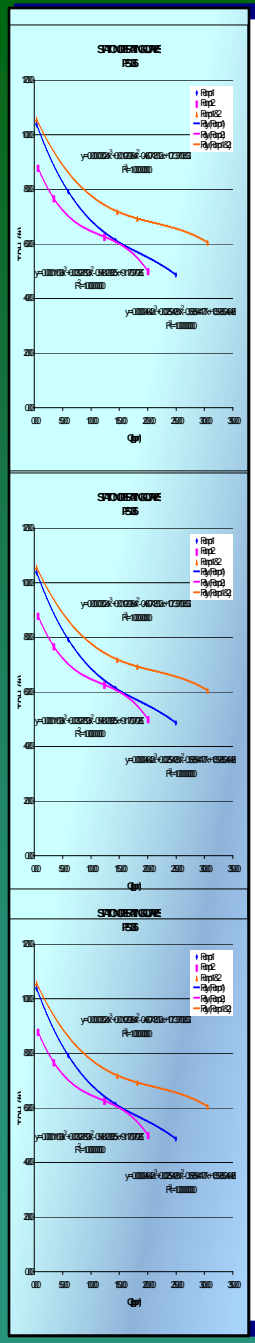


Effective Process Developed for Measuring and Analyzing In/Out Pump Station Flows Discharging Into Manifold Pressure Mains

Matt Leach, CH2M HILL - Presenting

Shelly Frie, CH2M HILL

Ed Snyder, CH2M HILL

Eric Nice, CH2M HILL

Reggie Rowe, CH2M HILL

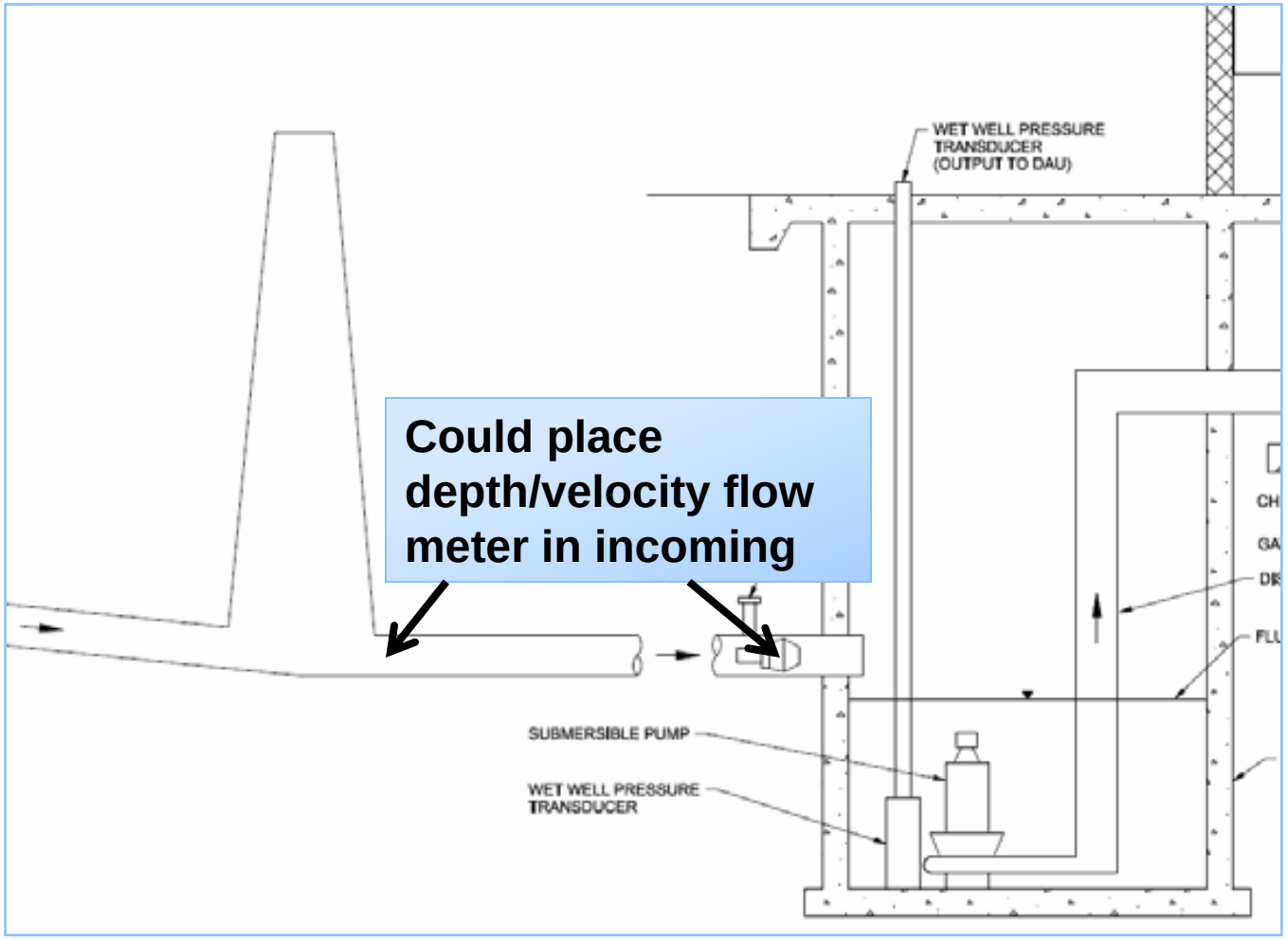
May 13, 2010

CH2MHILL

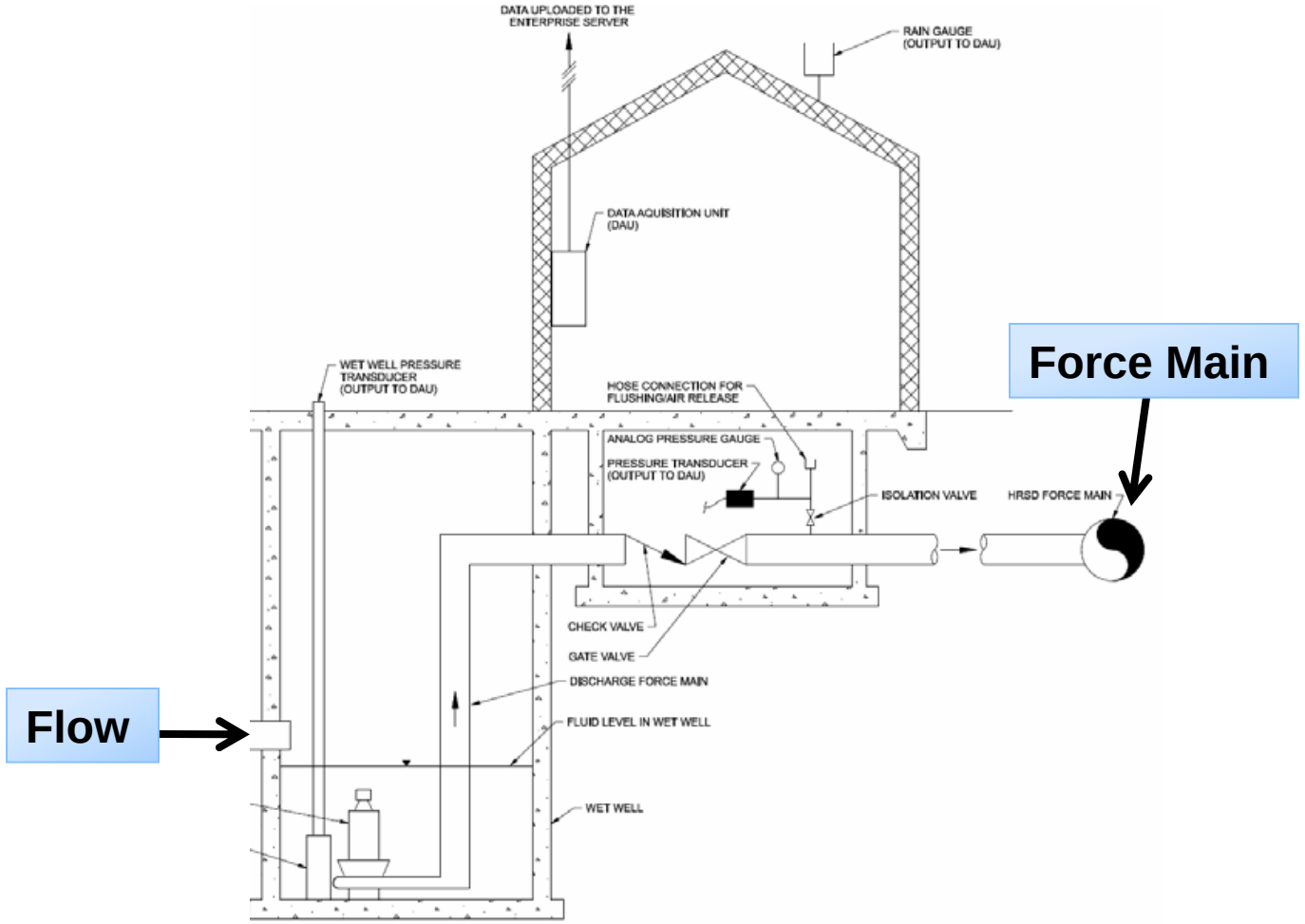
Overview

- Typical Station Layouts, System Components, and Hydraulic Challenges
- CH2M HILL's Station 3S Flow Measurement Concept
- City of Suffolk, VA Case Study Application of Station 3S

