# MONETIZING AND SPATIALLY REPRESENTING THE IMPACT OF FAILING WATER MAIN INFRASTRUCTURE

***Wednesday, April 25th***
***2:15pm – 2:45pm***
***Room #317***


Presented By:

Andy Simpson
Keith Burdette


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# INTRODUCTION


- What is the TW Economic Model?
- GIS Analysis Inputs
- Automated Data Analysis using ESRI Model Builder
- GIS Model Outputs and their visualization
- Multiple Asset Decision Module

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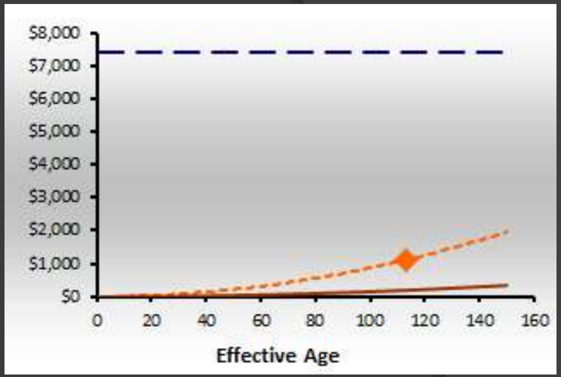
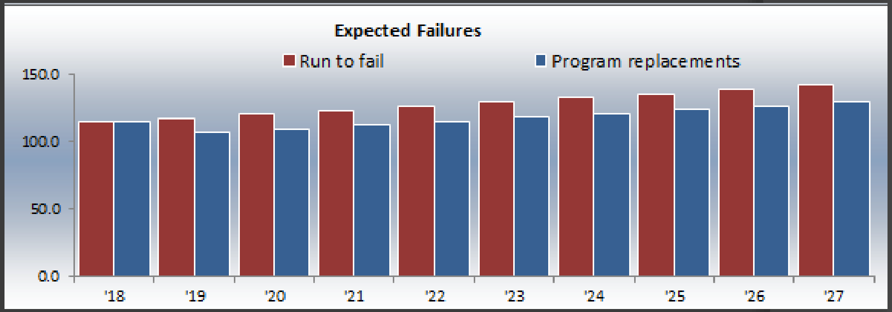
# WHAT IS THE TACOMA WATER ECONOMIC MODEL?




- Conceptually, it's a planning tool that helps Tacoma Water System Engineers and Planners to make better more informed decisions when deciding:
    - When is the best time to replace an Asset?
    - How an Asset is replaced?
    - Where the Asset is replaced?
- Known Asset Characteristics Are Evaluated Such As:
    - Age of the Asset
    - Pavement Type
    - Location in the System
    - Size
    - Soil Conditions
    - Length
    - Services Impacted
    - Many Other Attributes




- Each Asset Is Examined and Scored Based on a Complex Set of Parameters
- Spatially Represent Potential Future Infrastructure Failures and the Costs associated with those failures
- Ultimately, this tool helps us build a better Construction Improvement Programs or CIPs

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# WHAT IS THE TACOMA WATER ECONOMIC MODEL?

More Specifically:

- The model itself is an Excel based tool comprised of 2 workbooks
- First Workbook Interacts with Tacoma Water's GIS through a series of spatial questions and creates a profile for each asset
- Second Workbook, called the Multiple Asset Decision Module or MAD Module Allows end users to evaluate optimal replacement timing for a group of specific main segments into a Project
- GIS Analysis + Unique Project Parameters = Economic Modeled Project Results
- End User can make adjustments to the input parameters for specific circumstances that are unique to individual projects
- Publish the Project Results to the GIS System

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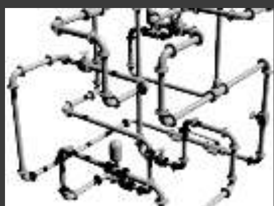
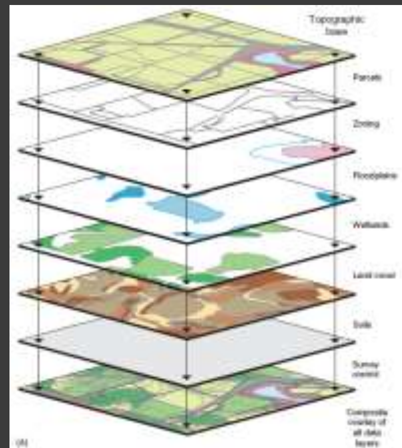
# WHAT IS THE TACOMA WATER ECONOMIC MODEL?

**Geodatabase**

GIS Pipe Network Dataset



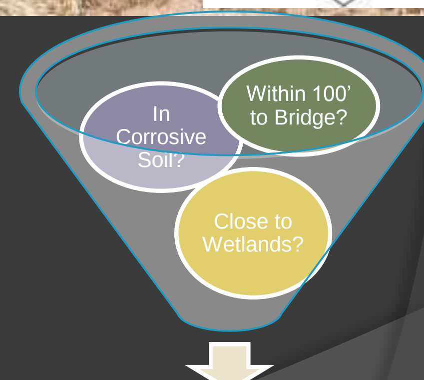



For Each Pipe:

