# Water Hammer

## Tackling Transient Events at San Jose Water Company

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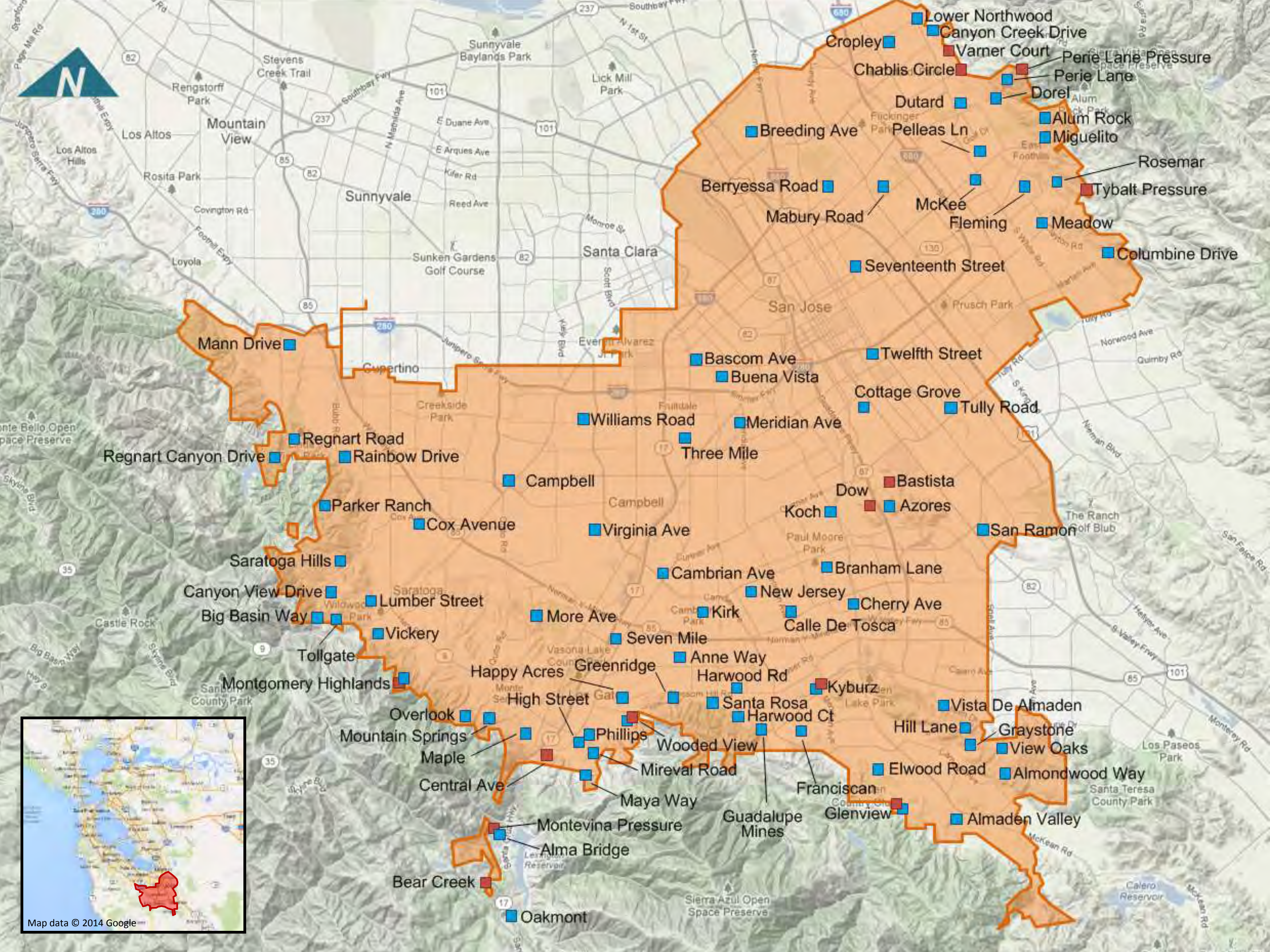


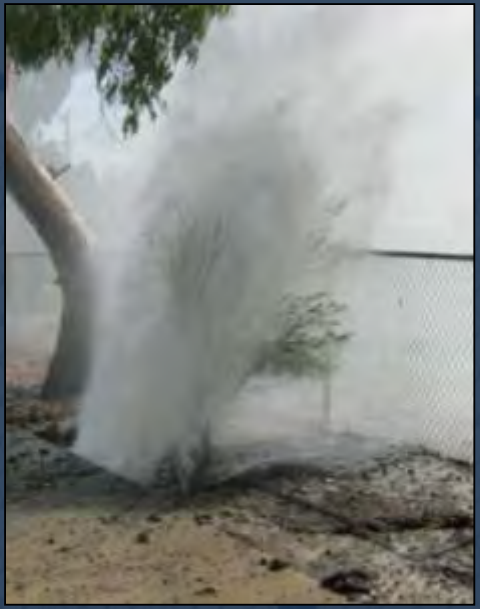
Lower Northwood
Canyon Creek Drive
Cropley
Varner Court
Perie Lane Pressure
Chablis Circle
Perie Lane
Dorel
Dutard
Alum Rock
Breeding Ave
Pelleas Ln
Miguelito
Rosemar
Berryessa Road
Tybalt Pressure
McKee
Mabury Road
Fleming
Meadow
Columbine Drive
Seventeenth Street
Mann Drive
Bascom Ave
Twelfth Street
Buena Vista
Cottage Grove
Tully Road
Williams Road
Meridian Ave
Regnart Road
Three Mile
Regnart Canyon Drive
Rainbow Drive
Campbell
Bastista
Dow
Parker Ranch
Azores
Koch
Cox Avenue
Virginia Ave
San Ramon
Saratoga Hills
Branham Lane
Cambrian Ave
Canyon View Drive
New Jersey
Lumber Street
Cherry Ave
Big Basin Way
Kirk
More Ave
Calle De Tosca
Vickery
Seven Mile
Tollgate
Anne Way
Happy Acres
Greenridge
Harwood Rd
Montgomery Highlands
Kyburz
High Street
Santa Rosa
Vista De Almaden
Overlook
Harwood Ct
Hill Lane
Mountain Springs
Phillips
Graystone
Wooded View
View Oaks
Maple
Mireval Road
Elwood Road
Almondwood Way
Central Ave
Franciscan
Maya Way
Guadalupe Mines
Glenview
Almaden Valley
Montevina Pressure
Alma Bridge
Bear Creek
Oakmont
Map data © 2014 Google

# Introduction

## What is Water Hammer?

Water hammer events (transient events) are disturbances in water flow from one steady-state condition to another.

(adapted from AWWA Manual M32; Mays, Water Resources Engineering 2005 Edition)

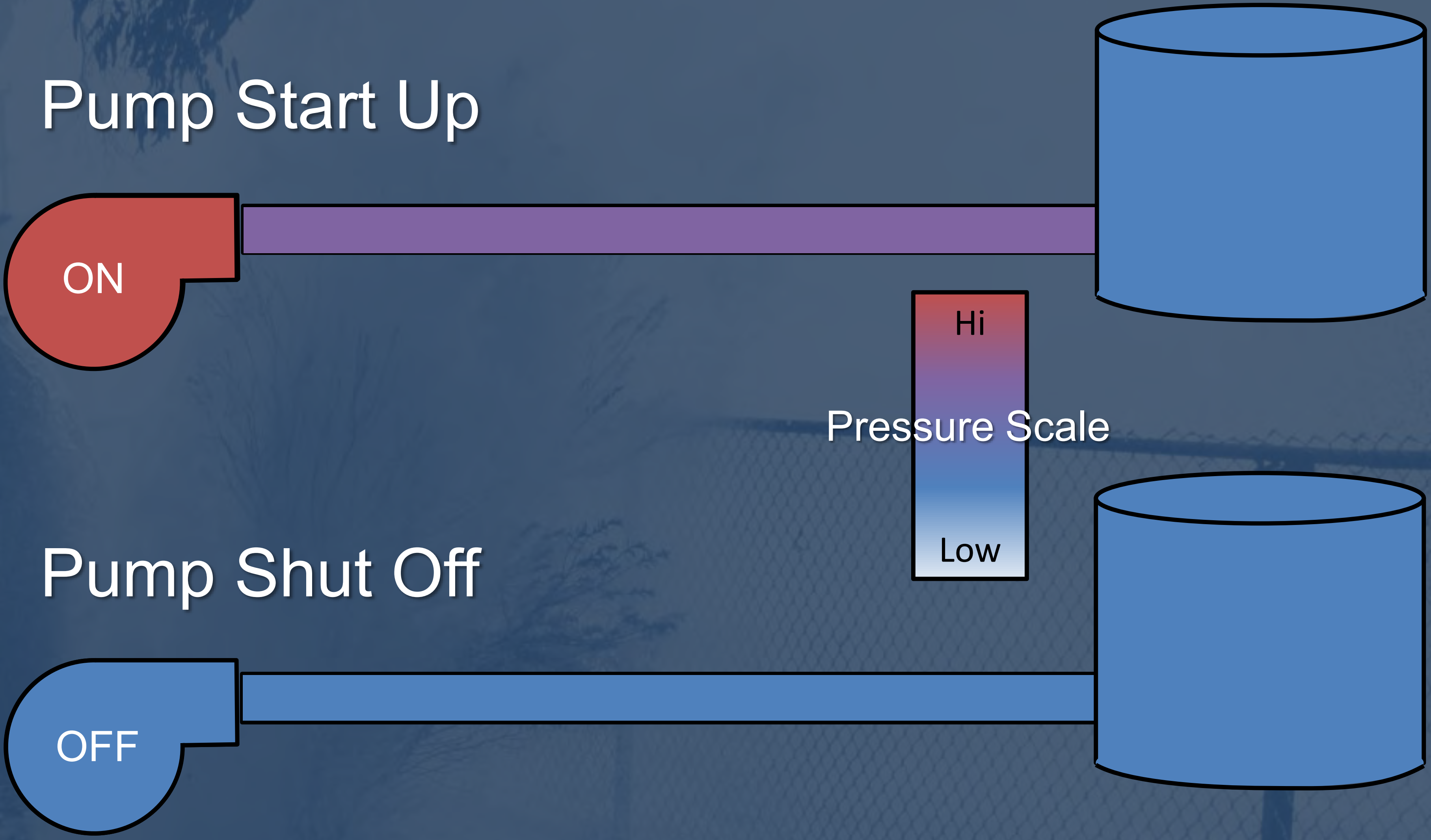


## What are Typical Causes of Water Hammer?

- Pump operations
- Valve operations
- Main breaks
- Rapid demand changes (hydrant flow)