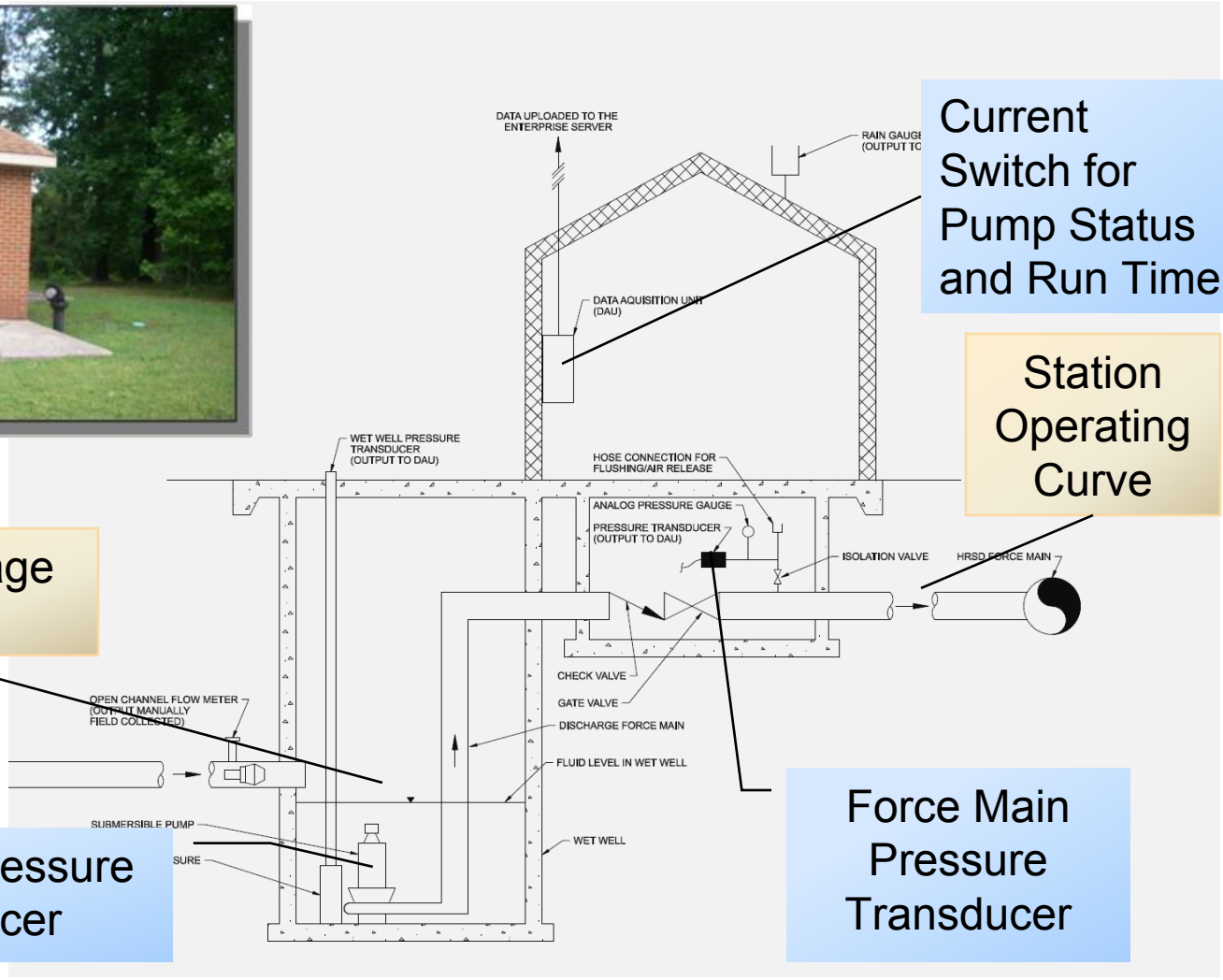
Typical Flow Measured Method for Pump Stations with a Discharge to Manhole



Pump Station Flow Measurement Approach Becomes More Complicated When Discharge is to a Force Main