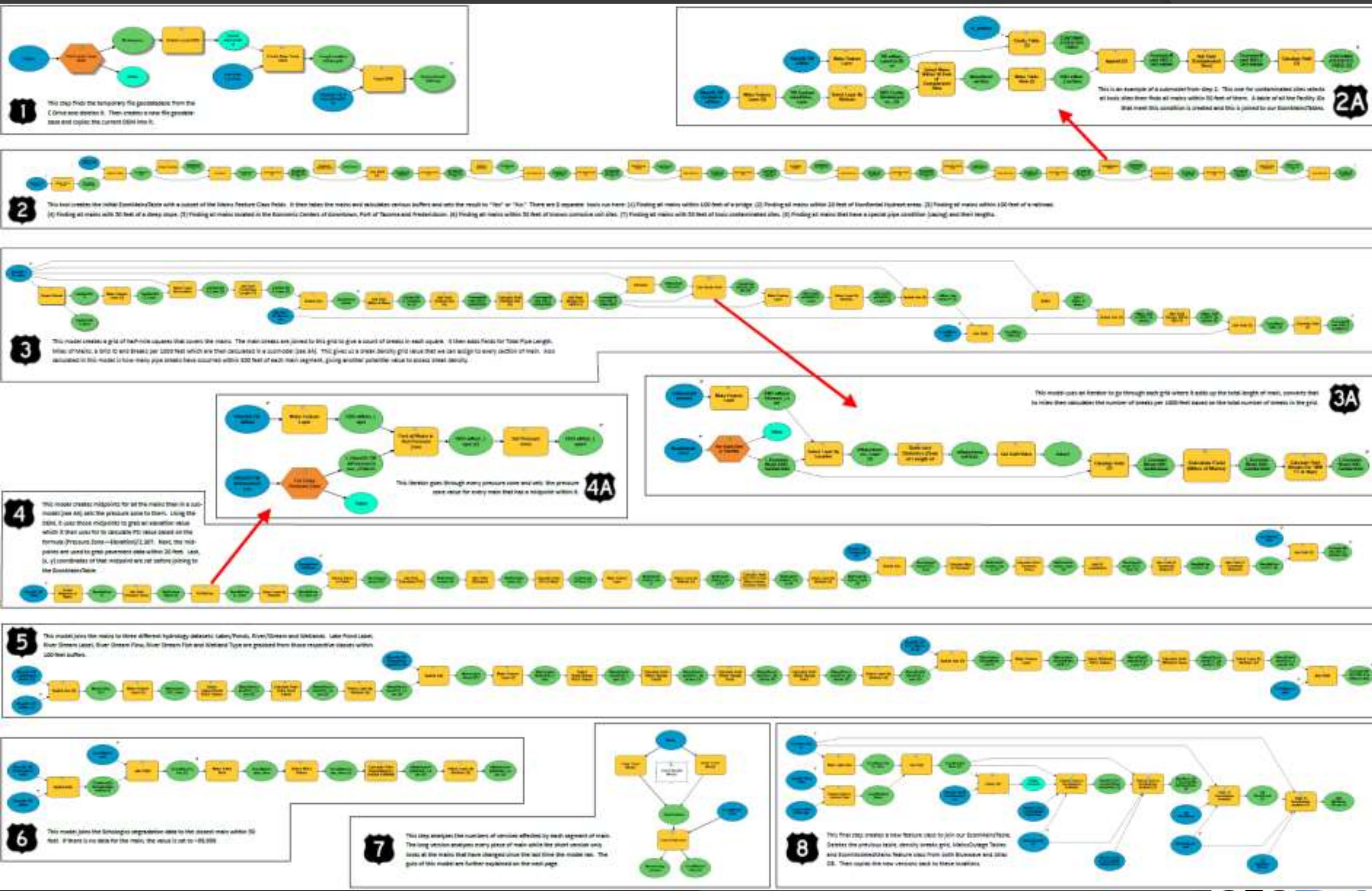
- -Install Date
- -Material
- -Size
- -Length
- -Geometry

?