# Wave Propagation Animations

Pump Start Up




Pump Shut Off

# Hydraulic Transient Concerns at SJWC

Hydraulic transient related concerns at SJWC:

- Infrastructure damage
- Property damage
- Regulatory compliance
- Public safety (pipe ruptures)
- Public health (negative pressures)
- Complaints

# Transient Analysis – Goals and Approach

- SJWC Goals
  - Verify existence and extent of problem
  - Determine mitigation measures
- SJWC Approach
  - Obtain necessary knowledge and analysis tools
  - Conduct field tests
  - Analyze data
  - Select surge protection devices

# Transient Analysis – Vickery Pump Station

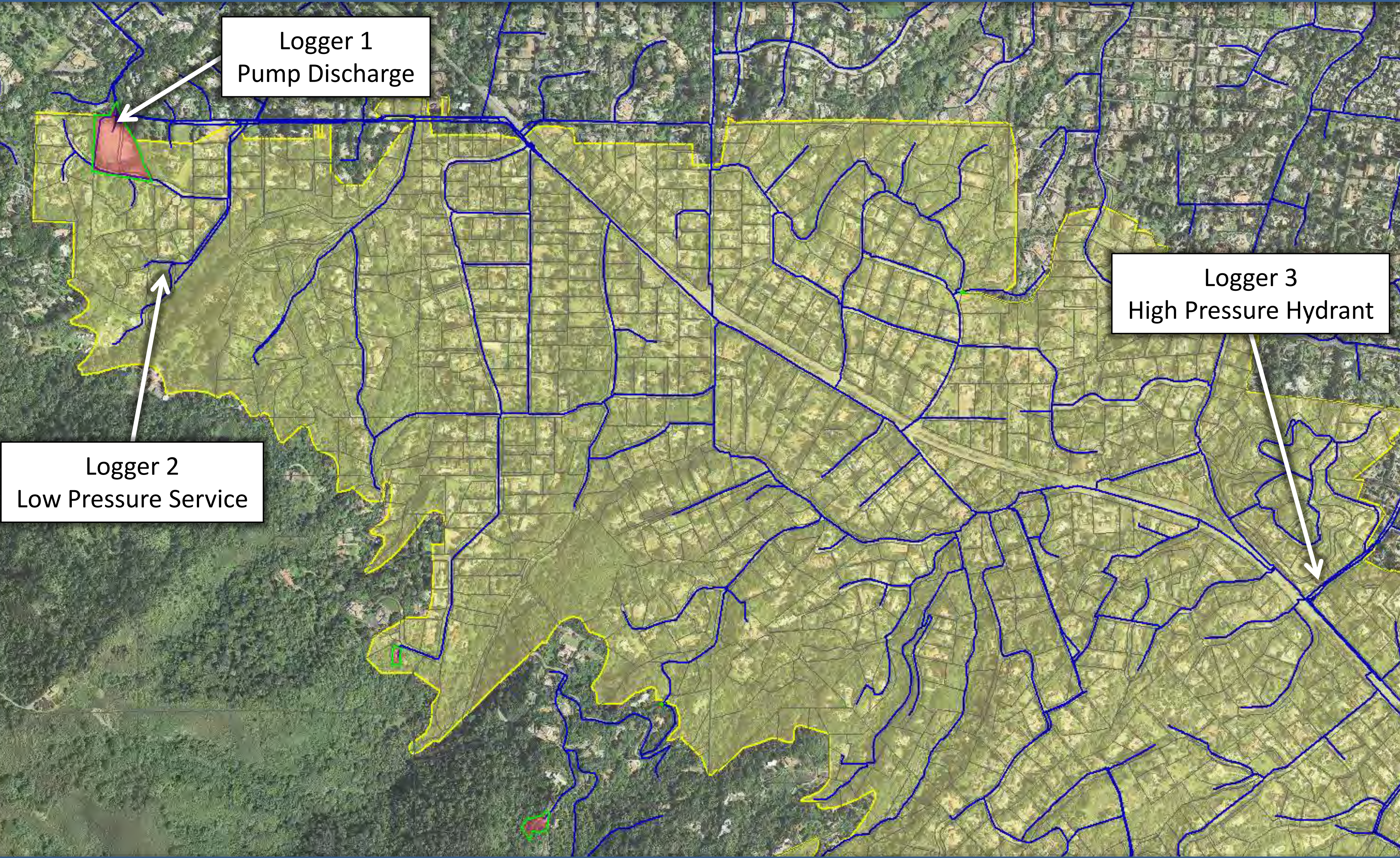
Background
- History of problems and mitigation efforts
- New booster pumps installed with pump control valves
- Surge tanks installed

# Transient Analysis – Vickery Pump Station

## Field Testing

- Select strategic locations to install pressure loggers
    - Pump discharge
    - High pressure regions
    - Low pressure regions
    - Dead end mains
- Coordinate with Operations department
    - Pump operations

# Transient Analysis – Vickery Pump Station



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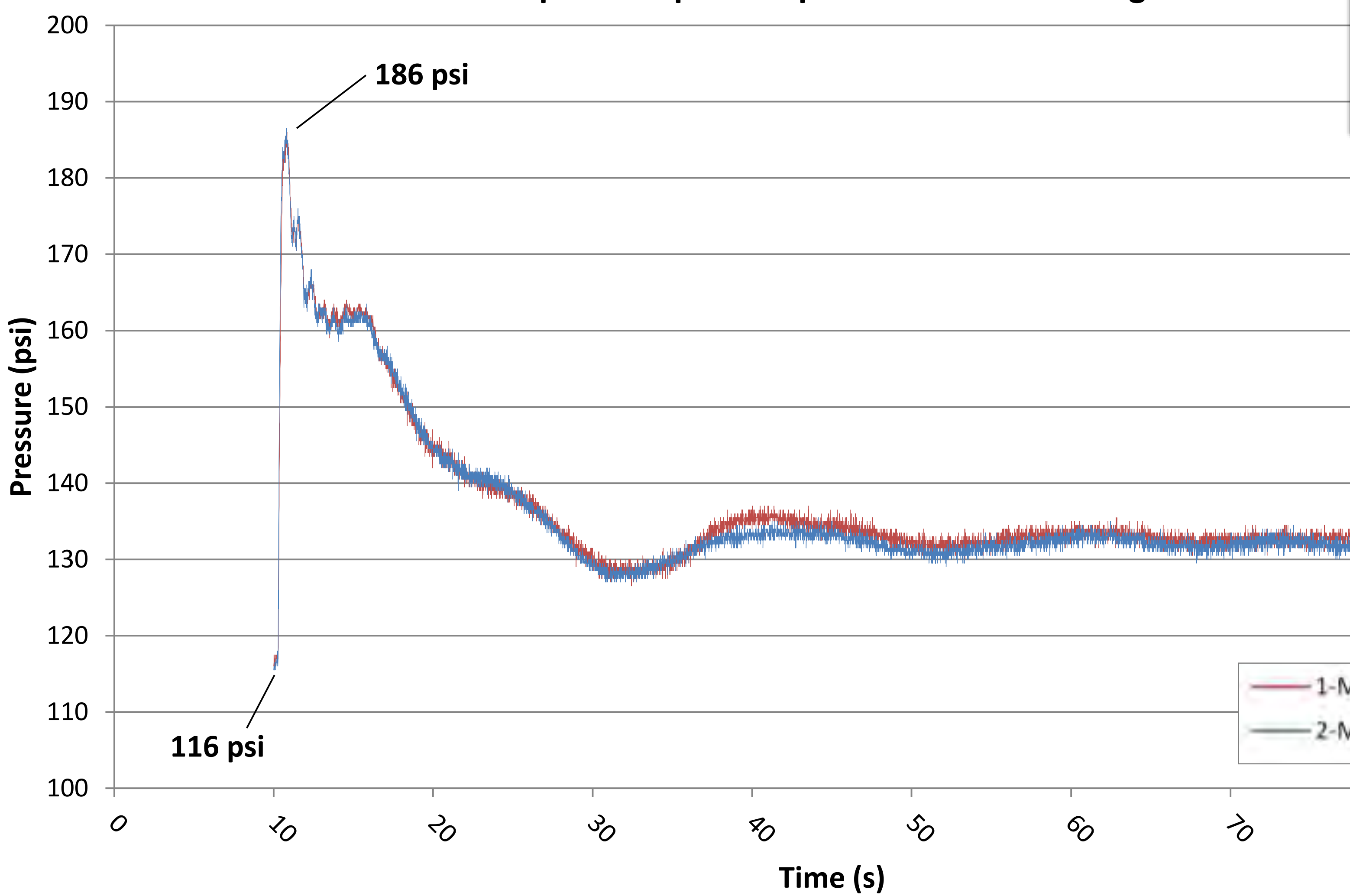


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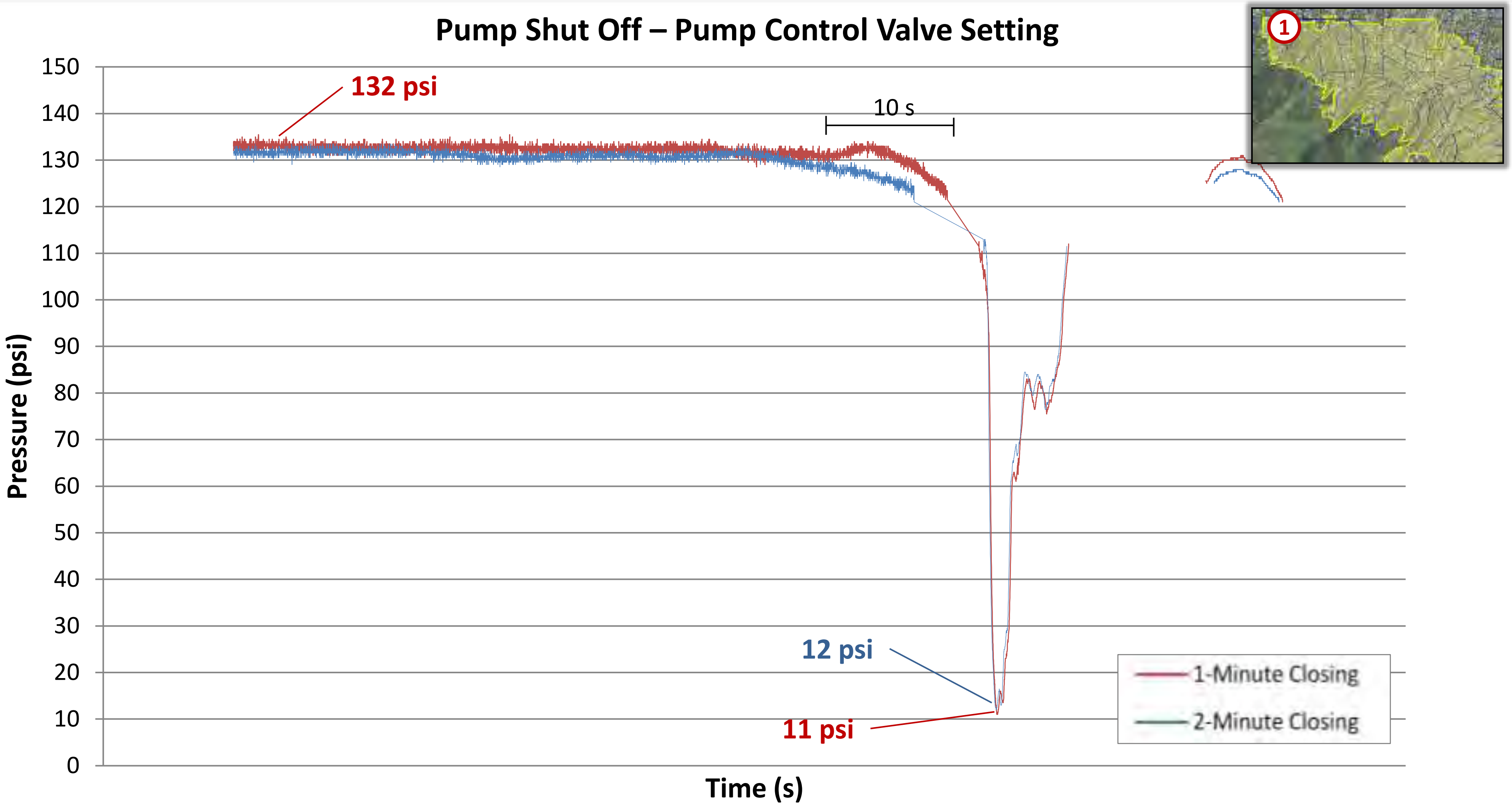