CH2M HILL's Station 3S (Surcharge Stage/Storage) Setting and System Components



Current Switch for Pump Status and Run Time

Station Operating Curve

Stage/Storage Curve

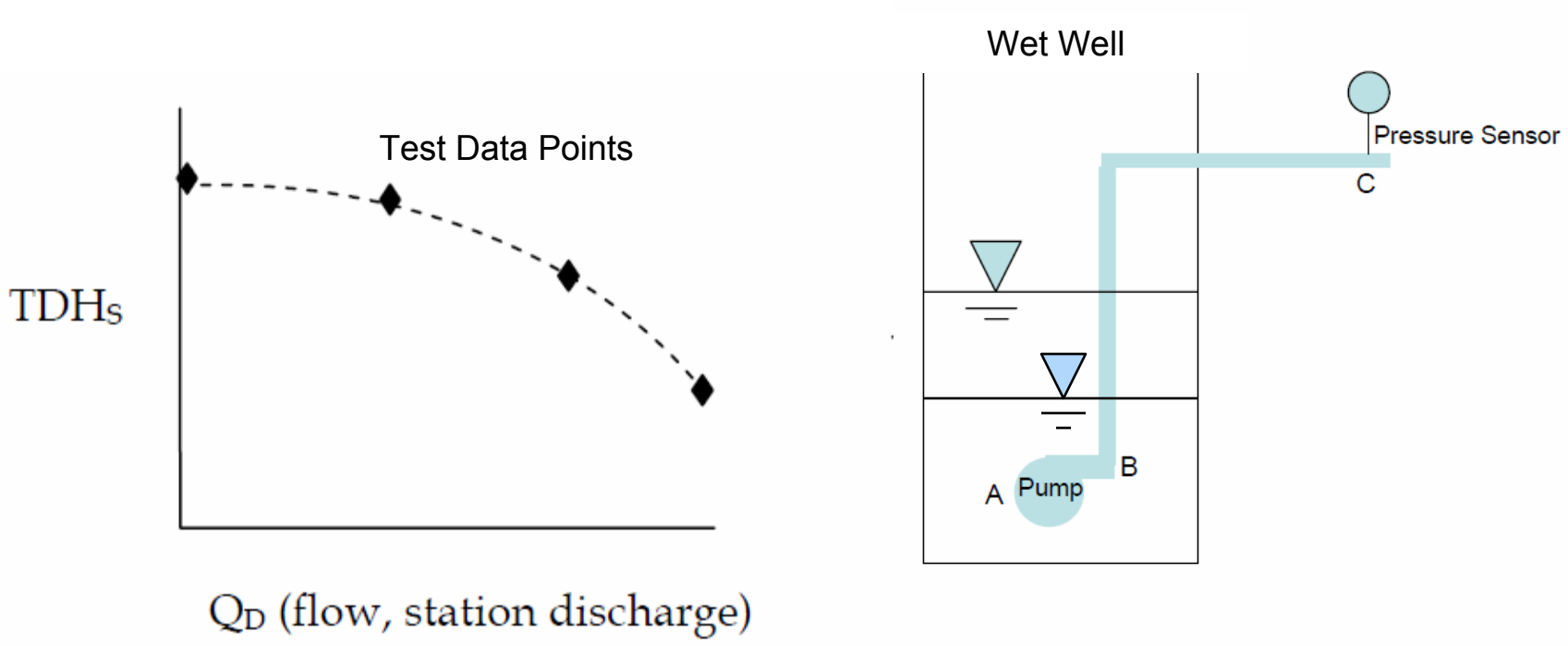
Force Main Pressure Transducer

Wet Well Pressure Transducer

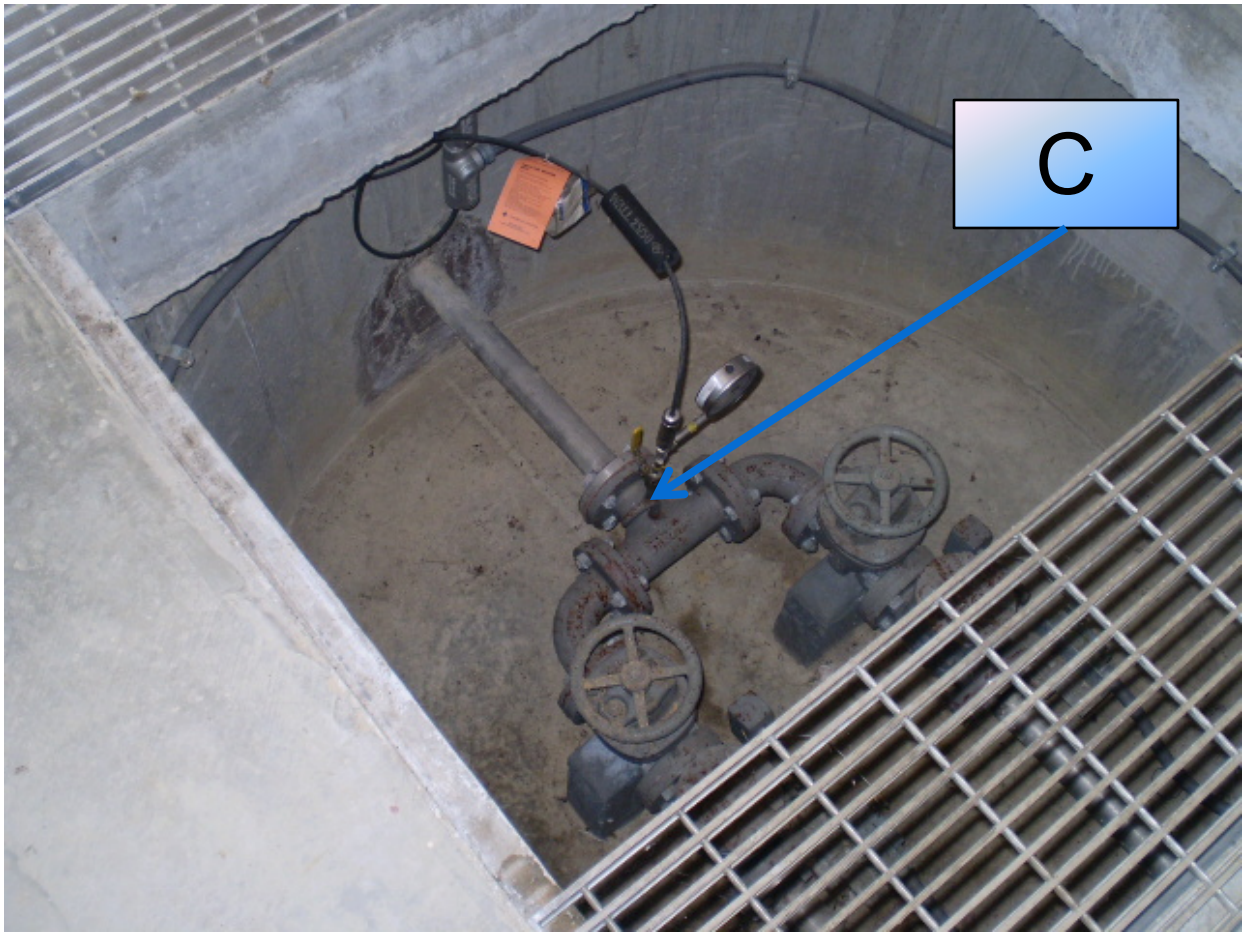
Station Flow Measurement Challenges

Hydraulic Challenges