**Economic Model**




# GIS ANALYSIS WITH ESRI MODEL BUILDER

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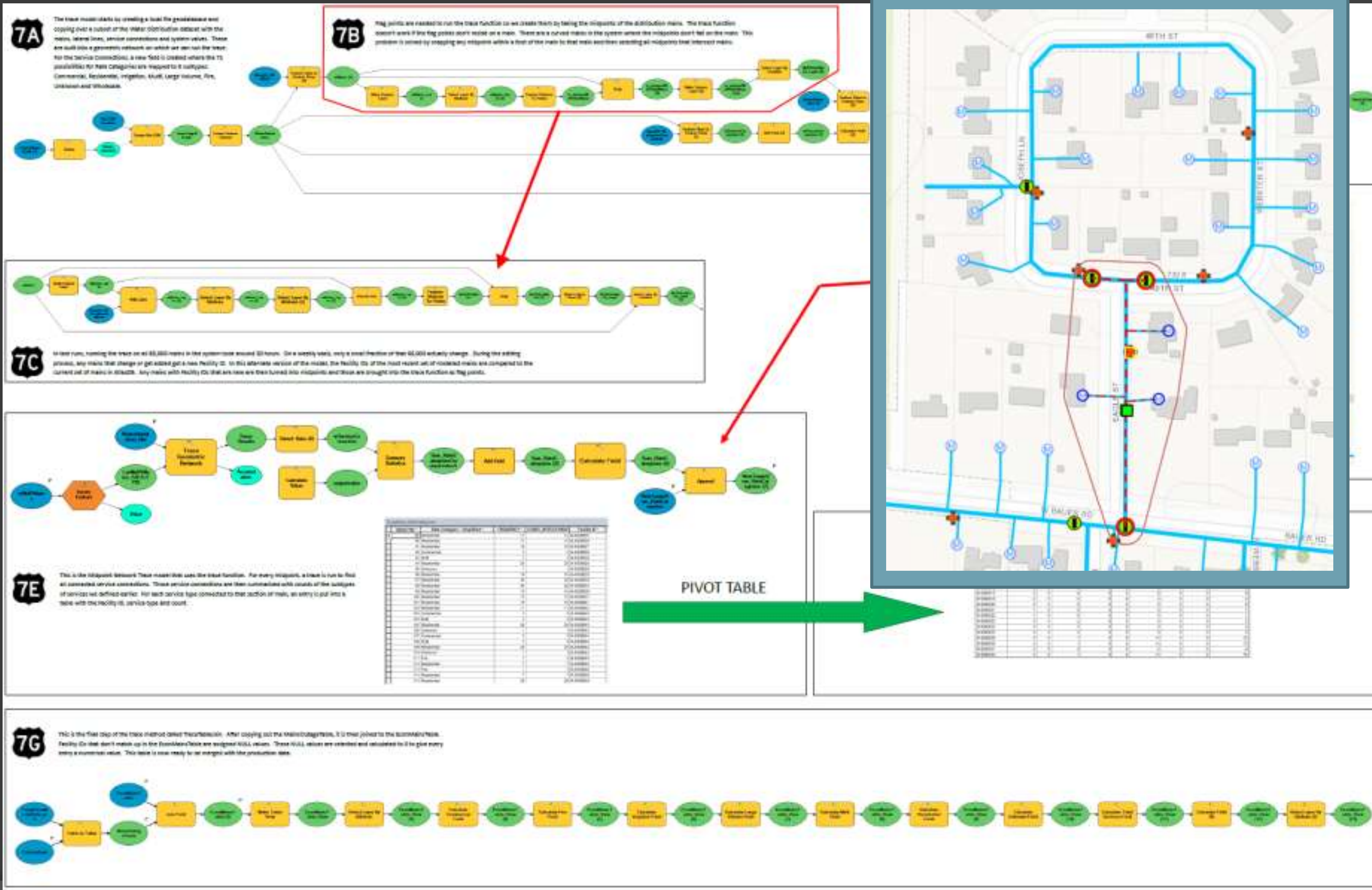
# GIS ANALYSIS SERVICE IMPACT COUNT




## Network Trace

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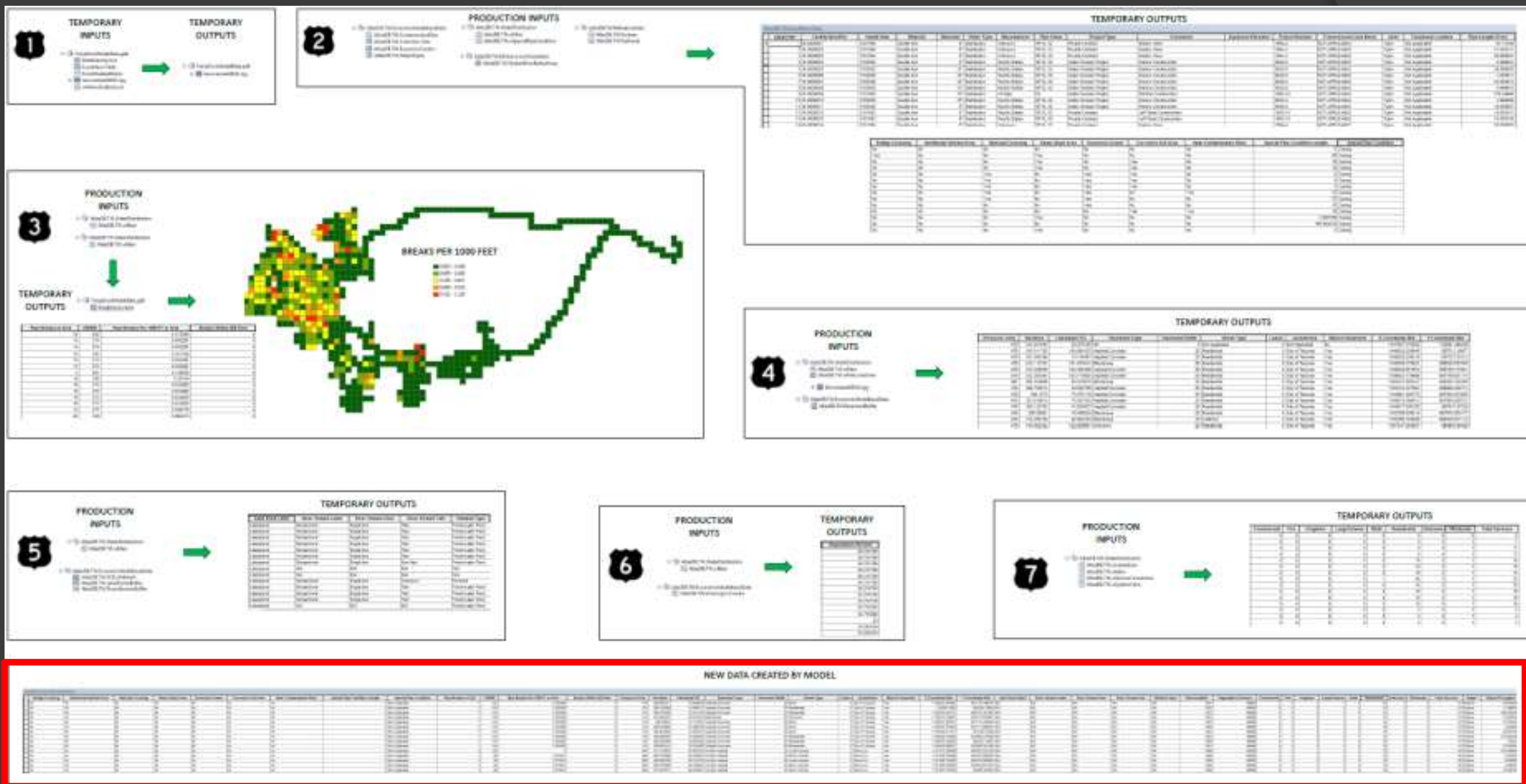
# GIS ANALYSIS INPUTS AND OUTPUTS

