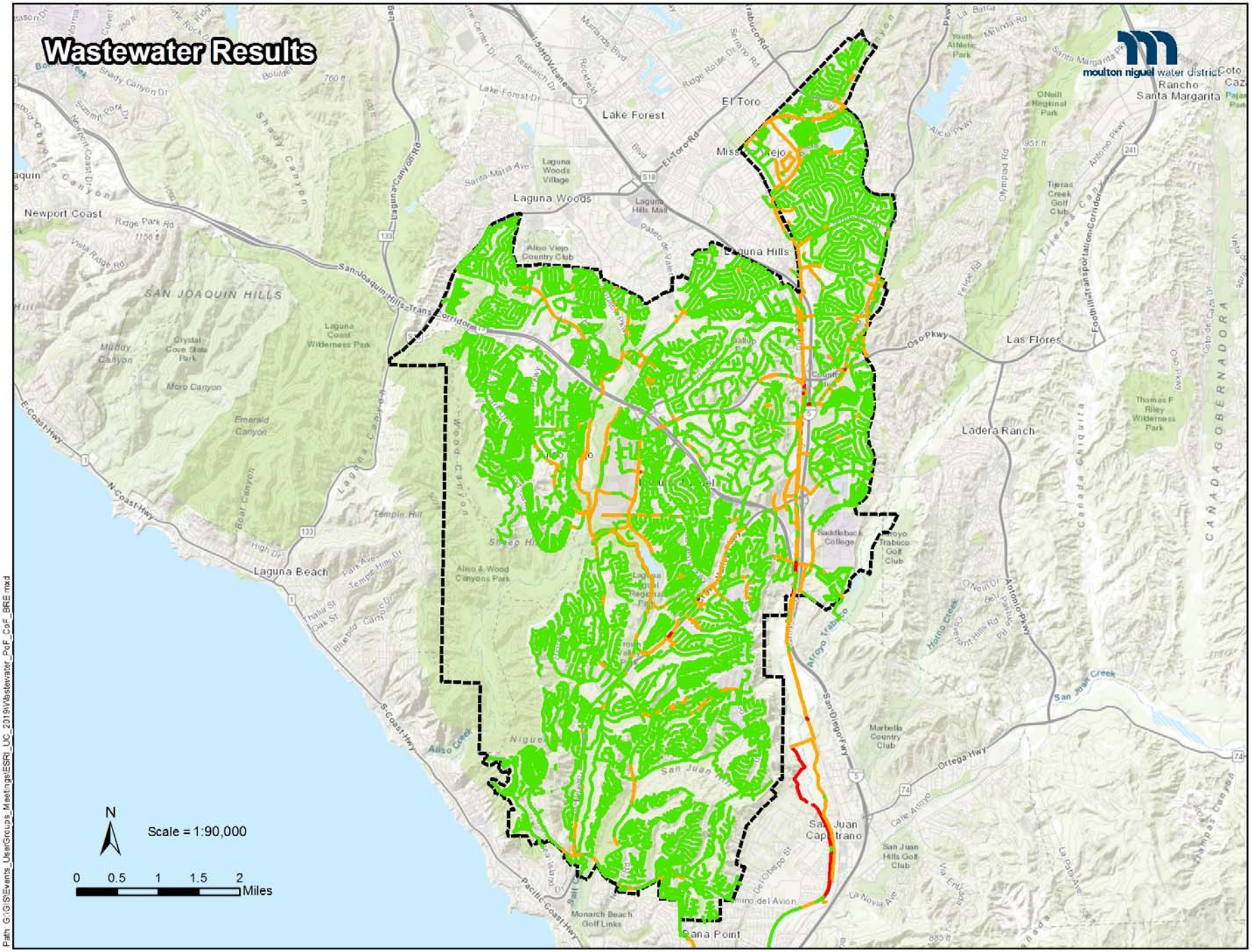