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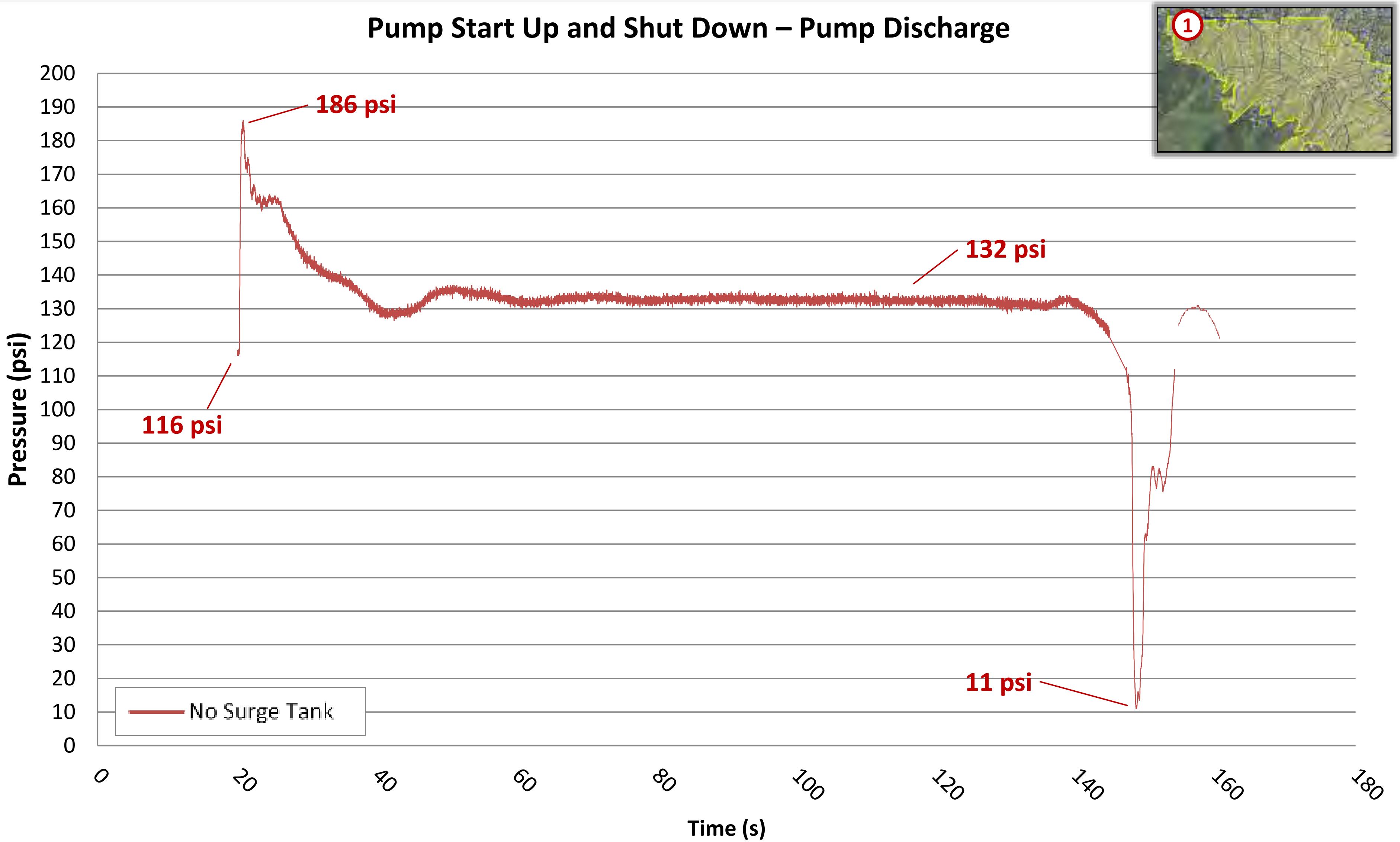

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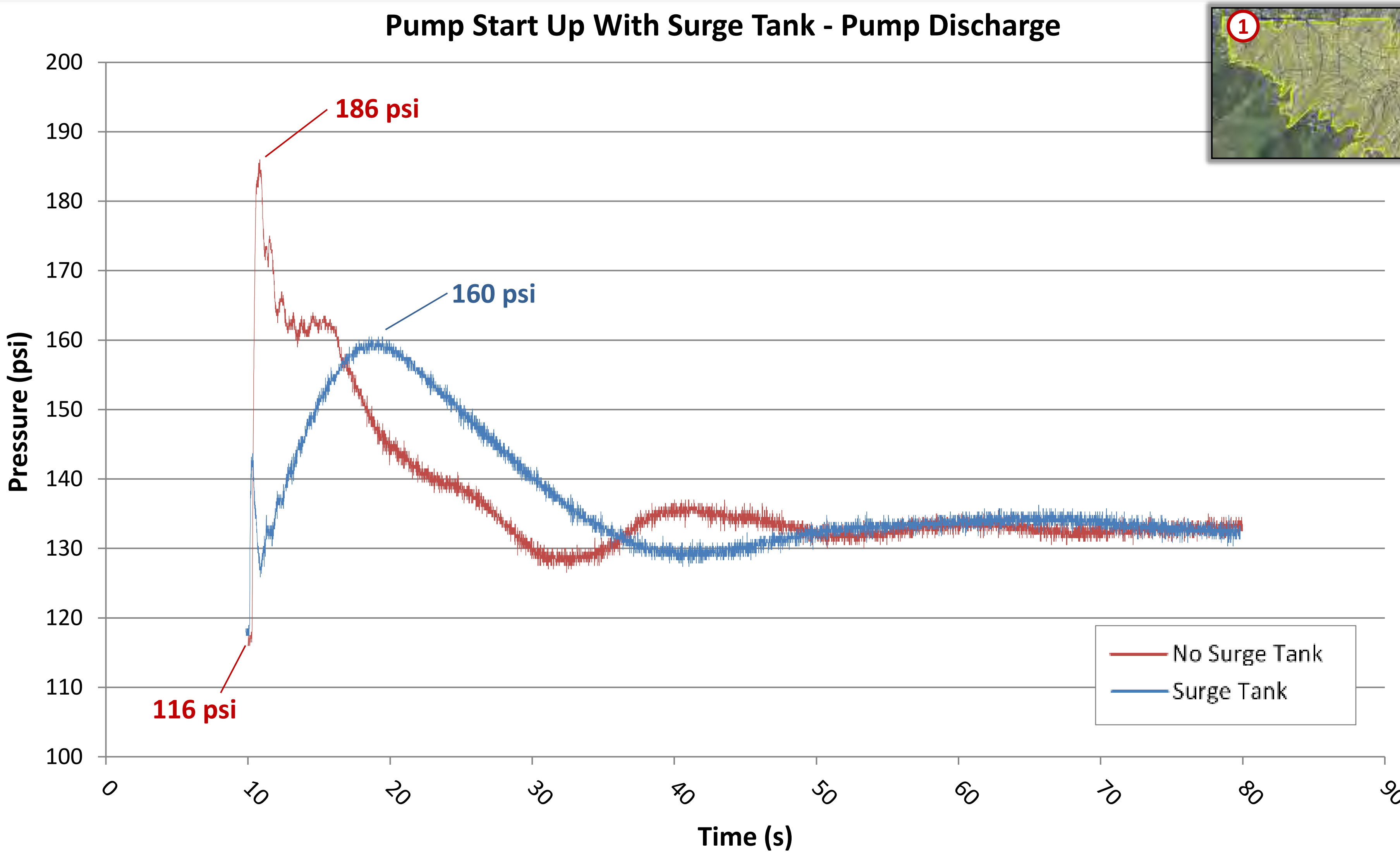