Variable Discharge: Develop Station Operating Curve

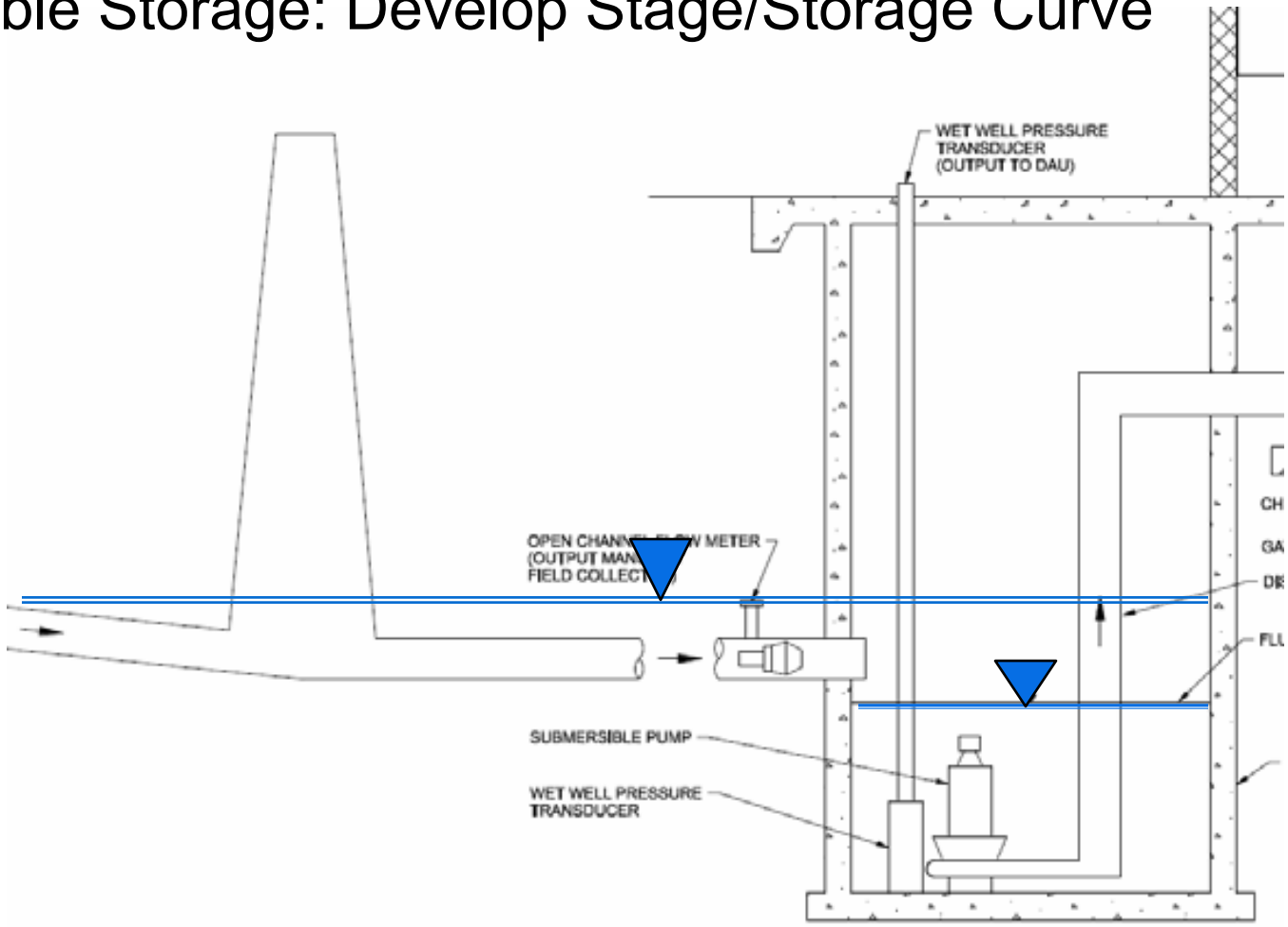


Example Station Discharge Pressure Sensor at Point C

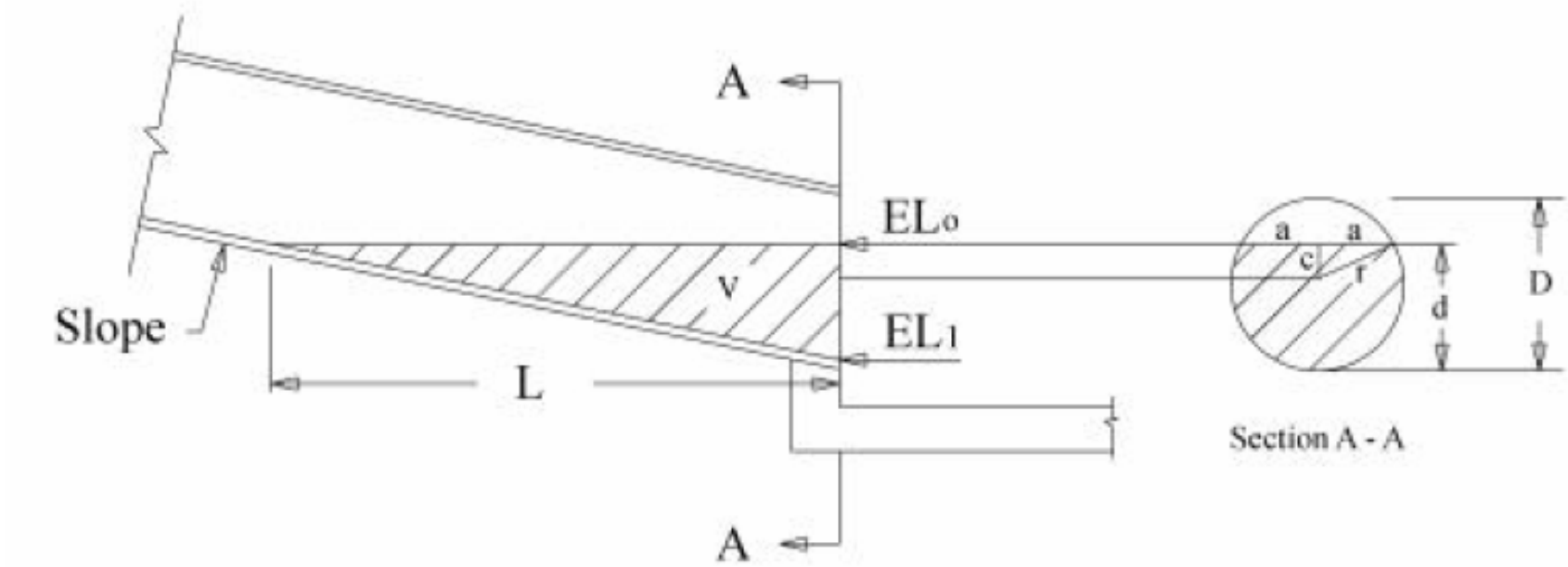


Hydraulic Challenges

Variable Storage: Develop Stage/Storage Curve

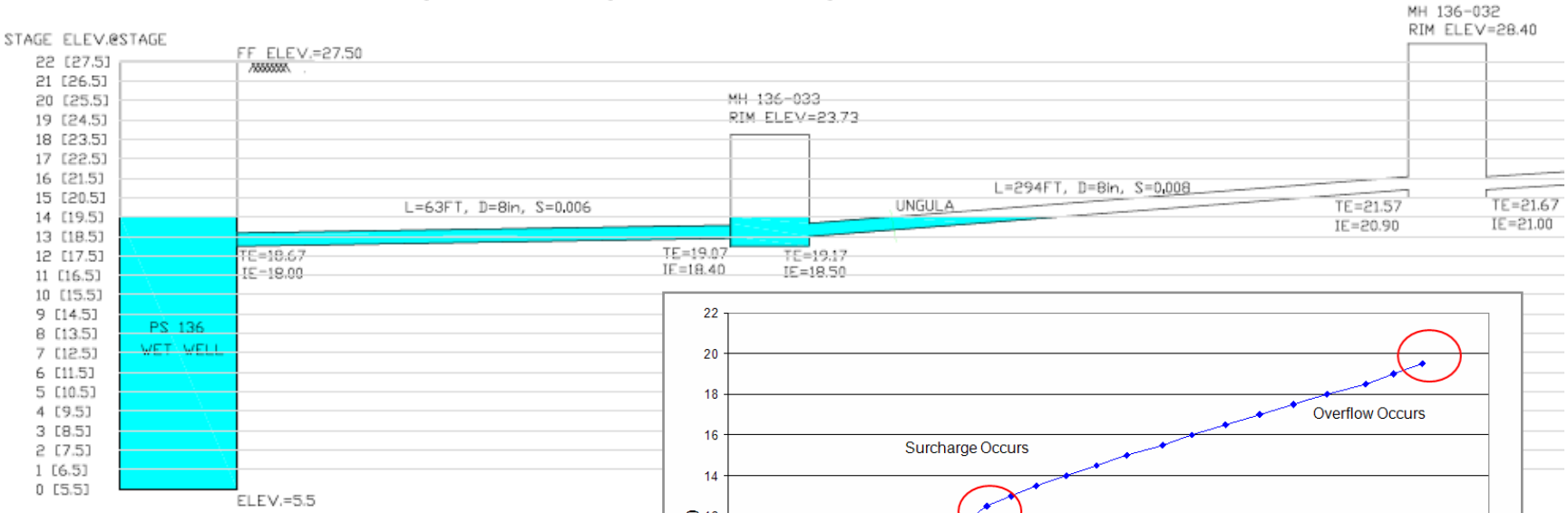


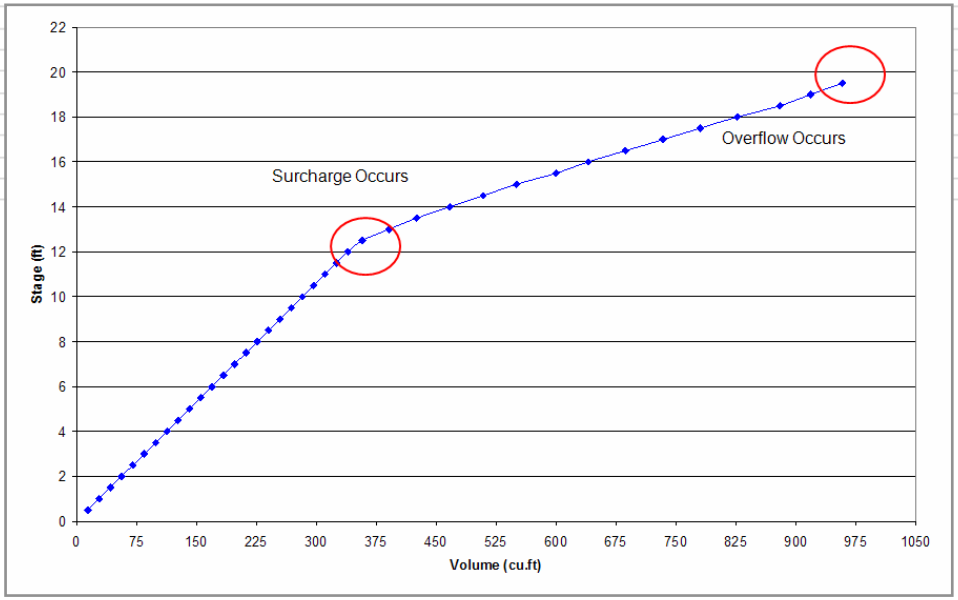
Pipe's Ungula Volume Affects Stage/Storage Total Volume



