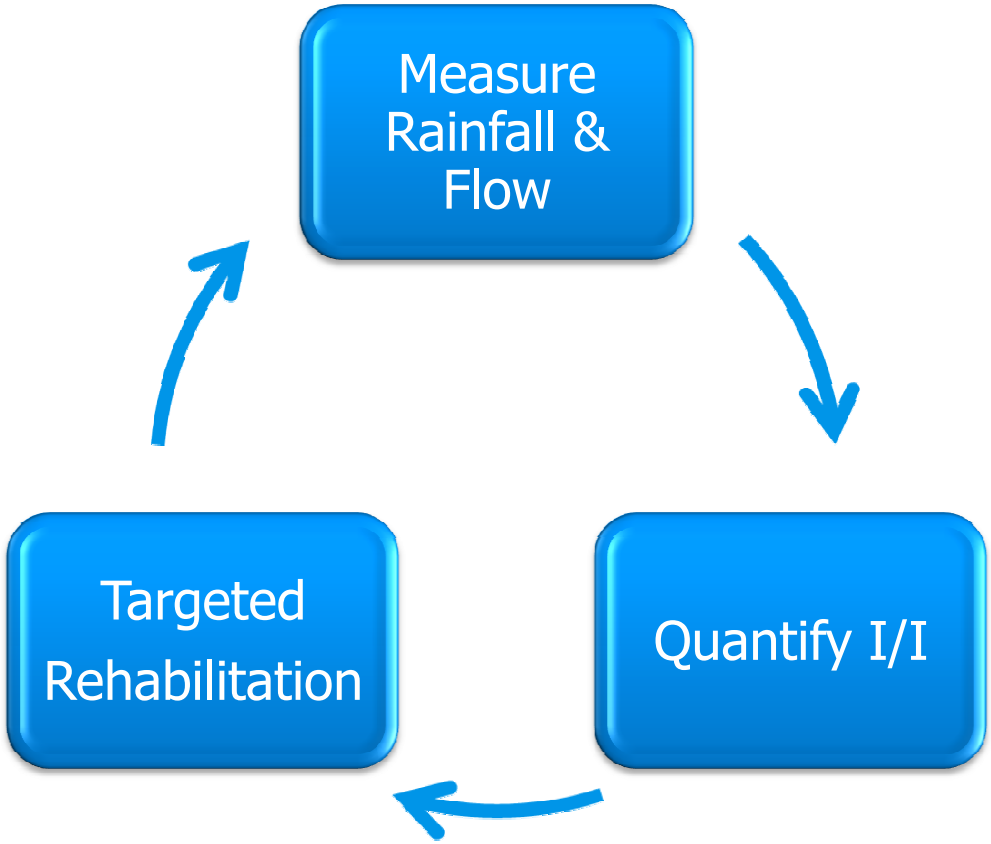
Antecedent Moisture Modeling

I/I Advisory Technical Panel
October 10, 2012

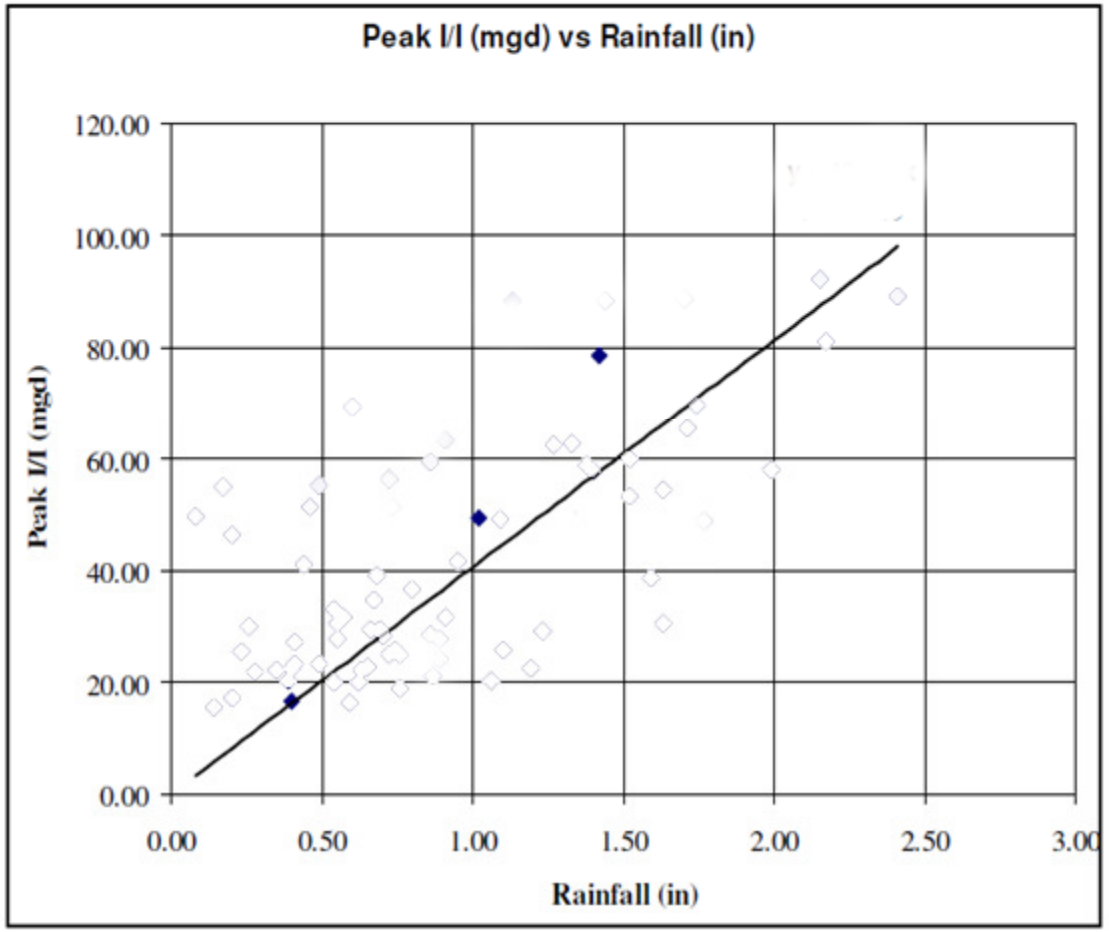
Protecting Our Water Environment
Metropolitan Water Reclamation District of Greater Chicago