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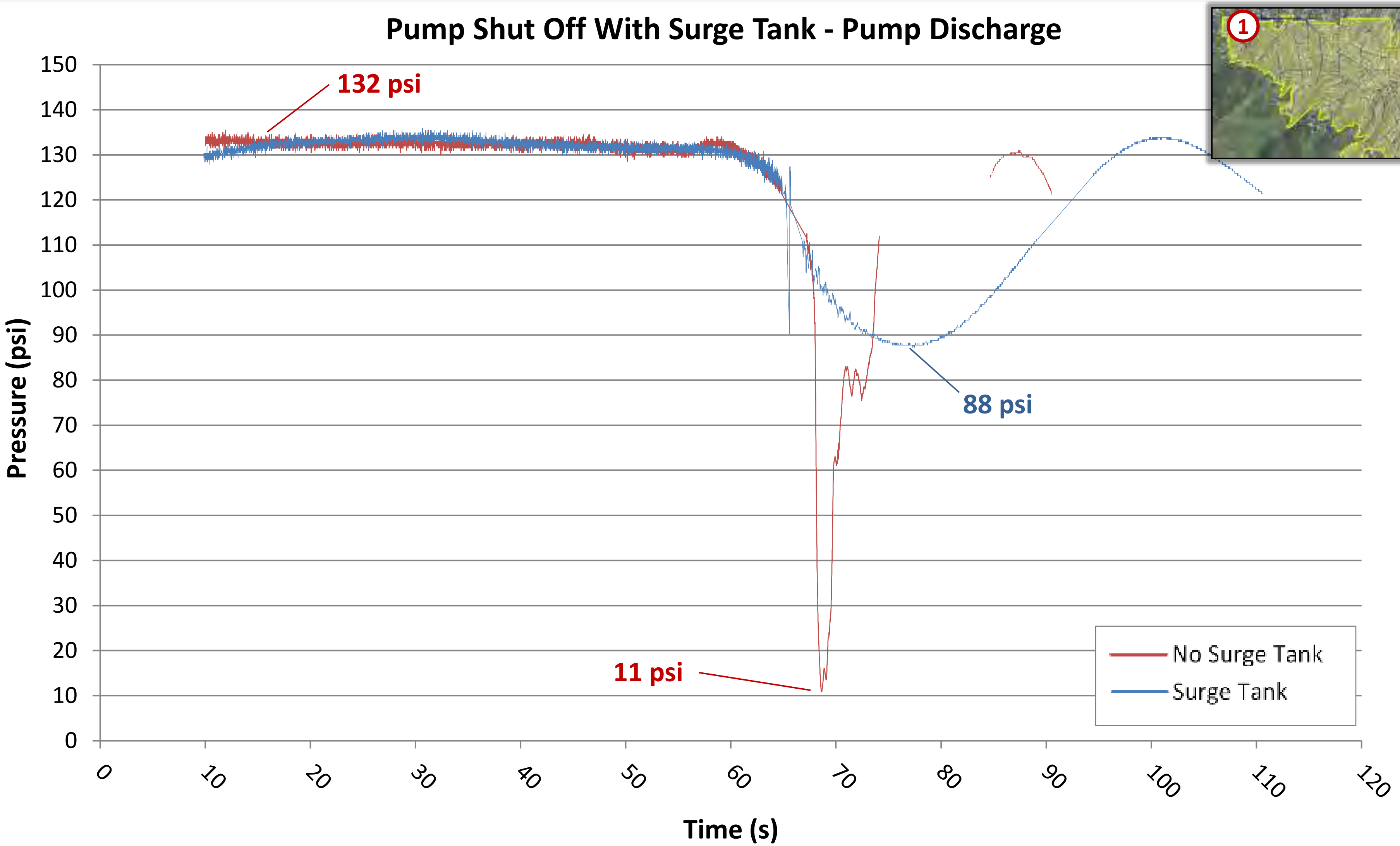

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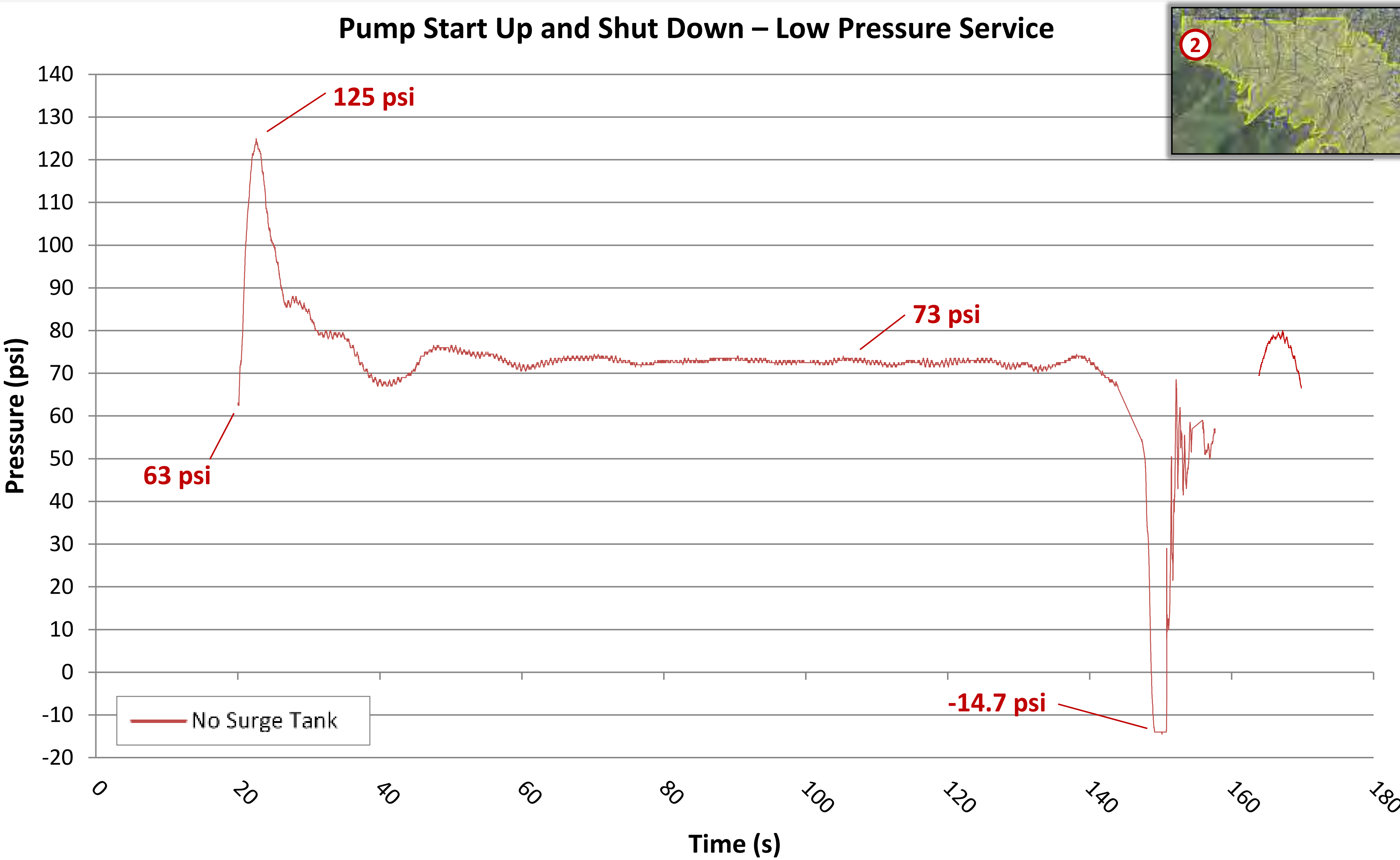

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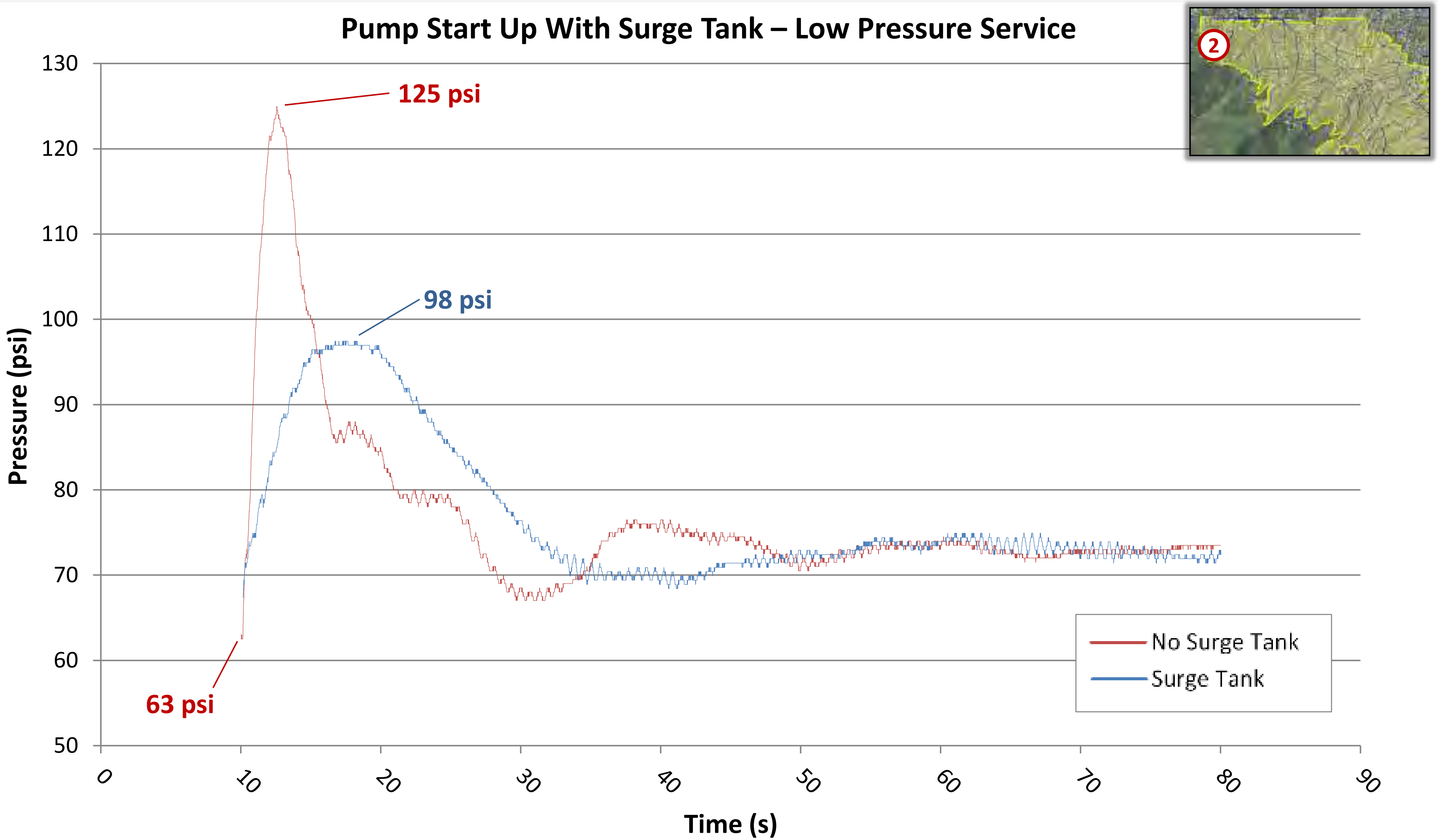