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# SPATIAL ANALYSIS RESULTS IN EXCEL

- Each main segment is analyzed based on the answers to our spatial questions
- Assumptions based on material, age and other risk factors determine the failure probability
- 3 levels of failure analyzed and weighted to create a consequence cost
- Replacement cost with and without pavement restoration
- All values collected together to be exported back to GIS

## DISTRIBUTION MAINS

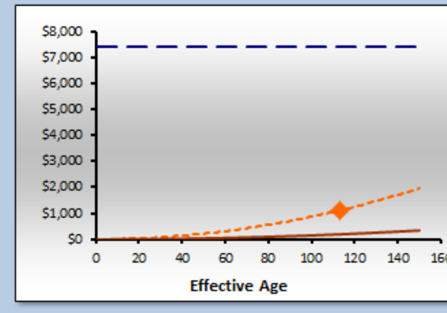
SAVE ASSET TO MAD | RELOAD ASSET

| DEMOGRAPHICS | |
|---|---|
| Asset ID | M-0099801 |
| Pipe diameter | 12 |
| Existing material code | CIP |
| Pipe length (ft) | 730 |
| Installation year | 1905 |
| Transmission Main Name | NA |
| Project Type | UNK |
| Project ID | Unknown |
| Pipe class | UNK |
| Approximate Location | BlueWave Link |
| Pressure Zone | 478 |
| Calculated Static Pressure | 52.55210291 |
| Jurisdiction | City of Tacoma |
| Road type | Collector |
| Pavement type | Portland Cement Concrete |
| Effective age (yrs) | 113 |

| INTERVENTIONS | |
|---|---|
| Existing material | CI OLD |
| Replacement type | DI |
| Replacement cost, base | $268,800 |
| Pavement Restoration | $102,247 |
| Replacement cost, total | $371,047 |

| ADDITIONAL DEMOGRAPHICS | |
|---|---|
| Joint type | Lead |
| SAP ID | NA |
| Zoning code | UP |
| Economic Center (if applicable?) | No |
| Estimated Install Year | |
| Manufacturer | UNK |
| Installation Contractor | UNK |
| In Pavement? | Yes |
| Pavement Width | 28 |
| Zoning description | |

| CRITICAL AREAS | |
|---|---|
| Bridge crossing | No |
| Highway crossing | No |
| Railroad crossing | No |
| Stream crossing | No |
| Wetland crossing | No |
| Contaminated soils | Yes |
| Corrosive Soils | No |
| Environmental issues | |
| Erosion | |
| Steep Slope | No |
| Hydrant Non-Rental | No |
| Property Damage | |




| RESULTS | |
|---|---|
| Age at replacement | 200 |
| Years To replacement | 87 |
| Year of replacement | 2105 |
| Benefit/cost ratio | 0.00 |
| Lifecycle cost of new asset | $7,419 |
| Net benefit of replacement | -$236,049 |
| Assumed data? | No |
| Lifecycle of new asset | 200 |