DONOHUE & ASSOCIATES

Conventional Approach



Flow vs. Rainfall



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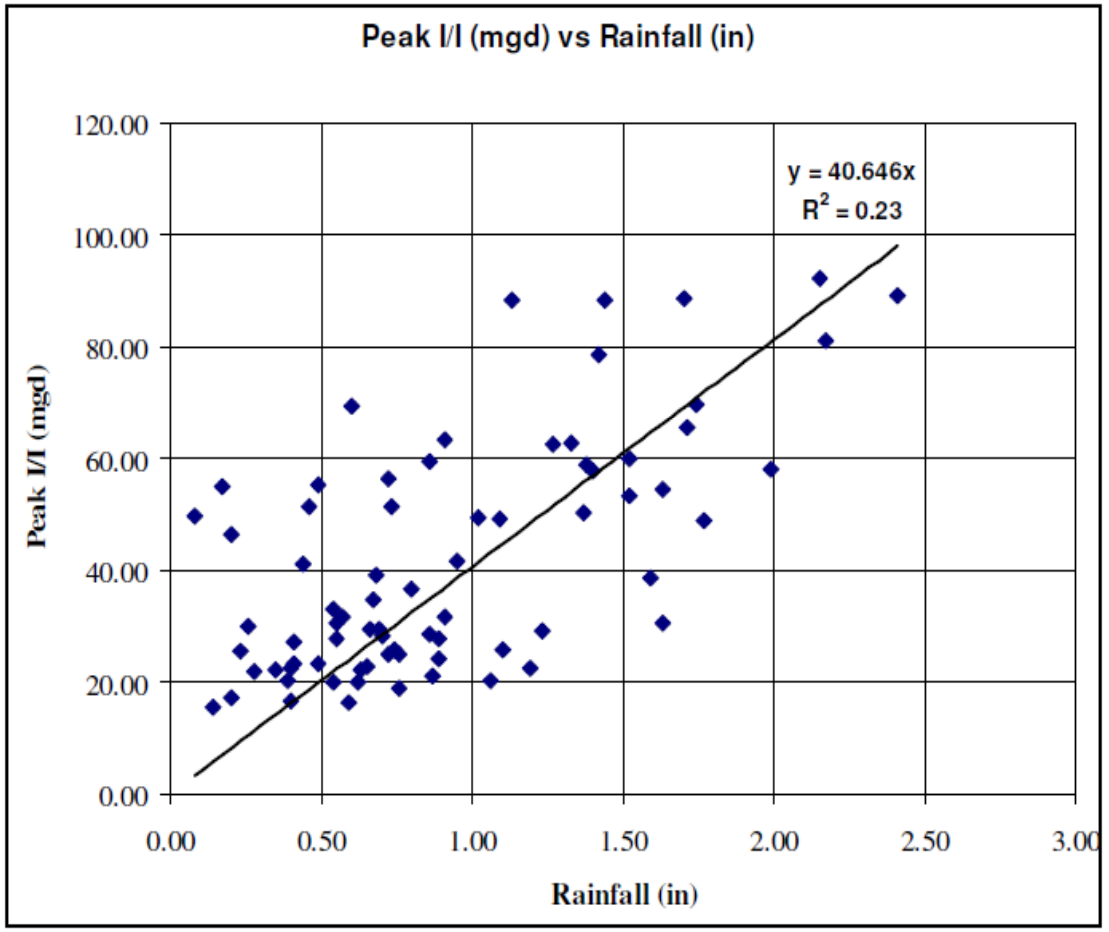