Hydraulic Challenges

Variable Storage: Stage/Storage Curve



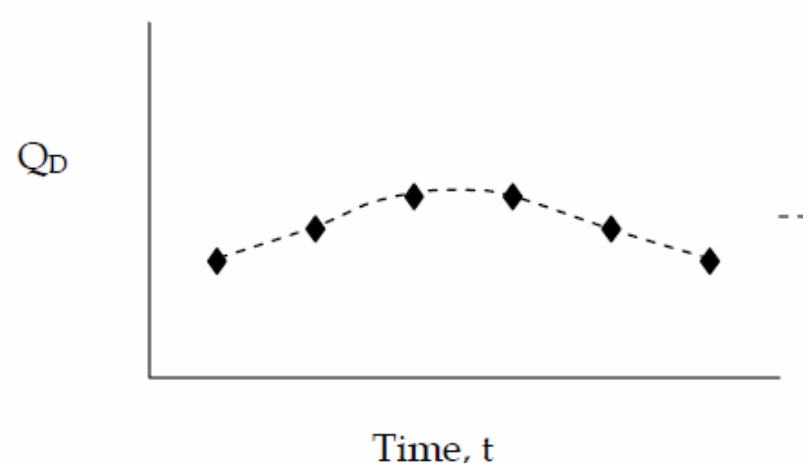


Flow Measurement Concept: Discharge

Record Discharge Pressure

Record Change in Wet Well Stage Elevation

→ Determine TDH_s → Determine Q_D from Station Operating Curve → Plot Q_D vs Time → Discharge Hydrograph



Flow Measurement Concept: Influent

$$Q_I = Q_D + \triangle V_S$$

Where:

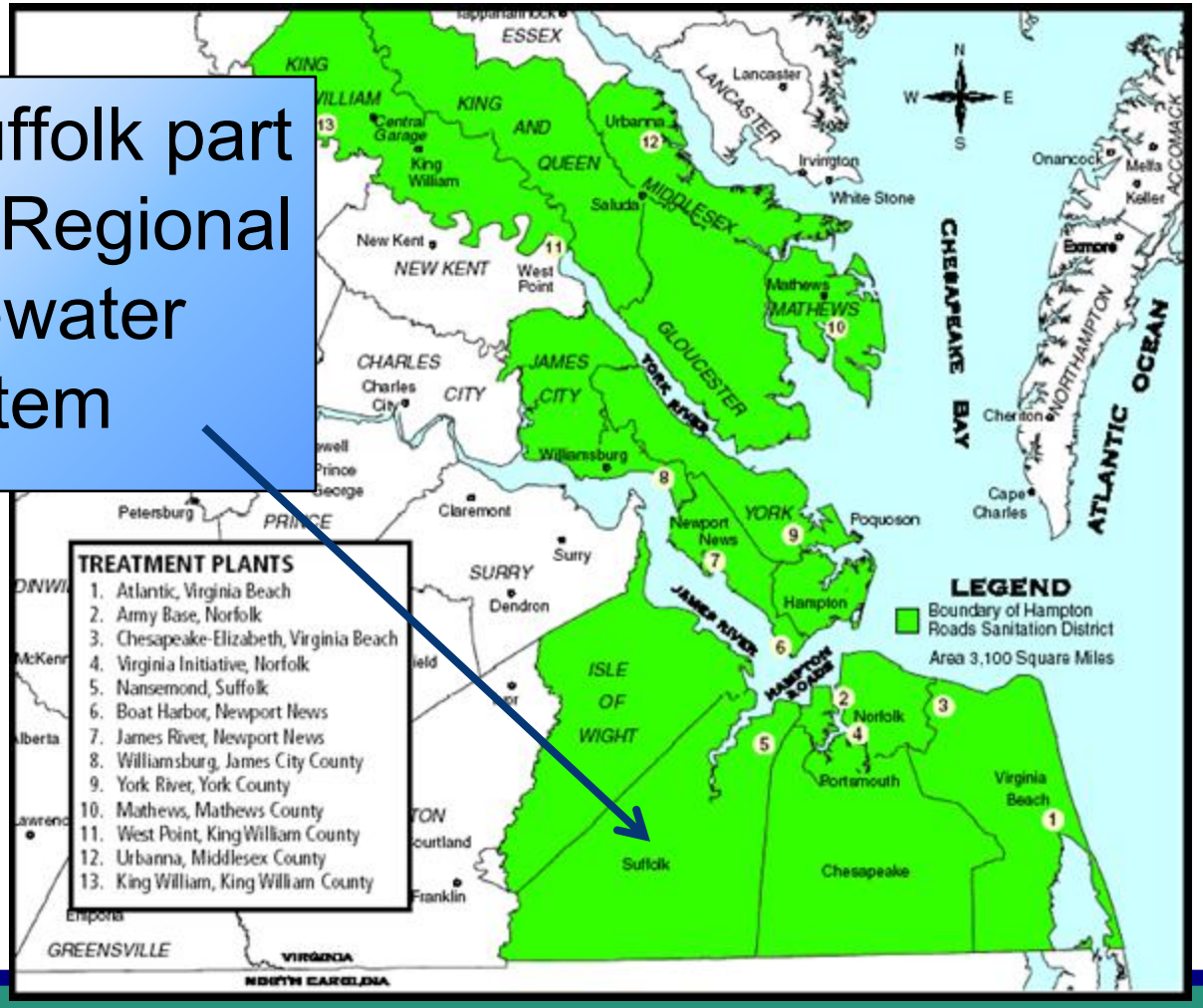
Q_I = total influent PS flow

Q_D = PS discharge flow

$\triangle V_S$ = rate of change in stage/storage volume (±)

City of Suffolk, VA Case Study Application

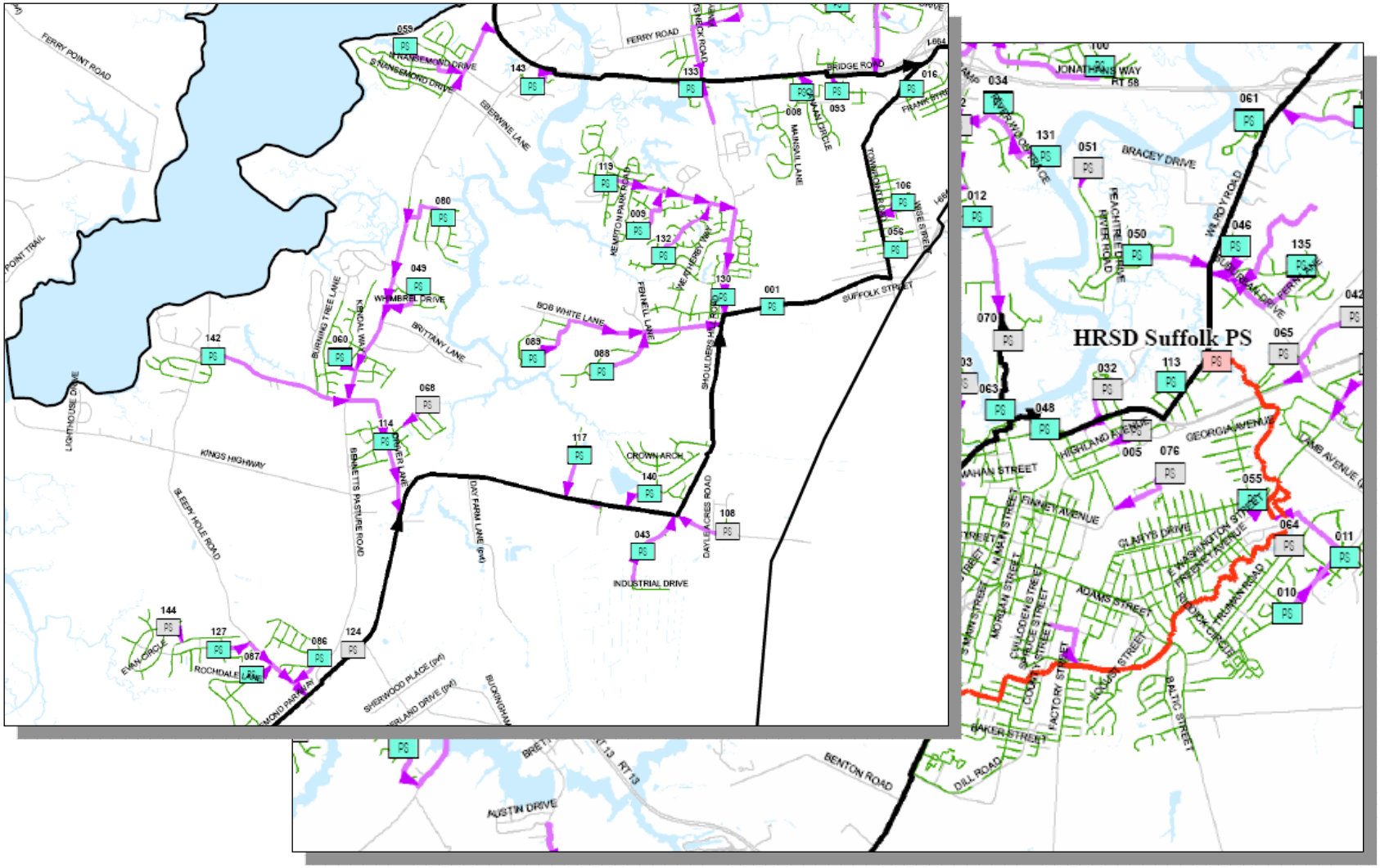
City of Suffolk part of HRSD Regional Wastewater System