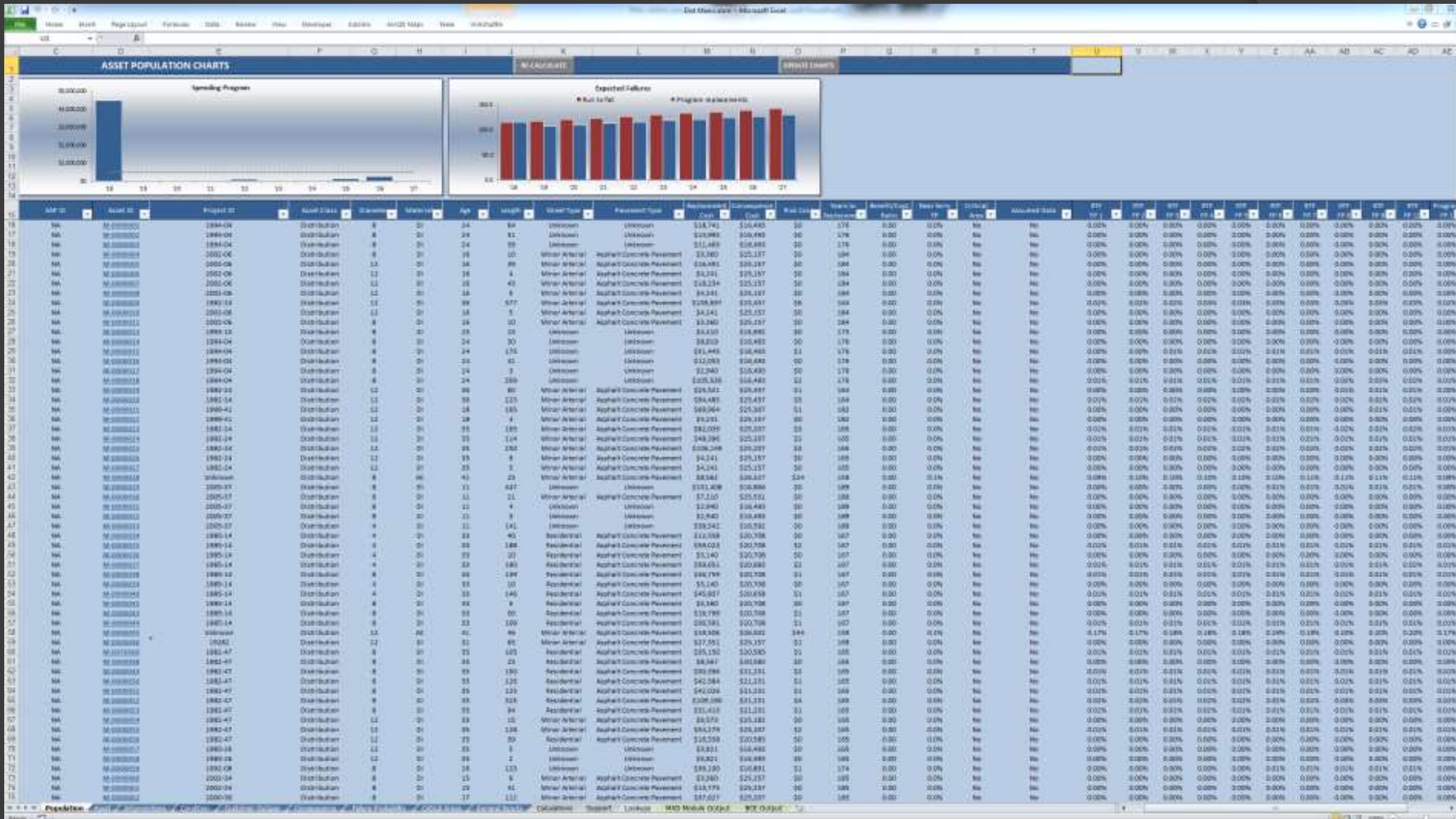
| PROBABILITY OF FAILURE | |
|---|---|
| Breaks by project 1000' | 0.18930192 |
| Degradation Percent (Condition Assessment) | -99999.00 |
| Corrosive Soils | No |
| Abnormal breaks per 1000' | Yes |
| Existing multiplier | 1.75 |
| Replacement multiplier | 0.73 |
| Probability of failure | 1.99% |

| CONSEQUENCE OF FAILURE EXISTING | |
|---|---|
| Services Affected | 22 |
| Services Cost Per Hour | $644.28 |