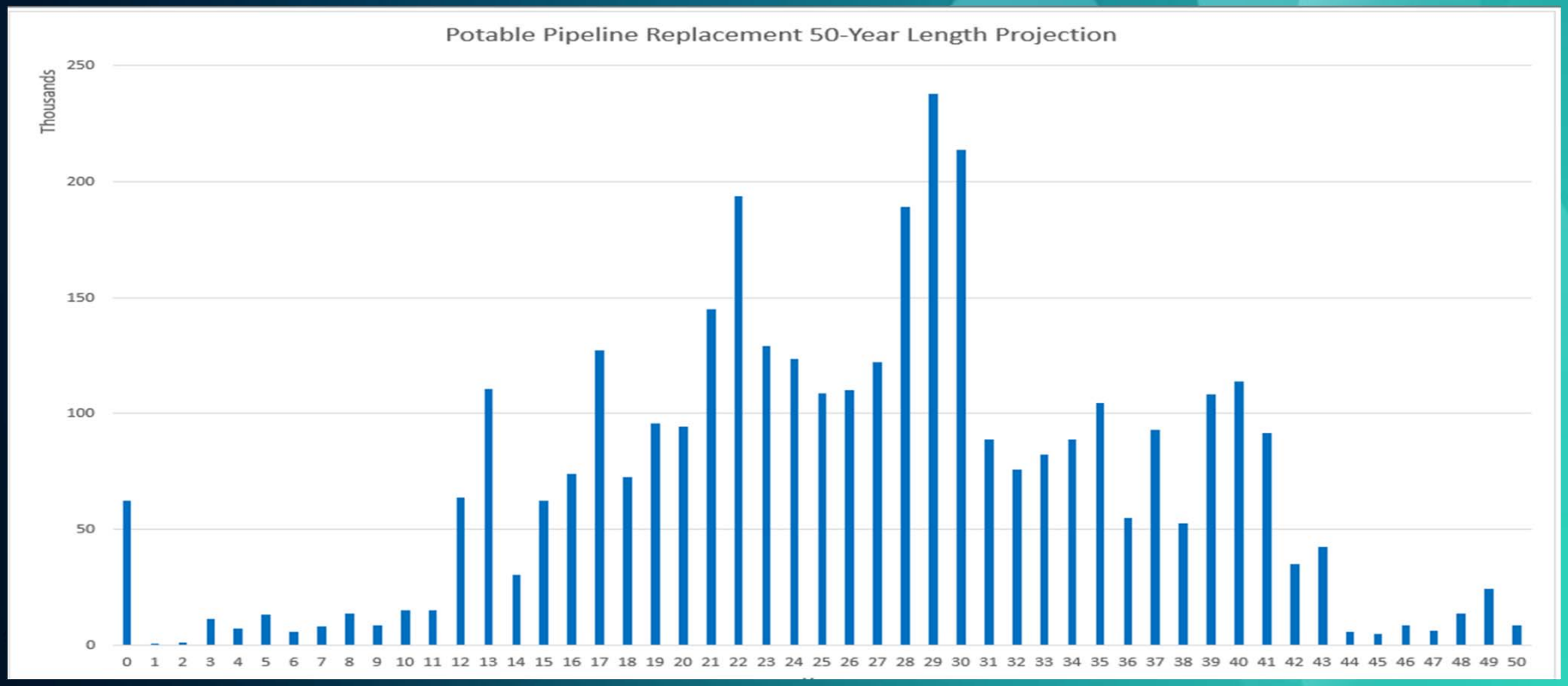
# Wastewater Results