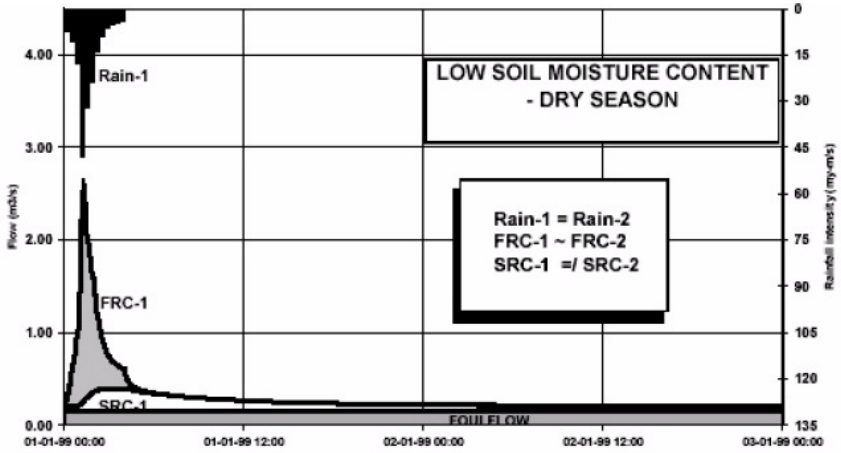
Consequences of Uncertainty

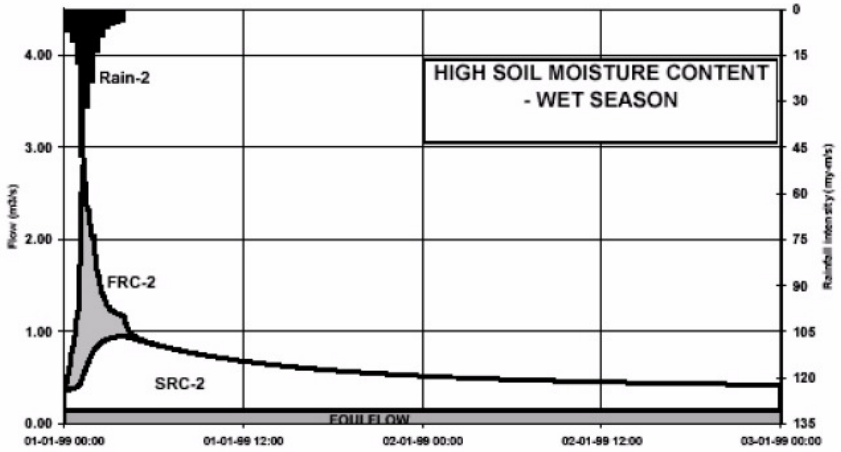
- Inability to quantify I/I
- Inability to quantify effectiveness of rehab
- Overly conservative improvements

Nature of the Problem

- **Unknown pathways for I/I to enter sewers**
- **Unknown soil types / permeability**
- **Antecedent moisture**
  - Short and long response times
  - Seasonal response
  - Back-to-back events

Effect of Antecedent Moisture



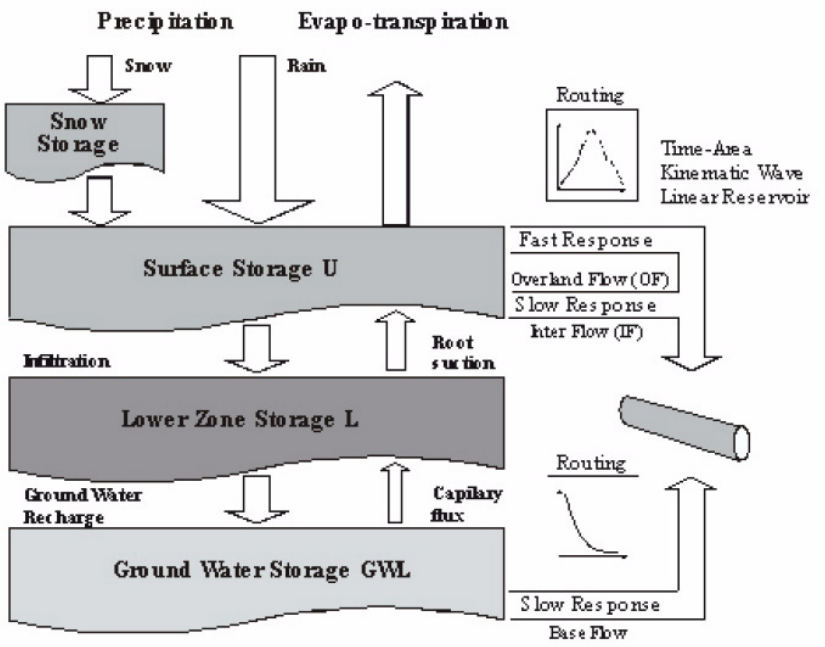


THERE IS A BETTER WAY!