| Minor leak or break | $33,829 |
| Major leak or break | $16,355 |
| Catastrophic break | $5,731 |
| Consequence of failure | $55,915 |

| RISK COST | |
|---|---|
| Near-term Risk | $1,112 |

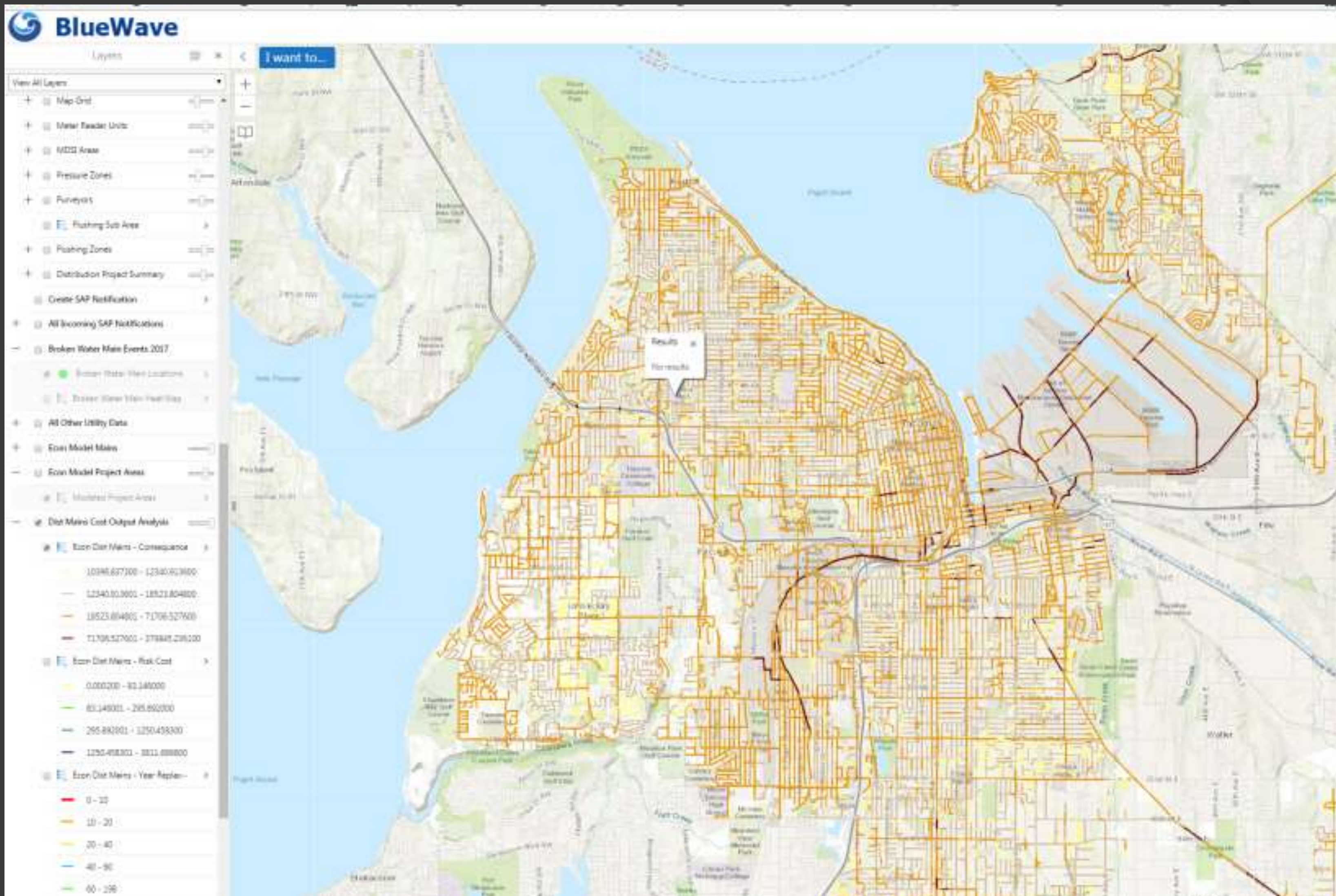
| DATA SUPPORT | |
|---|---|
| Location | |
| C FID | M-0010884 |
| Jurisdiction | City of Tacoma |
| Pavement Type | Portland Cement Concrete |
| Road Type | Collector |
| Number of Street Lanes | 2 |