Special Order By Consent

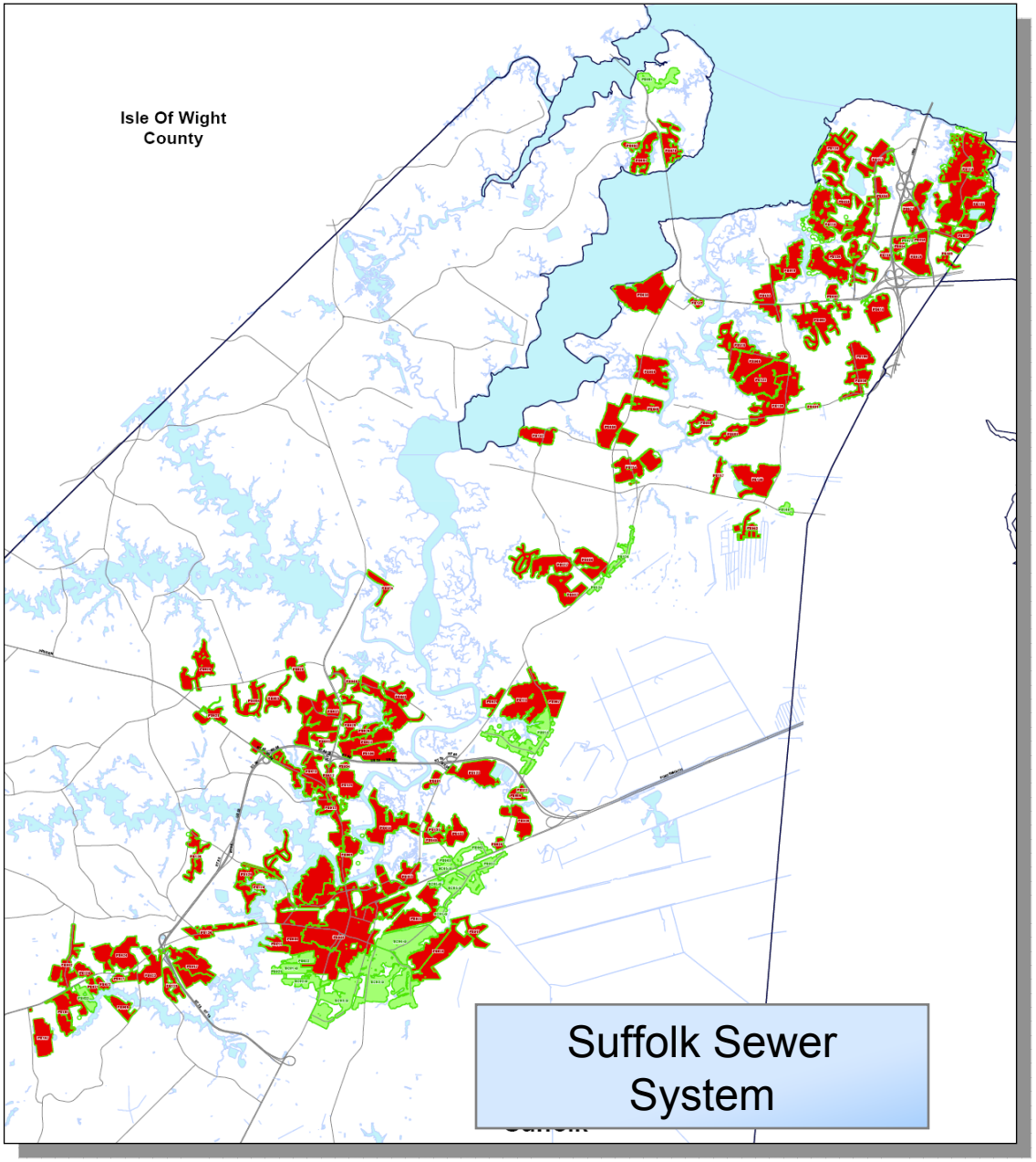
- Issued by the Virginia Department of Environmental Quality to the Hampton Roads Sanitation District and 13 area localities
- Purpose is to reduce sanitary sewer overflows from the wastewater collection systems
- Consent Order requirements:
  - sanitary sewer flow monitoring
  - identify SSES basins and perform condition assessment to determine rehabilitation
  - develop a sewer system model
  - adhere to Regional Technical Standards

Suffolk Sanitary Sewer System Inventory



Flow Monitoring

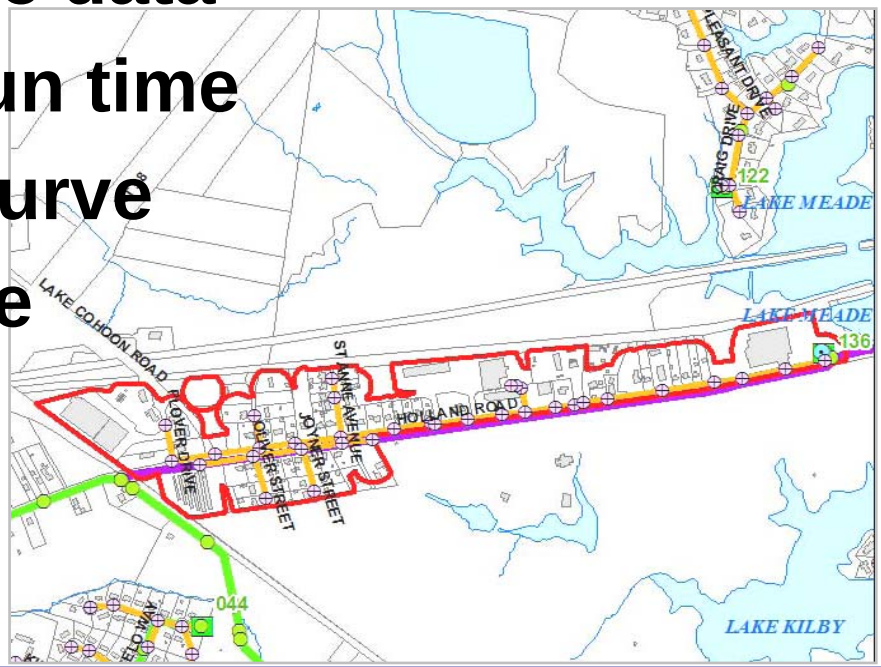
Suffolk installed flow monitoring equipment at 100 of their 132 pump stations.