- **Antecedent Moisture Modeling (AMM)**
- **Long-Term-Simulations (LTS)**

Antecedent Moisture Modeling

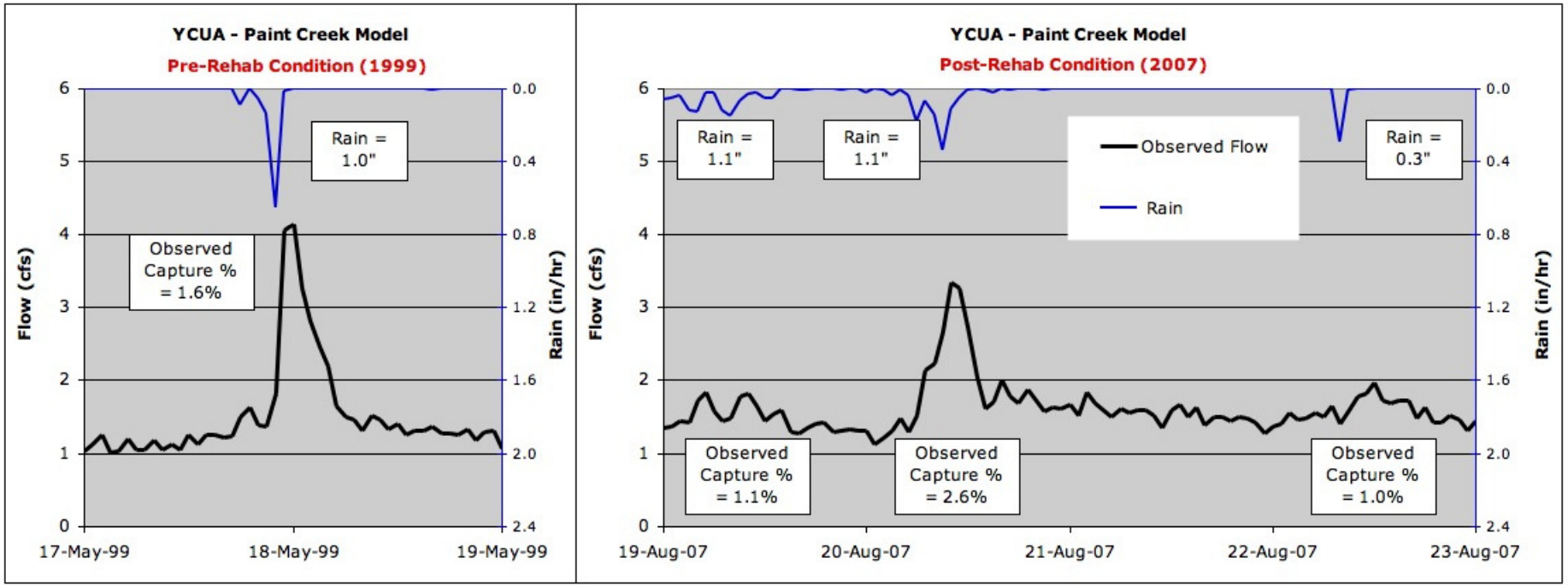
- Rainfall Dependent Infiltration (RDI)
- Simulates hydrologic cycle



Antecedent Moisture Modeling

- **Rainfall Dependent Infiltration (RDI)**
- **Simulates hydrologic cycle**
- **Predicts short & long-term response**
- **Simulates effect of back-to-back events**
- **Predicts wet weather response over long periods of time**
- **Empirical model** (requires long-term calibration)

I/I Reduction Effectiveness



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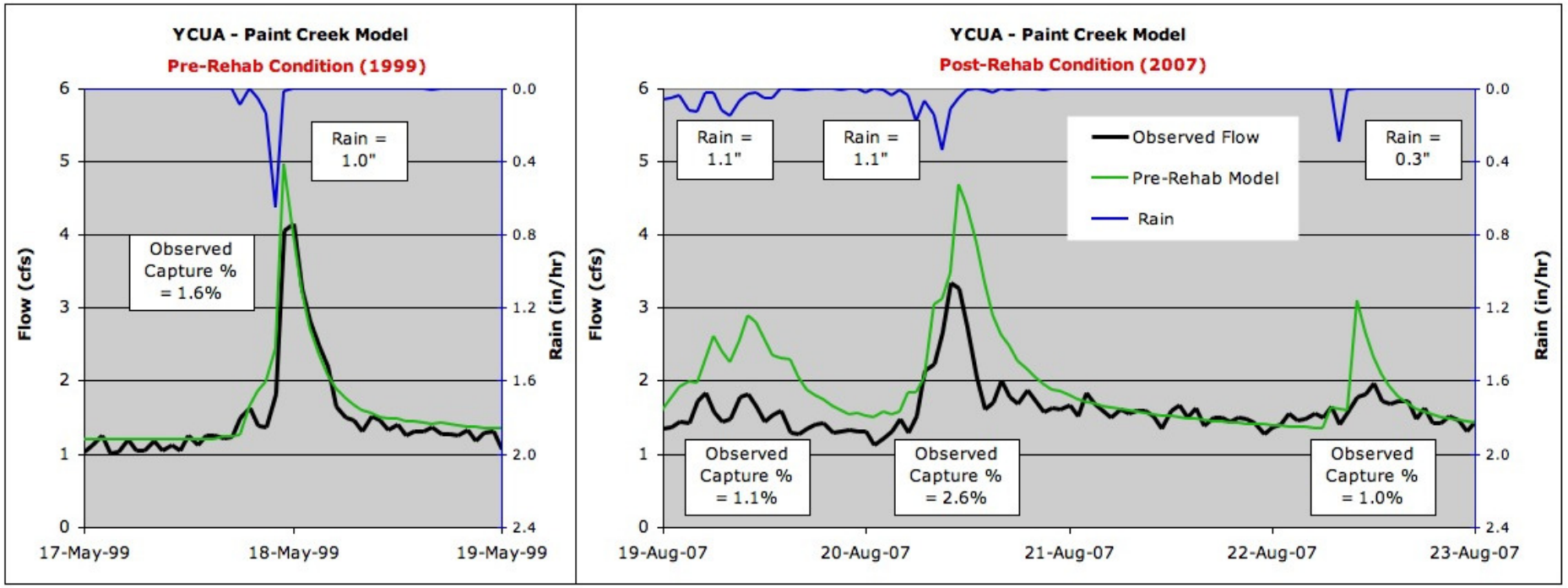