# MODELED MAINS IMPORTED INTO EXCEL




- Costs for each main segment calculated and exported back to GIS

# MODELED MAINS DISPLAYED ON THE MAP

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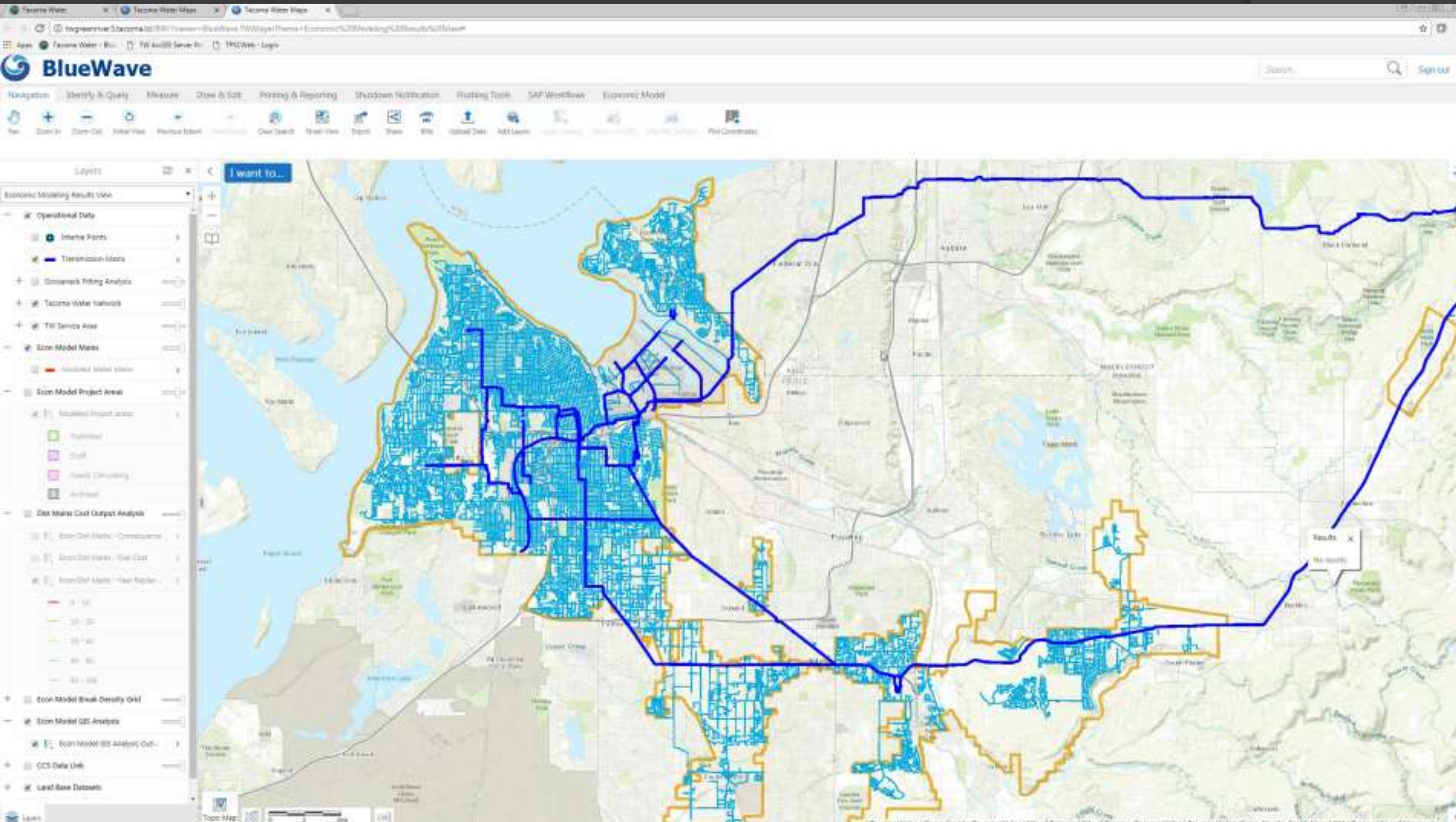
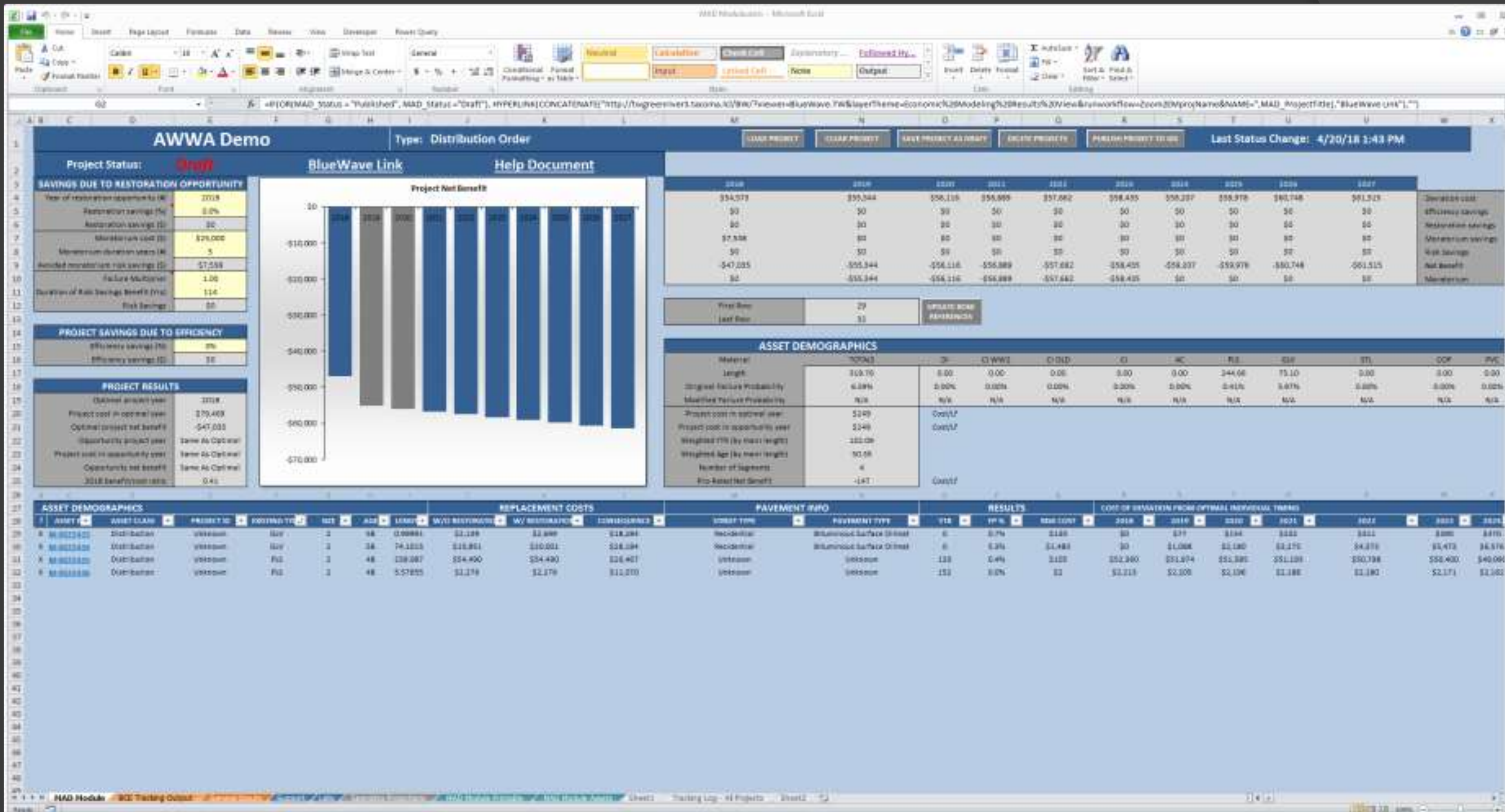
# ECONOMIC MODEL MAP DEMO