# How This Project Has Benefitted MNWD:

- Have been able to forecast capital budgets based on overall risk score, helping us to plan pipe rehab and replacement at optimal times
  - Run to end of useful life when appropriate
  - Replace earlier when CoF dictates



# How This Project Has Benefitted MNWD:

- Identified projects for sewer lining
  - Queried certain defects, then sorted by BRE
    - Broken, void visible
    - Severe infiltration

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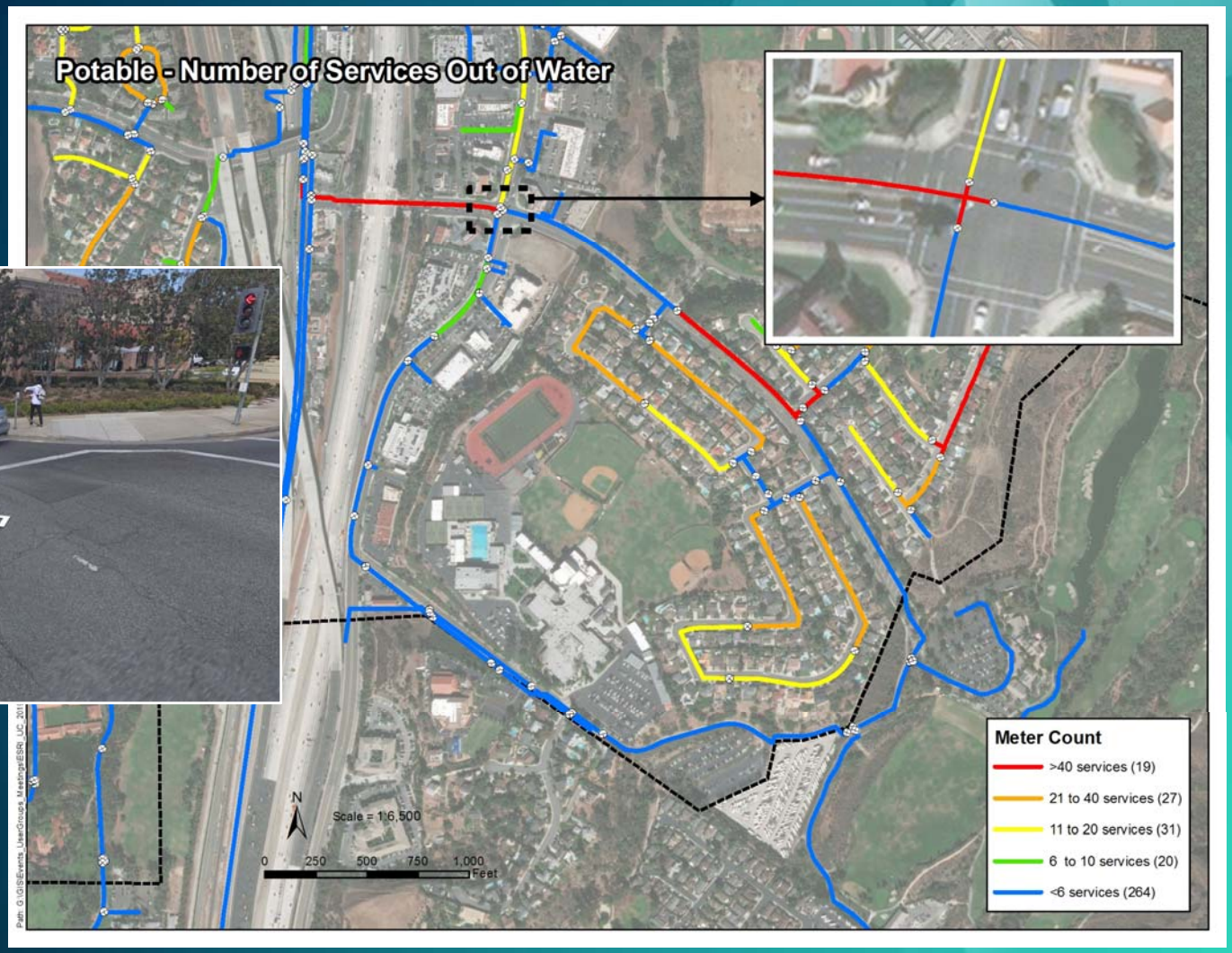
# How This Project Has Benefitted MNWD:

- Identified vulnerable areas in the event of line breaks

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# How This Project Has Benefitted MNWD:

- Collaboration between departments, leverage institutional knowledge

# Lessons Learned:

- Good data enables good decisions
- Input from Operations is critical and leads to better outcomes
- Asset management isn't insurmountable…you can accomplish a lot using ESRI tools, commonly-used software, and solid data

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# Next Steps:

- Add additional factors and adjust weighting
- Include more types of critical facilities
- Automate more of the project via models and scripts, especially geoprocessing components
- Look to incorporate new types of condition assessment data from new CMMS

ModelBuilder

python™

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