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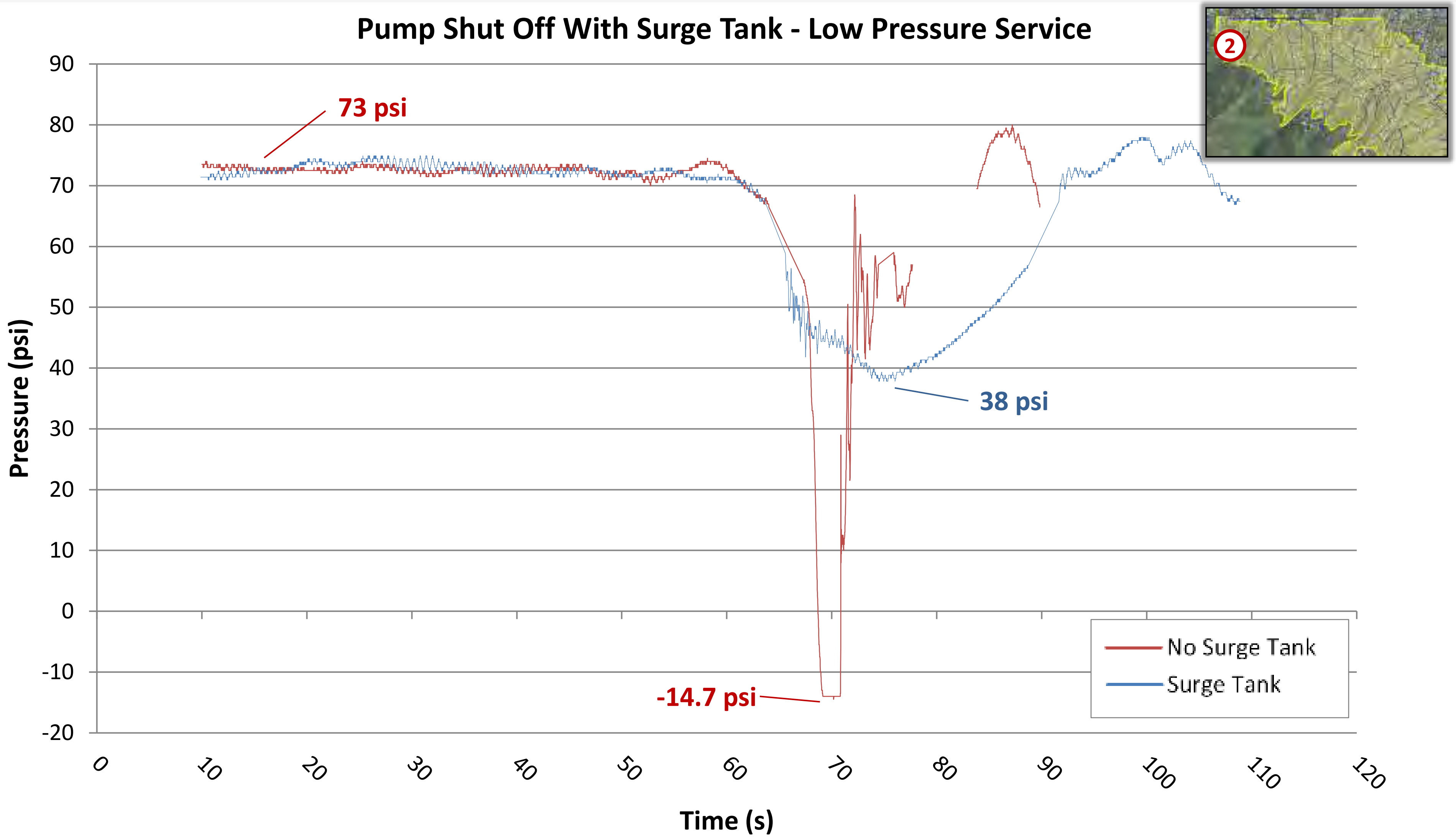

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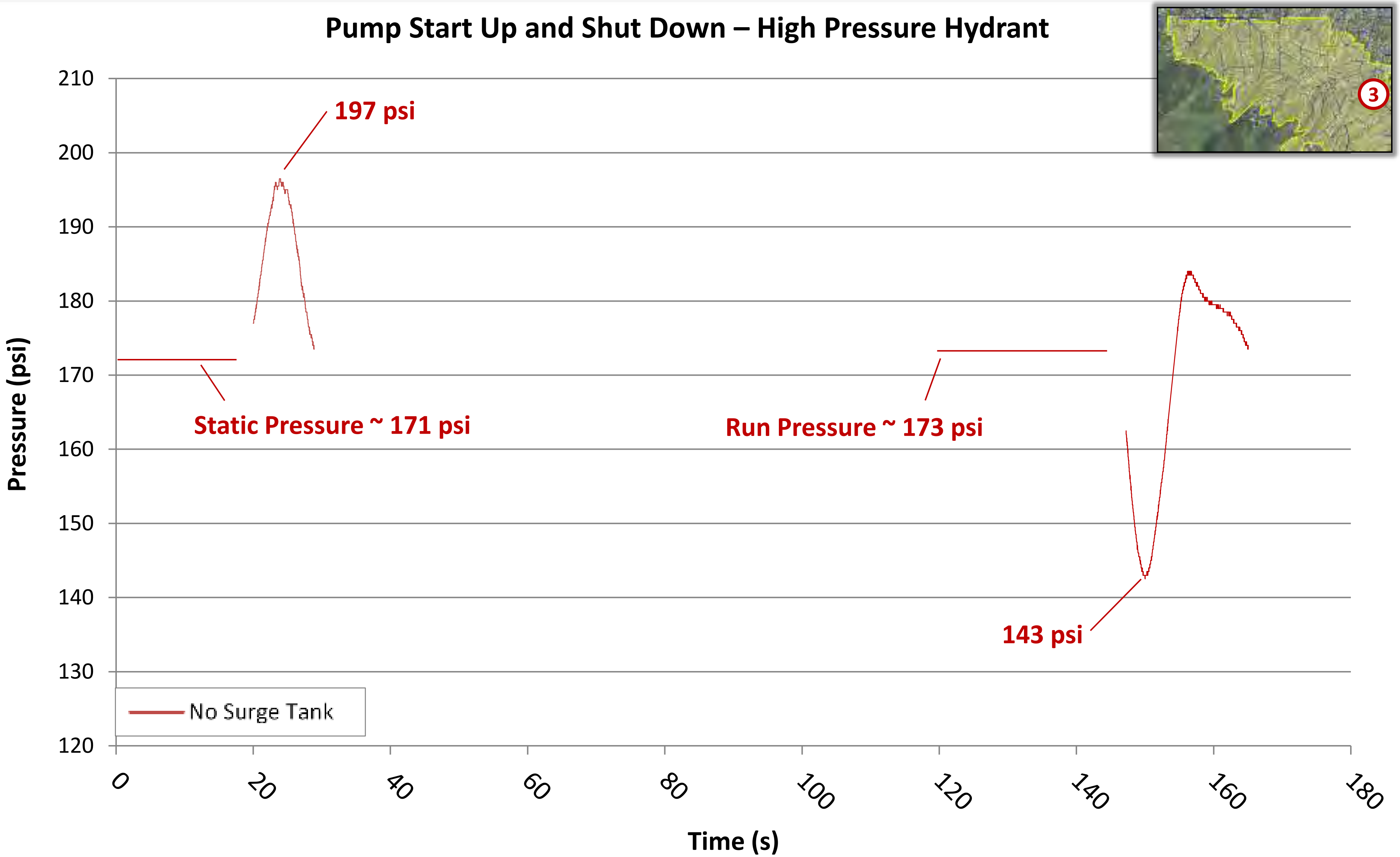
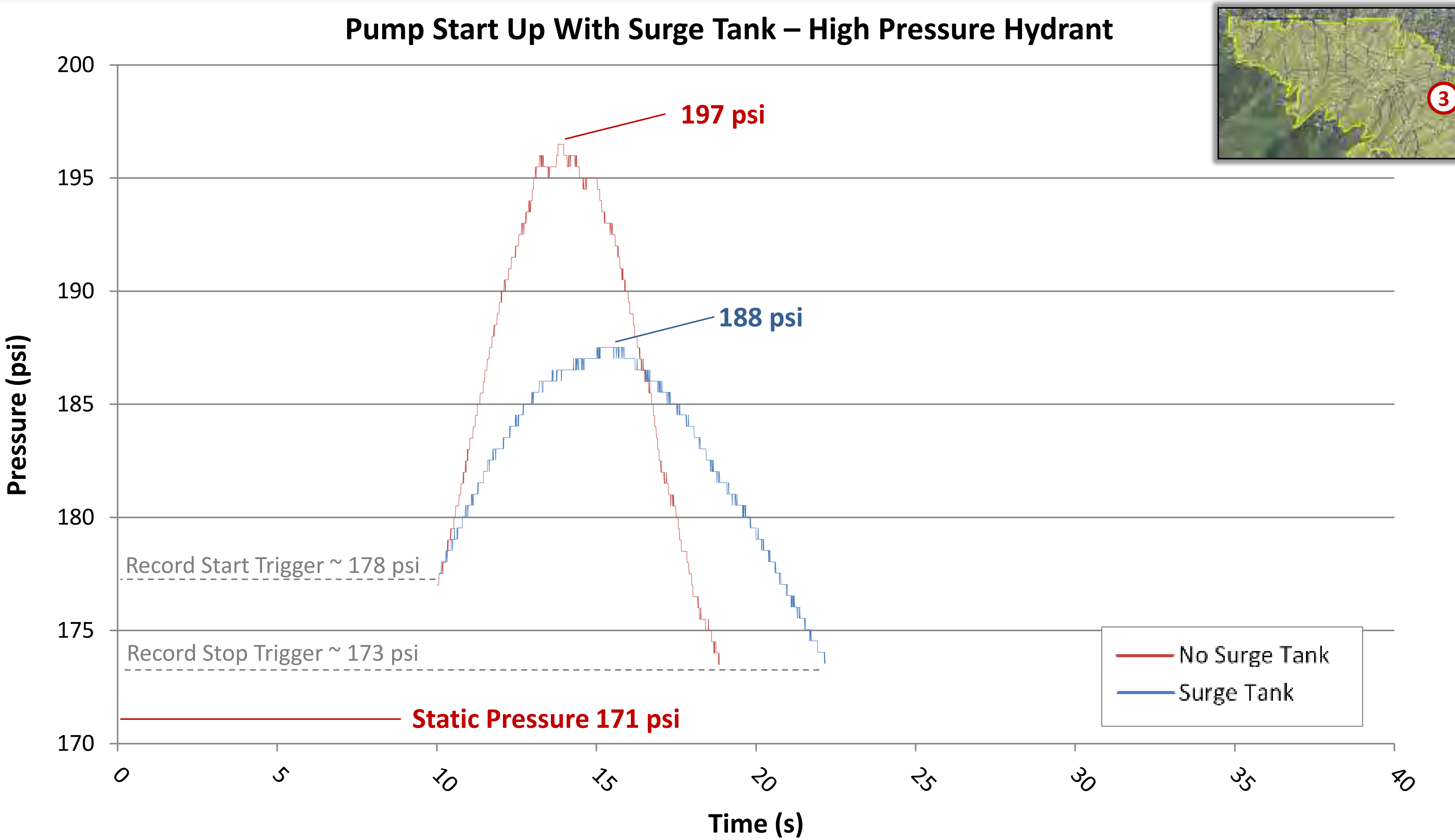