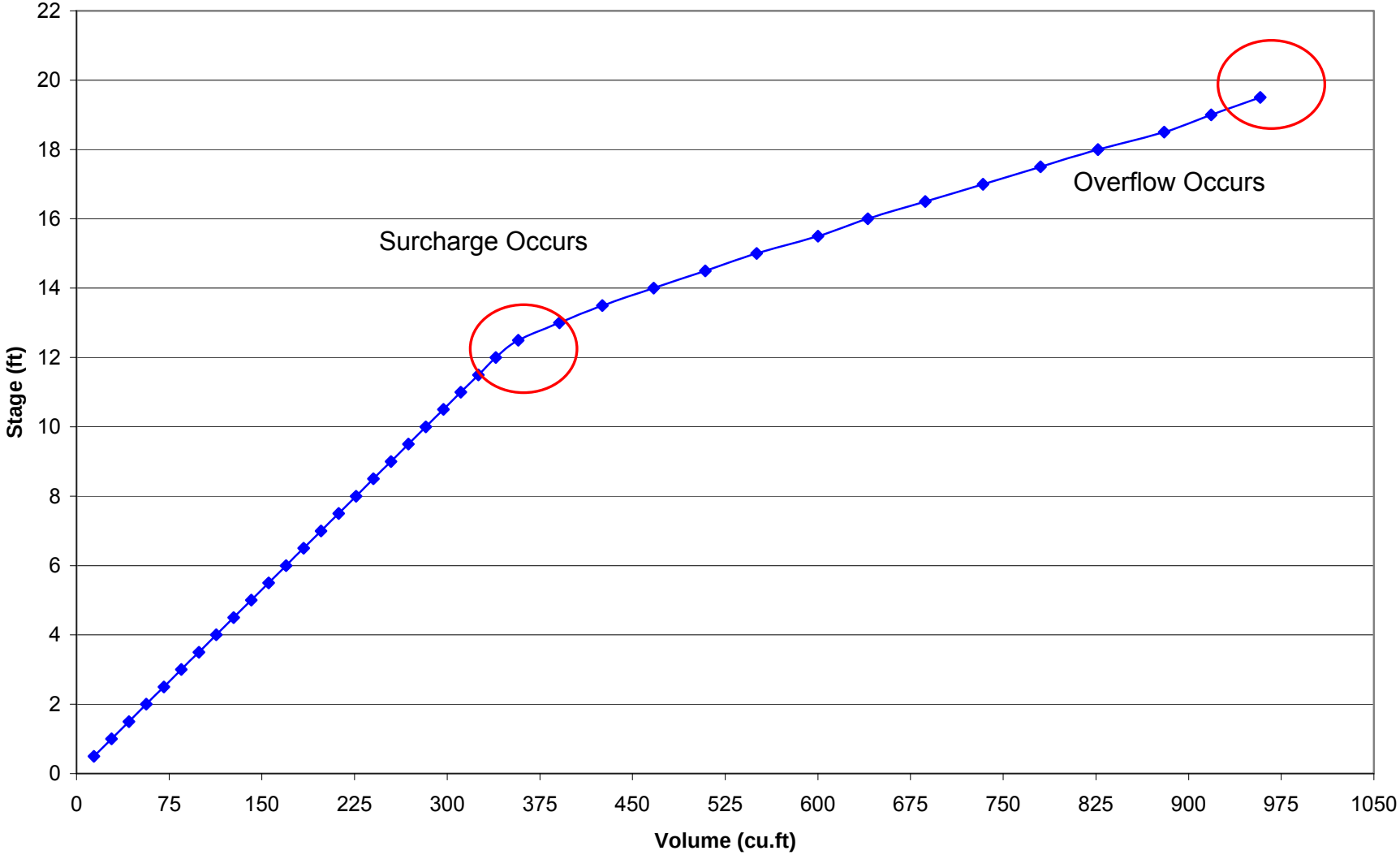
Example Flow Monitoring Sequence for PS 136

Flows were calculated using:

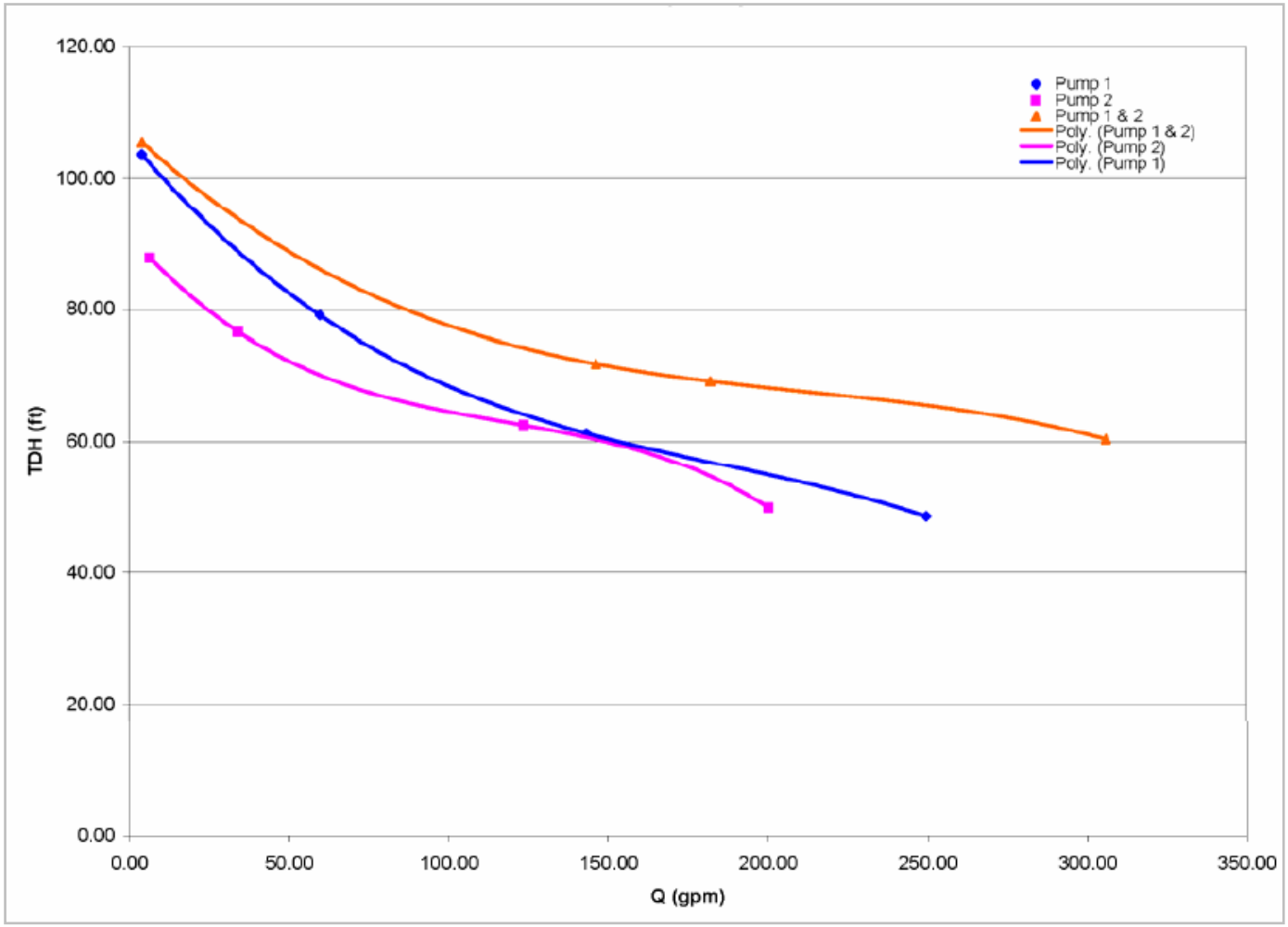
1. **wet well pressure data**
2. **force main pressure data**
3. **pump status and run time**
4. **station operating curve**
5. **sewer system stage storage curve**