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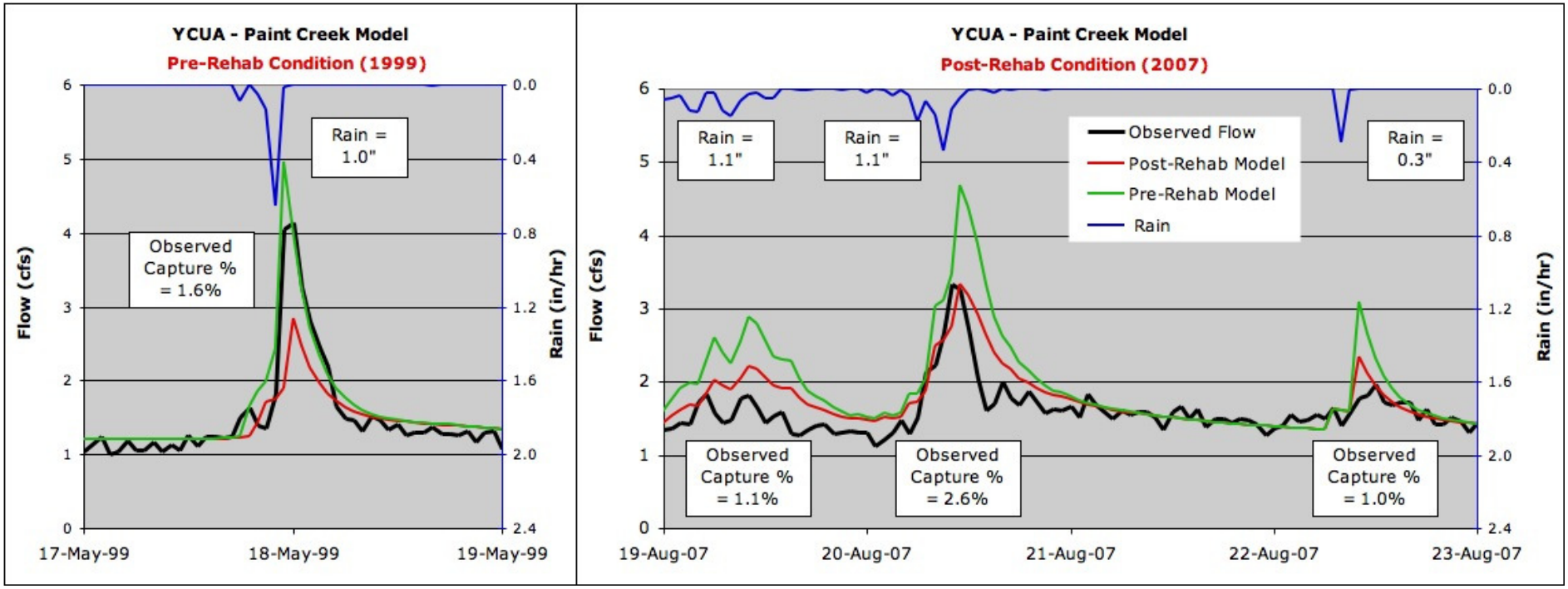