# Transient Analysis – Vickery Pump Station

**Pump Start Up With Surge Tank – High Pressure Hydrant**



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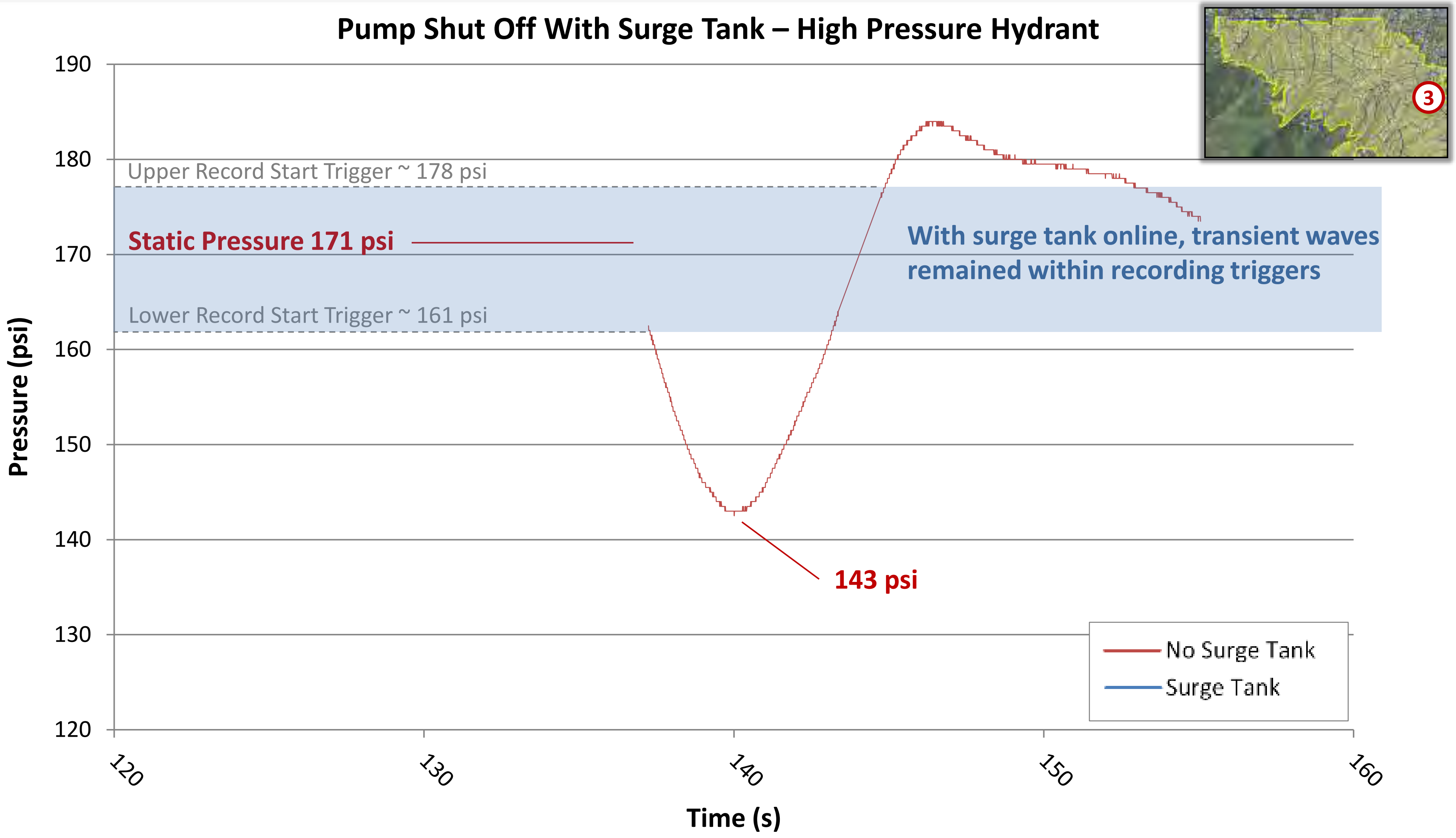


# Transient Analysis – Pavilion Pump Station

Background

- History of problems
- Mitigation efforts

# Transient Analysis – Pavilion Pump Station

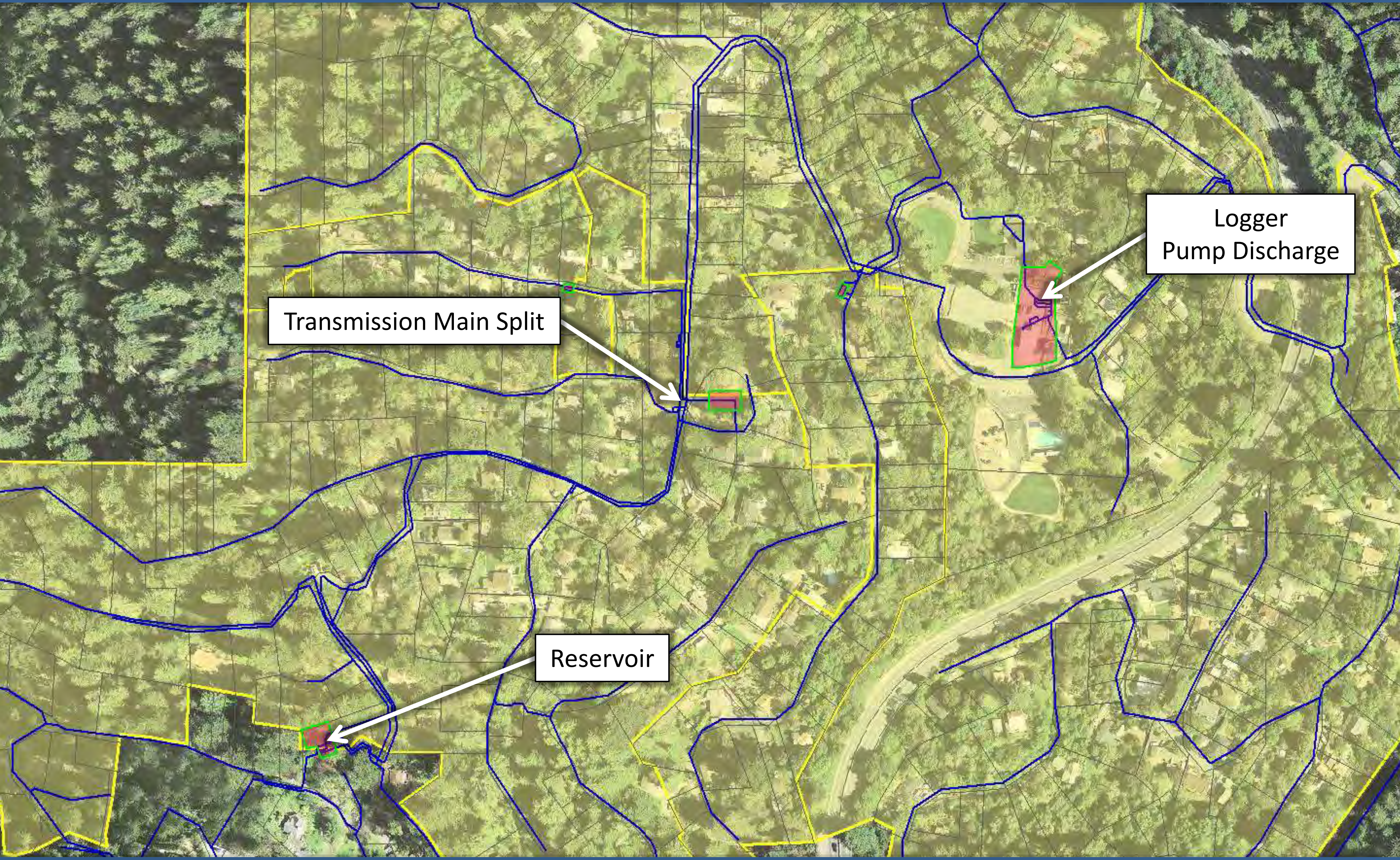
Field Testing

- Strategic locations to install pressure loggers
- Coordination with Operations department

Surge Modeling

- Calibration of existing system
- Future system (with surge protection device)

# Transient Analysis – Pavilion Pump Station



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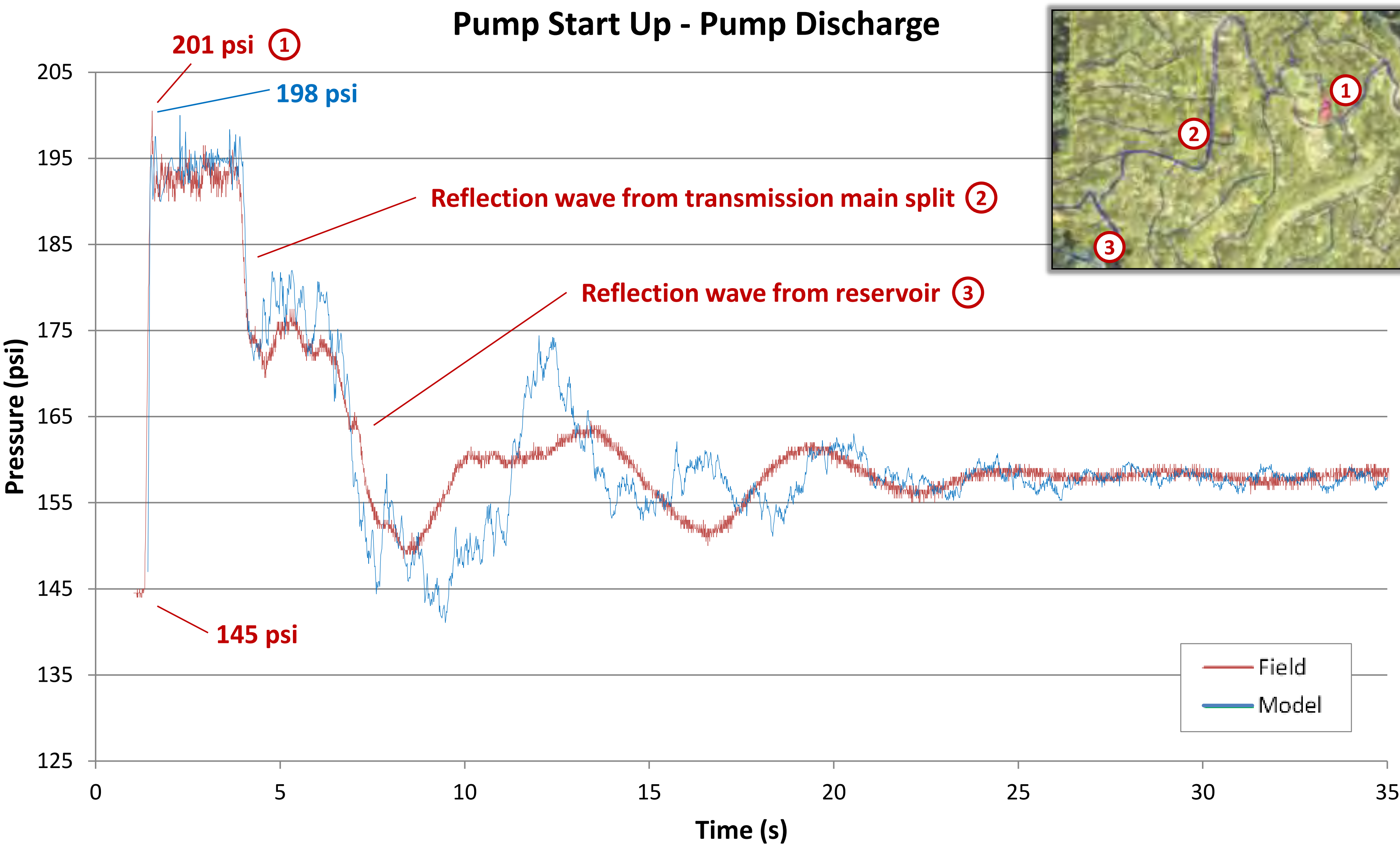