# MAD MODULE – MULTIPLE ASSET DECISION MODEL




- Tool that groups main segments into projects to determine viability

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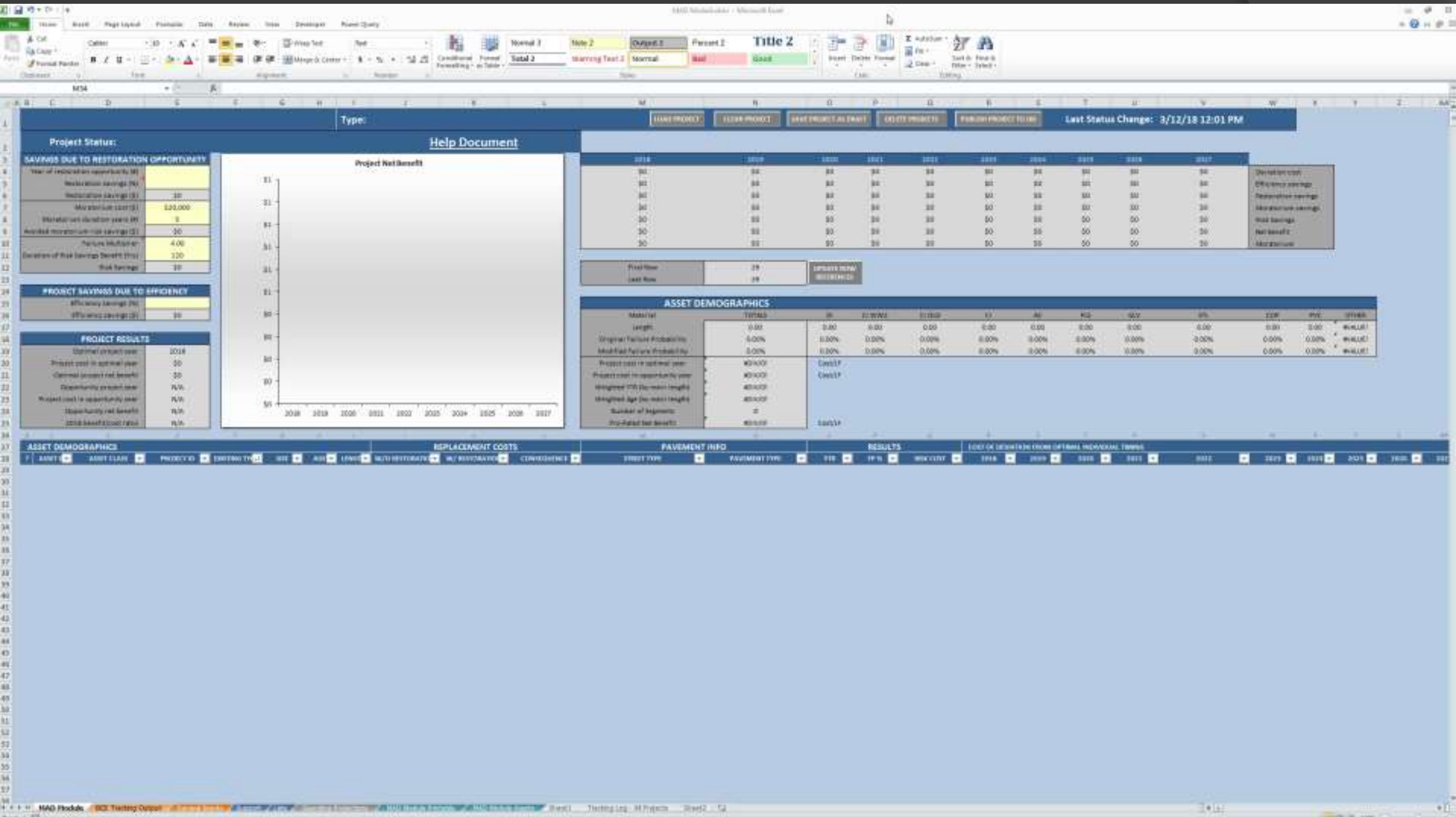
# MAD MODULE DEMO

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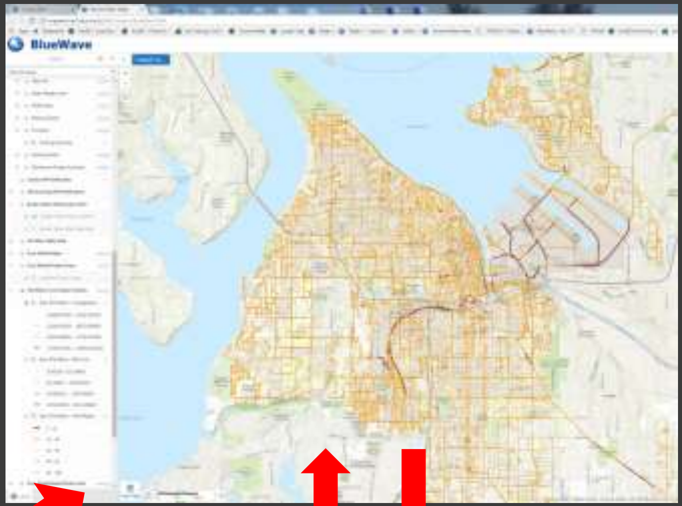
# MAJOR ECONOMIC MODEL COMPONENTS

1) Input GIS Analysis


3) Visualize Potential Asset Failure locations

2) Asset Profile For Each Pipe
- Probability of Failure
- Years To Replacement
- Consequence of Failure Cost
- Other Asset Assumptions

4) User selects mains in the Multiple Asset Decision Module and performs Benefit/Risk/Cost project level analysis that can be published back to the map

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# MORE ON THE ECONOMIC MODEL USAGE AT TACOMA WATER

**Next Session On This Topic:**

*“The Right Money, on the Right Mains, at the Right Time: Tacoma's Strategic Main Replacement Program Through Economic Modeling”*

Presented By: Matt Hubbard

When: Thursday April 26th, 11:00 -11:30am in room #316

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# QUESTIONS?



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