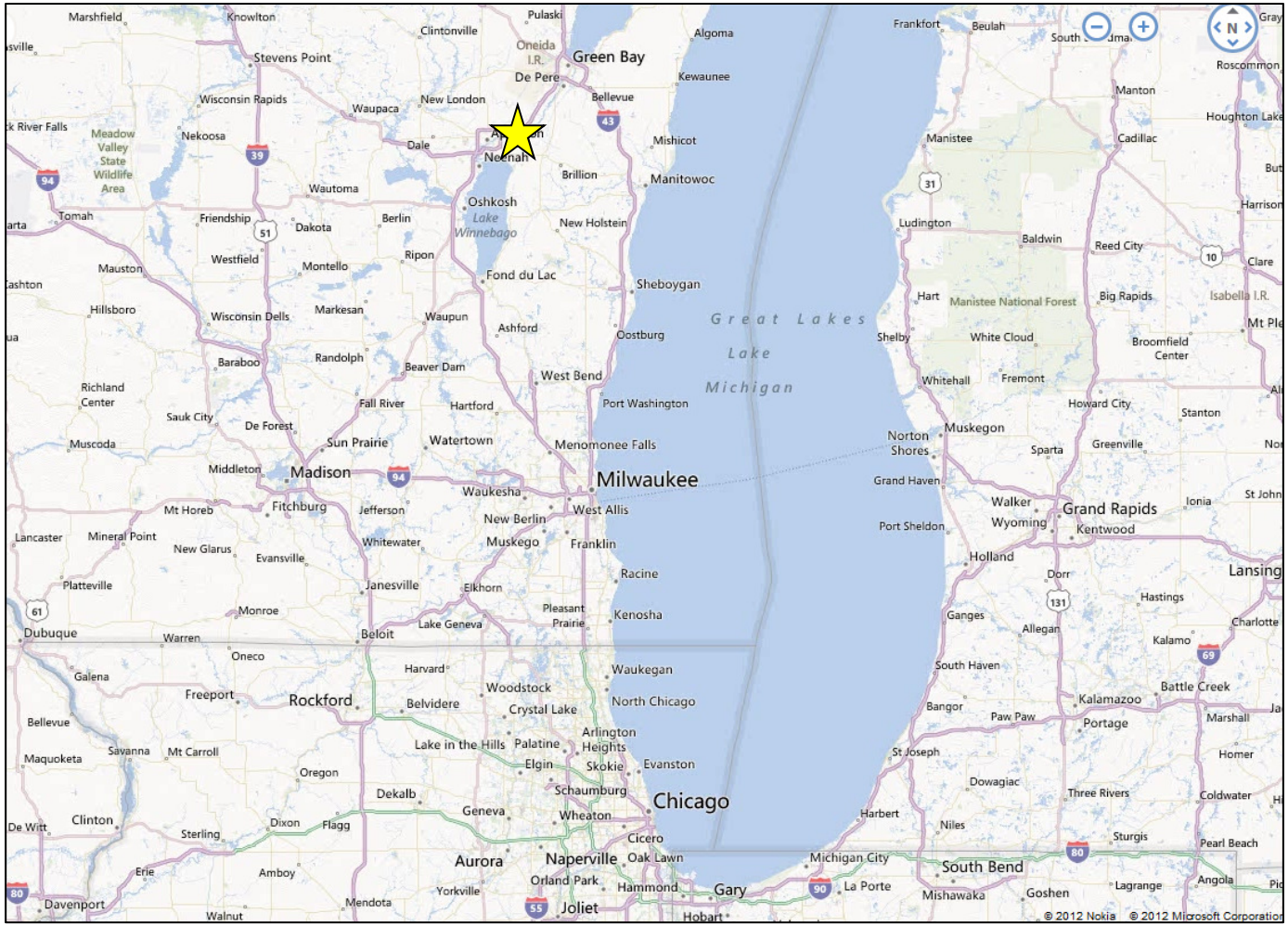
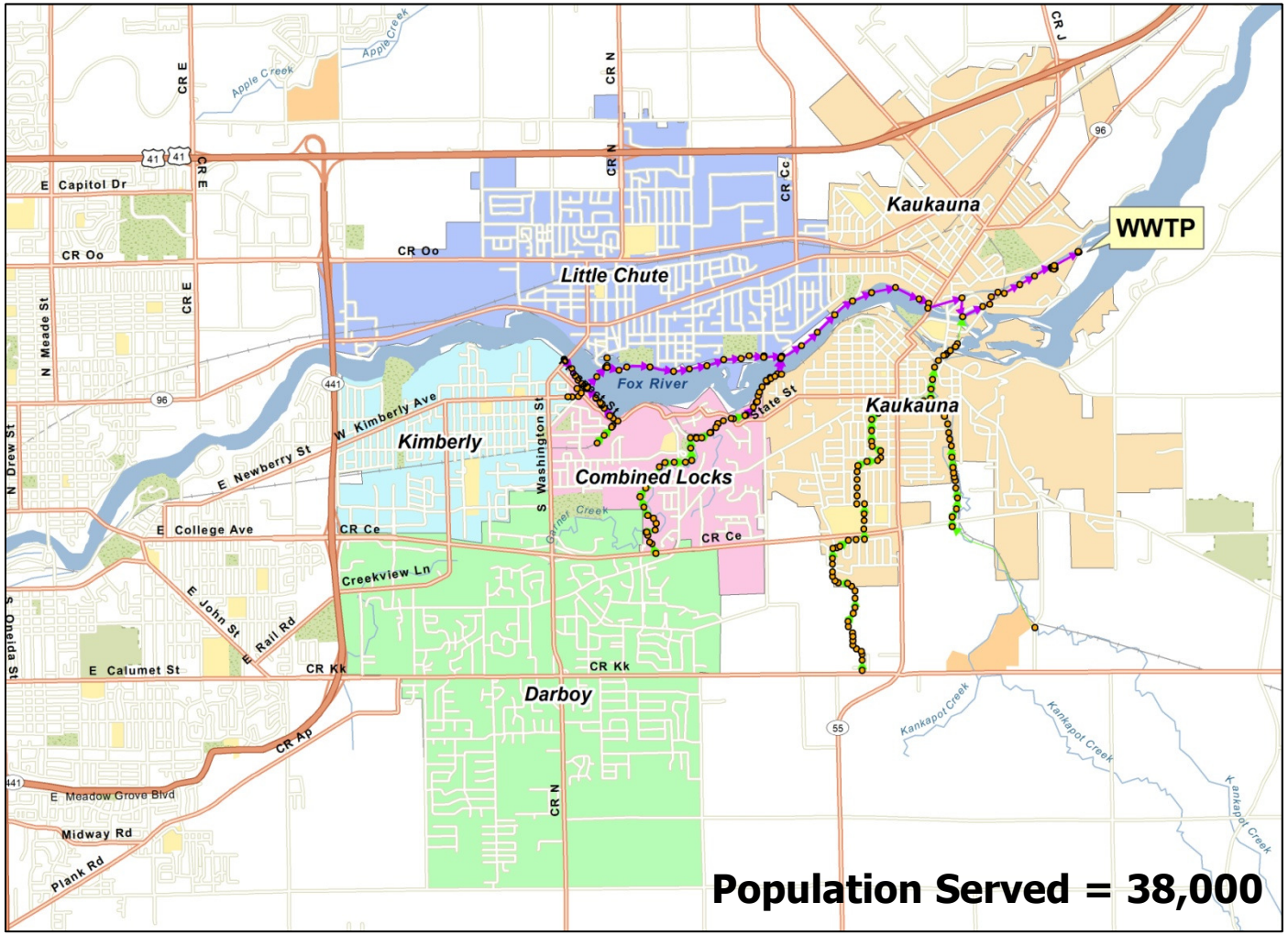