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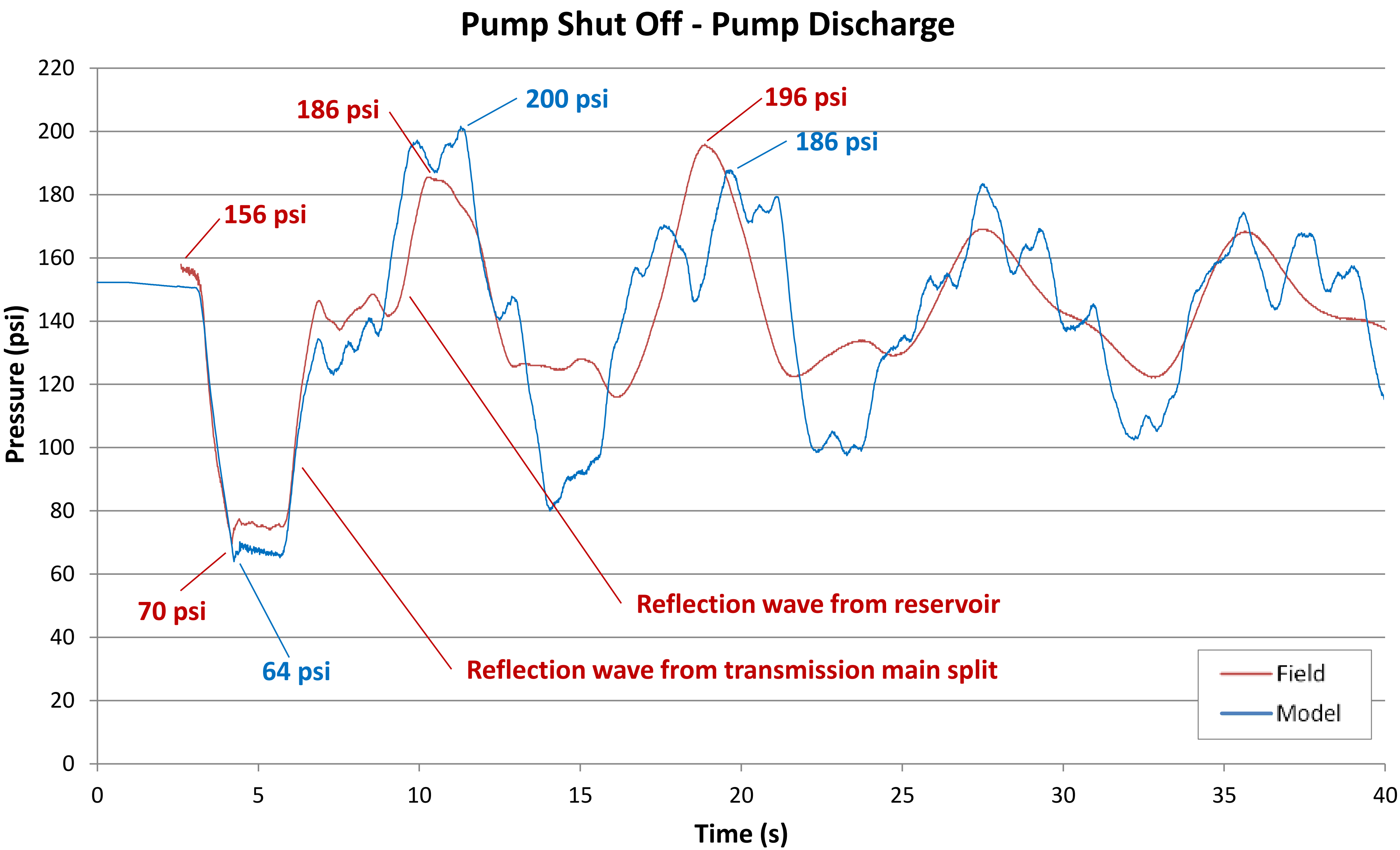

# Transient Analysis – Pavilion Pump Station

## Initial Surge Tank Sizing:

$$T_c = \frac{2L}{a}$$

$$T_c = \frac{2 \times 4,080\ ft}{1,800\ ft/s} = 4.5\ s$$

$$Surge\ Tank\ Volume = T_c \times Q$$

$$Surge\ Tank\ Volume = 4.5\ s \times 8.7\ gal/s = 40\ gal$$

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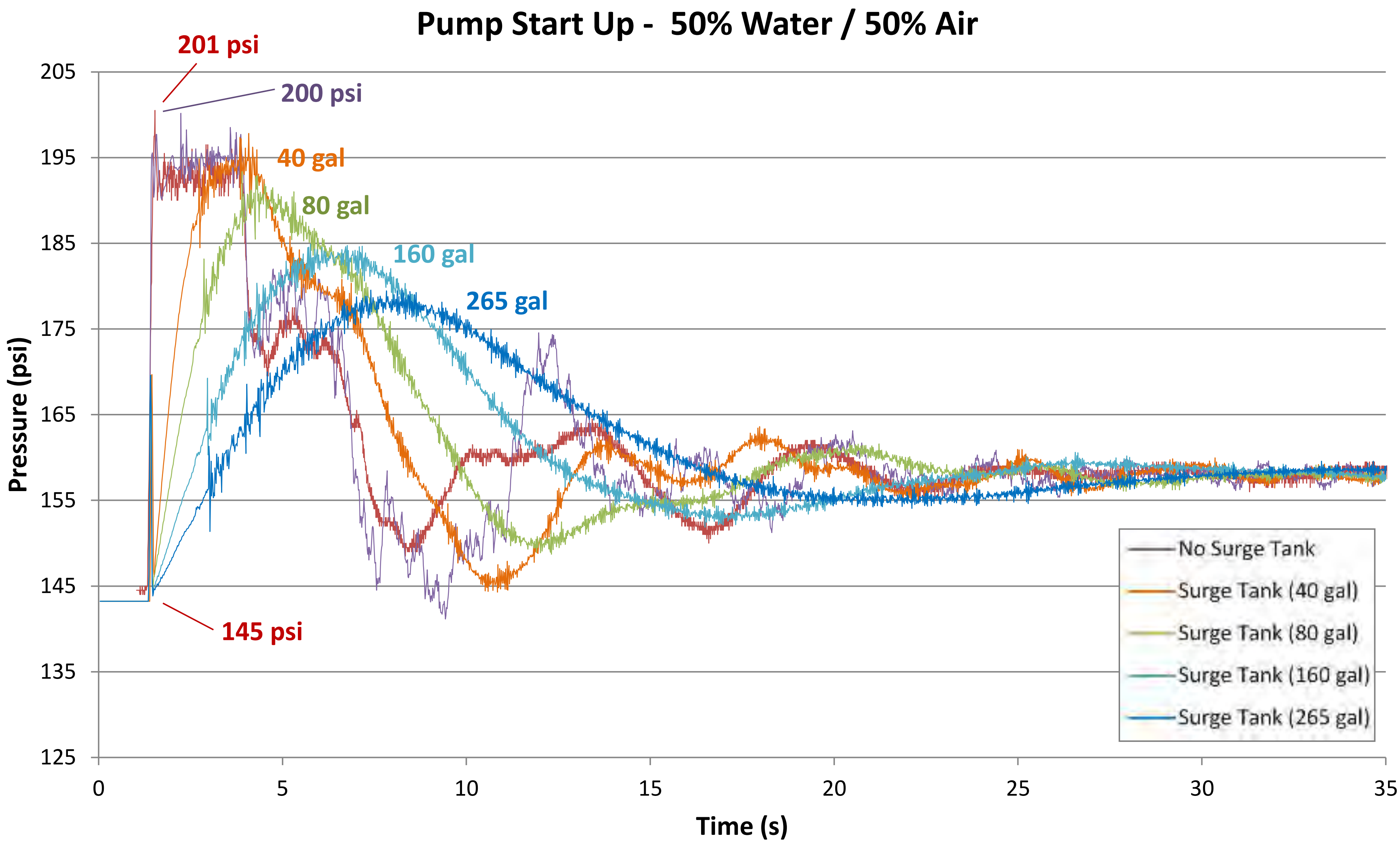