PS136 Stage Storage Curve

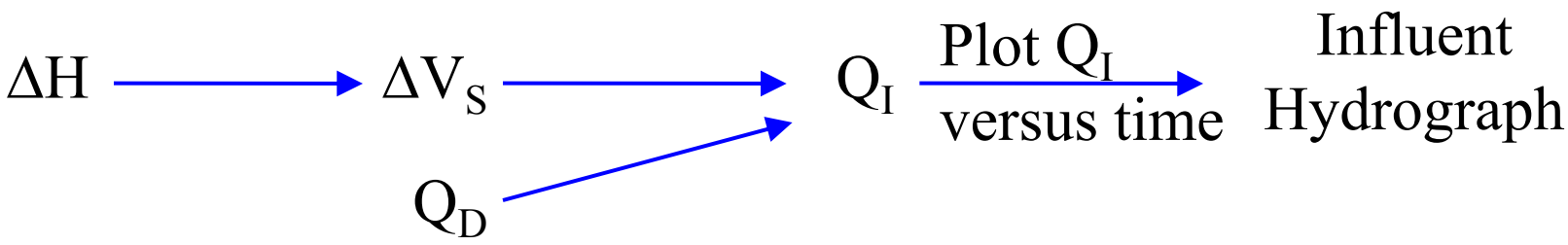


PS 136 Station Operating Curve



Flow Calculation

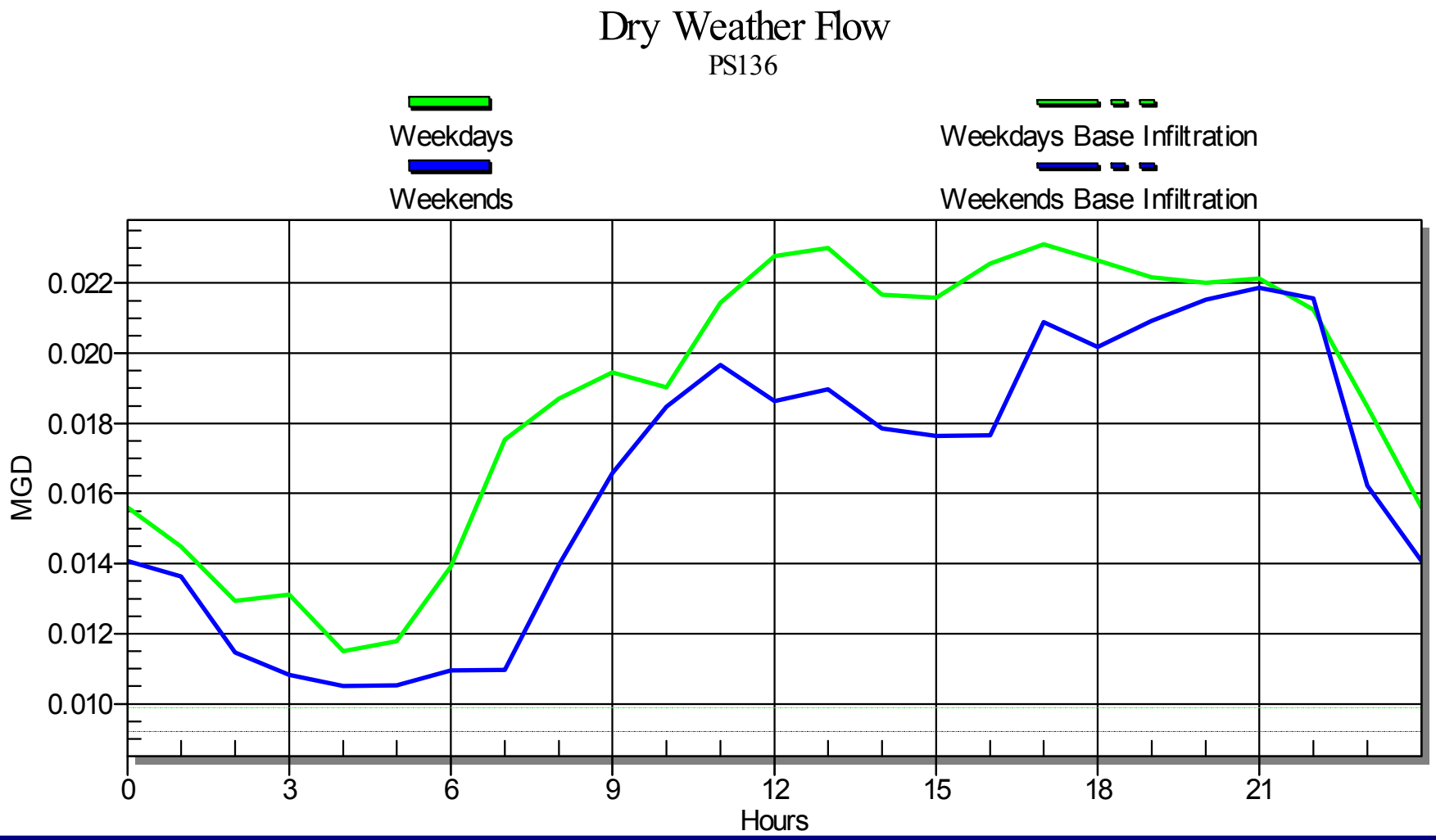
- Station operating curves were used to determine the discharge flows, Q_D, from the pump station based on the TDH
- Station influent flow calculation sequence:



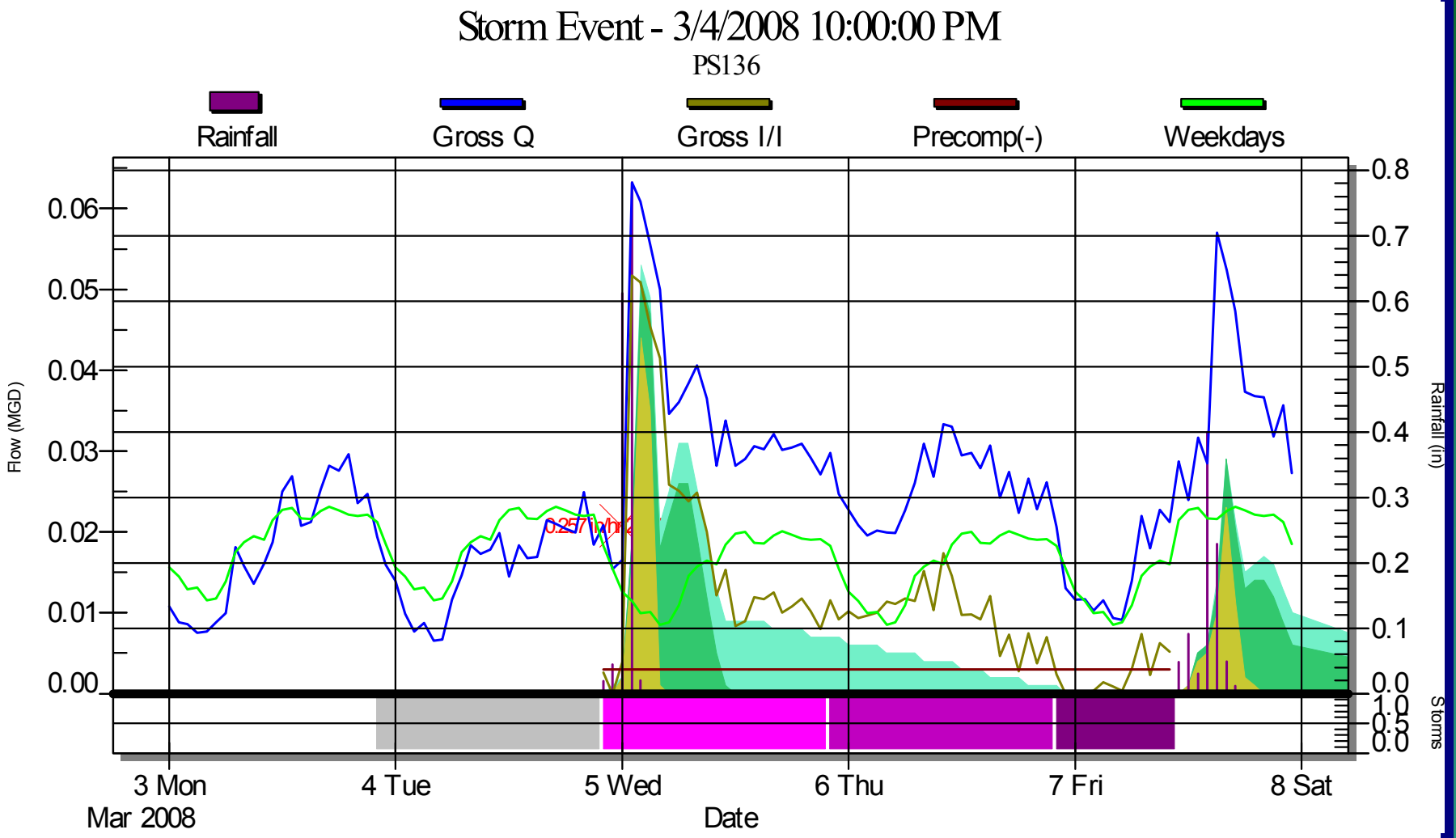
Flow Evaluation

- Reviewed flow data from a minimum six month monitoring period.
- Identified dry weather and wet weather periods
- Reviewed rainfall data and use inverse distance squared to distribute the rainfall for each monitored basin
- Characterized the dry weather and wet weather flows for monitored basins

Example Dry Weather Flow Evaluation



Example Wet Weather Flow Evaluation



Summary

- The process worked as anticipated and now provides continuous flow measurement
- Cost of installations ranged from $7,000 to $9,000
- Algorithm design was adjusted to account for pump start and stop pressure surges
- Periodic maintenance of pressure sensors required
- Automated the process and download the flows from the client's enterprise web site