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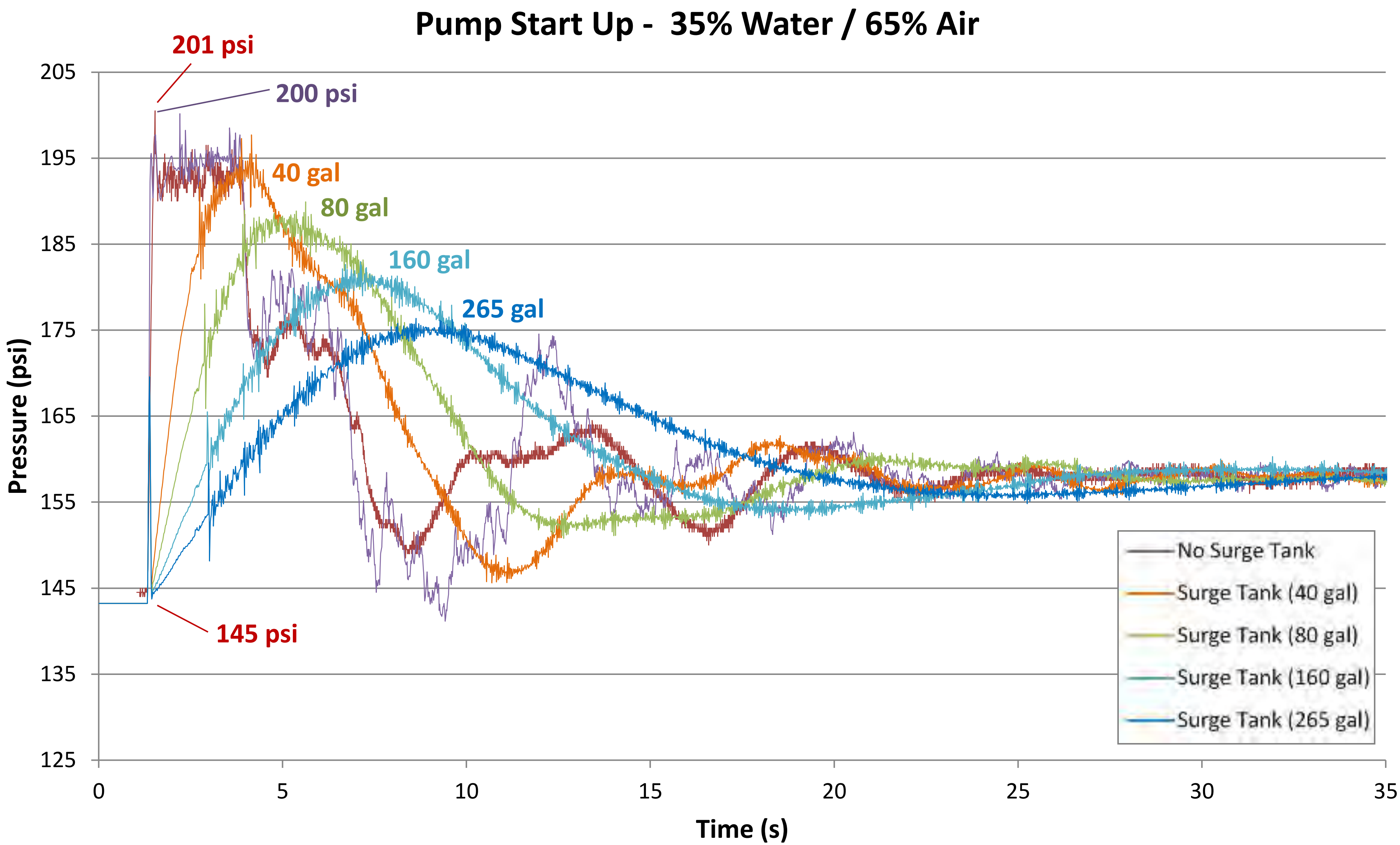

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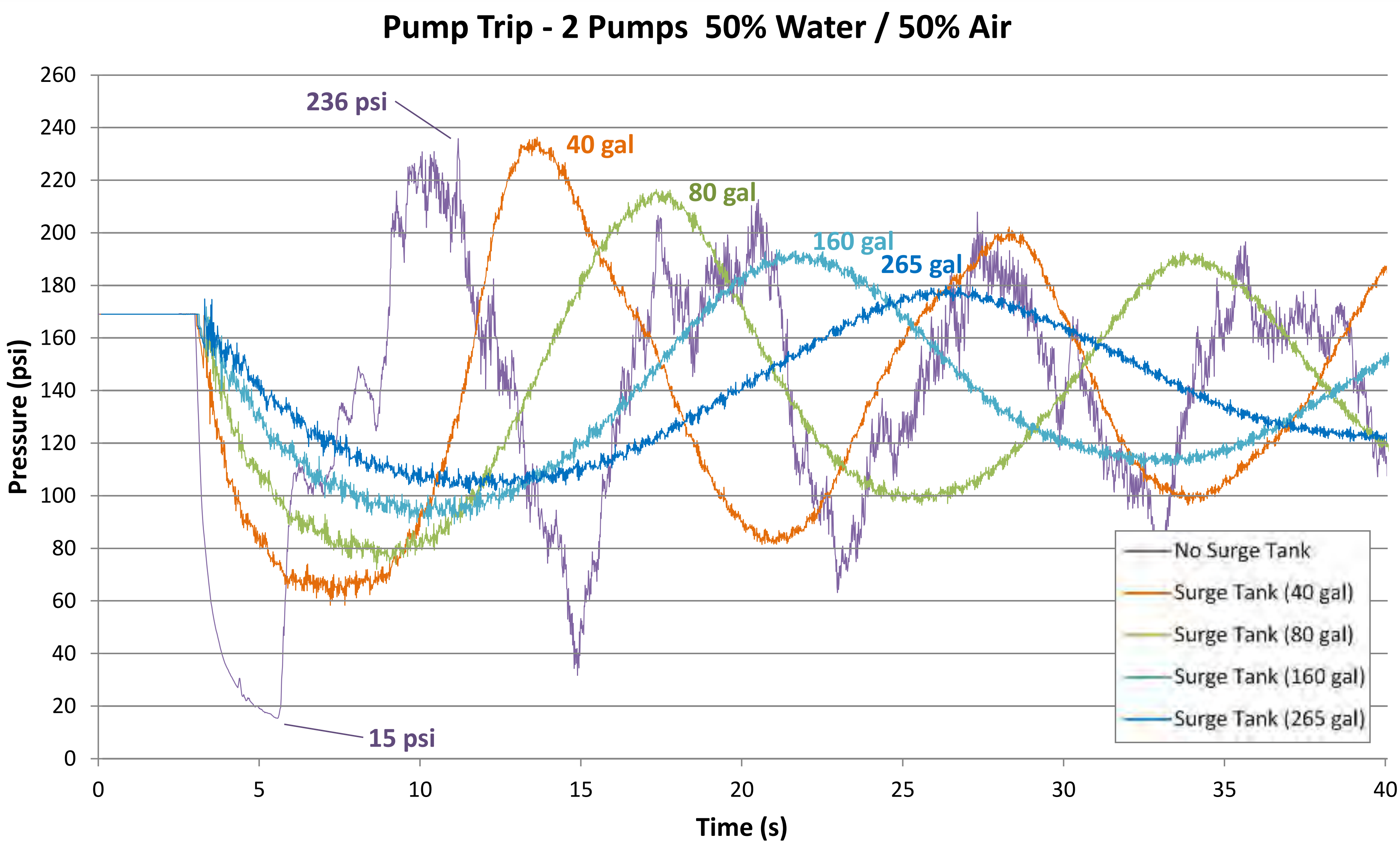

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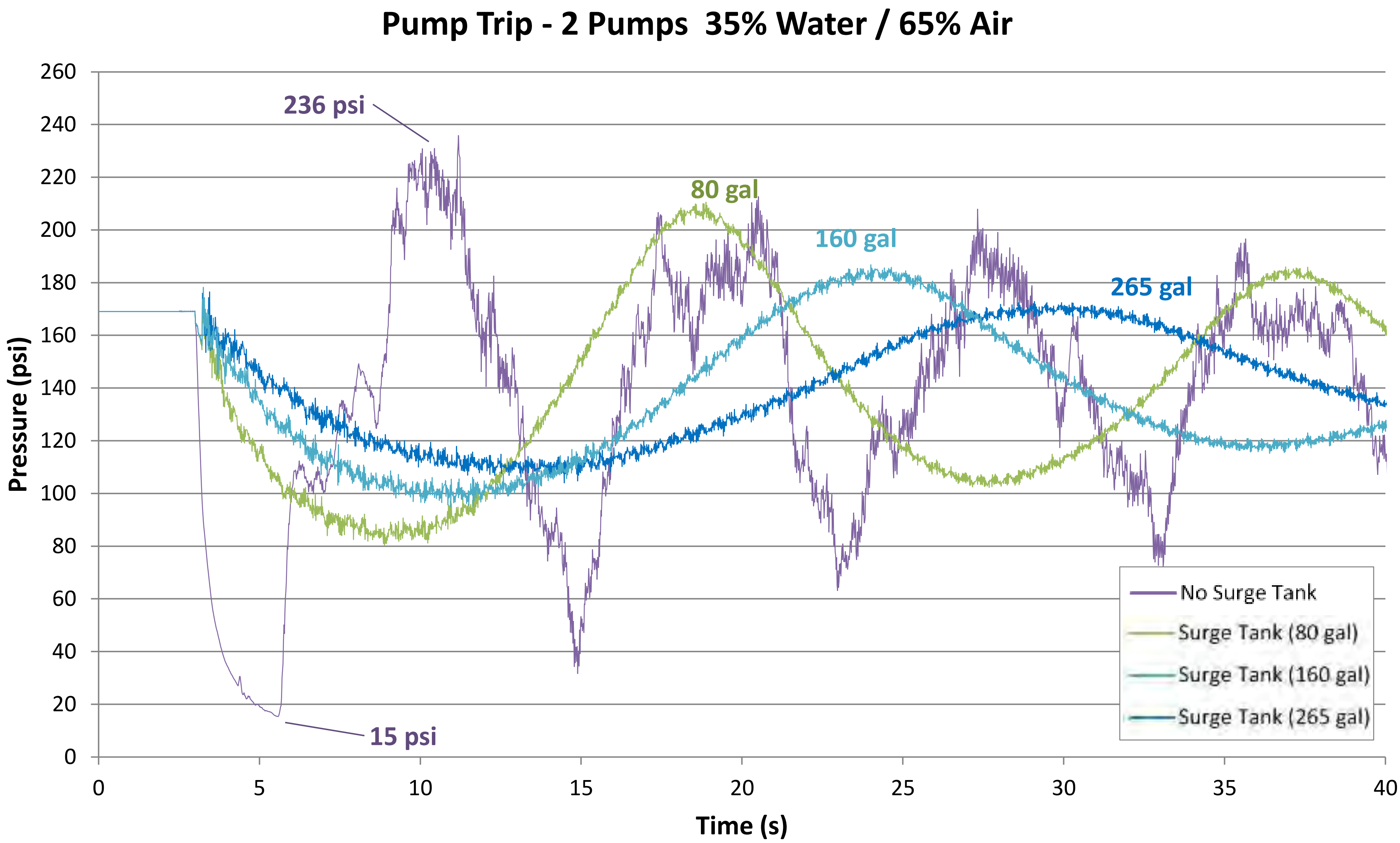

# Conclusion

- Hydraulic transients are regularly occurring in water distribution systems
- Transient waves can be far more extreme than anticipated
- Transient waves propagate further than expected
- Certain surge protection devices can be very effective, others not as effective
- Surge protection devices can help mitigate potential public safety and public health concerns
- Surge modeling is highly recommended for sizing surge protection devices
- More transient analysis needs to be performed

# Contact Information


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