Heart of the Valley



Protecting Our Water Environment

Heart of the Valley



Protecting Our Water Environment

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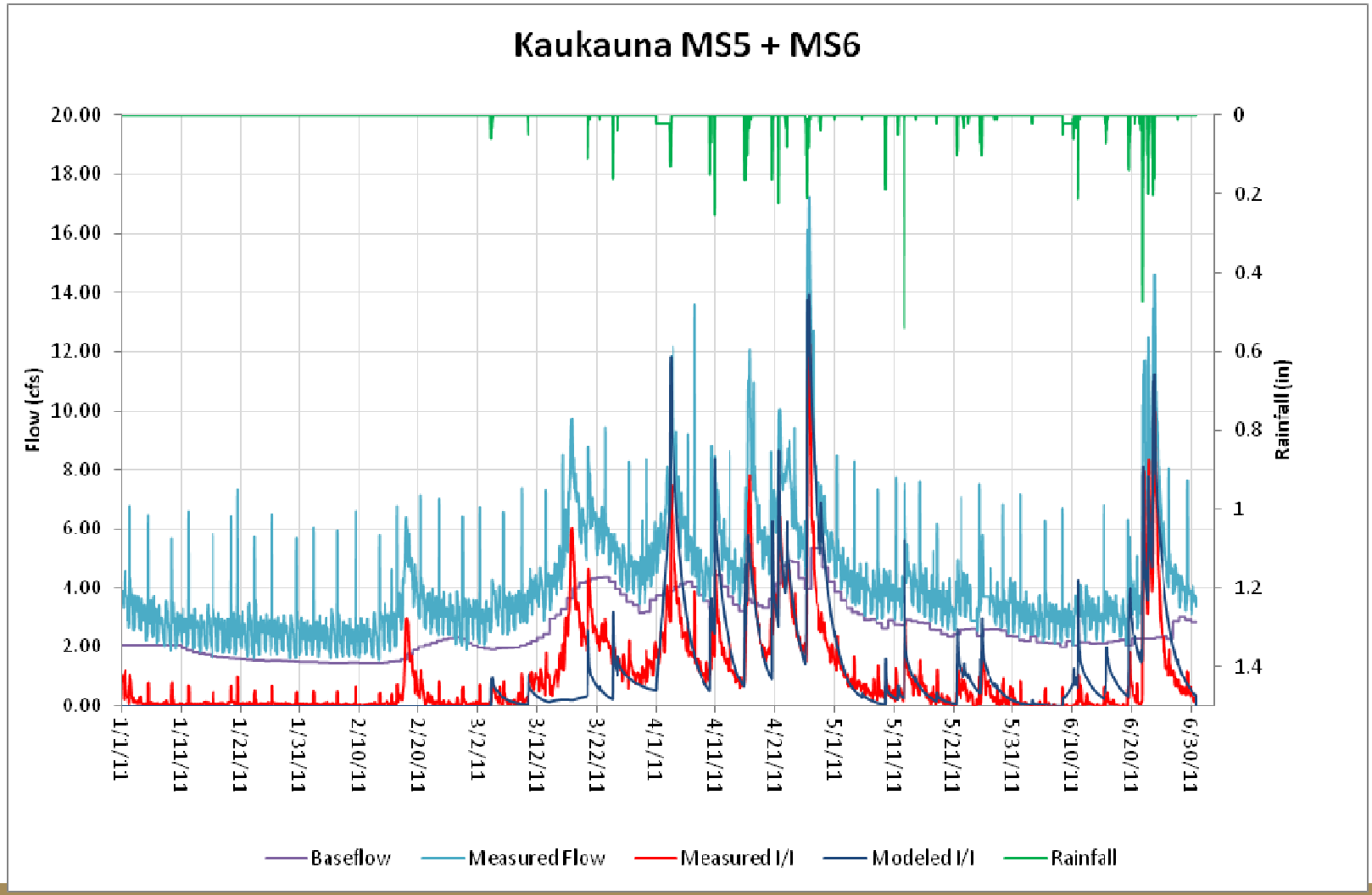
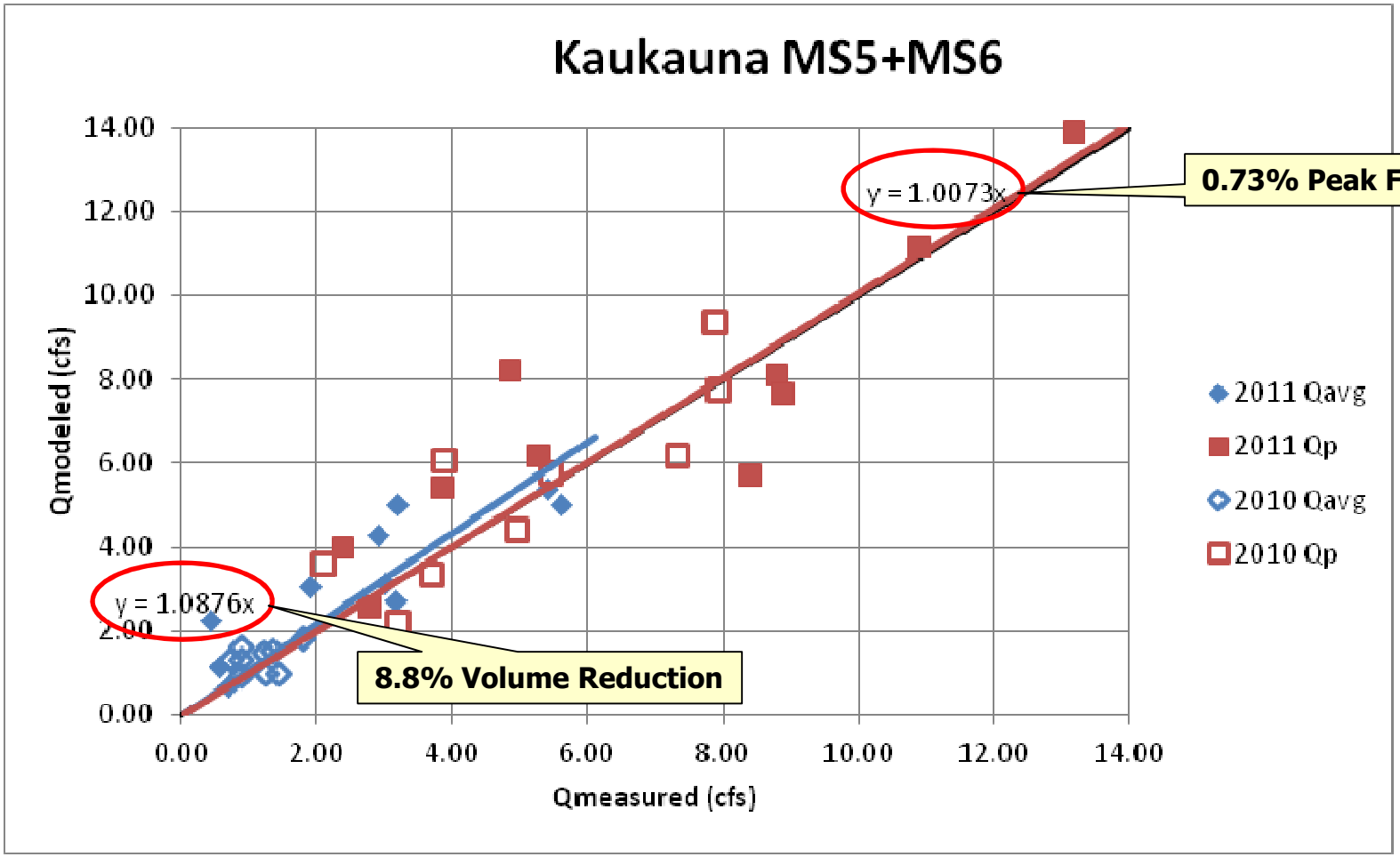


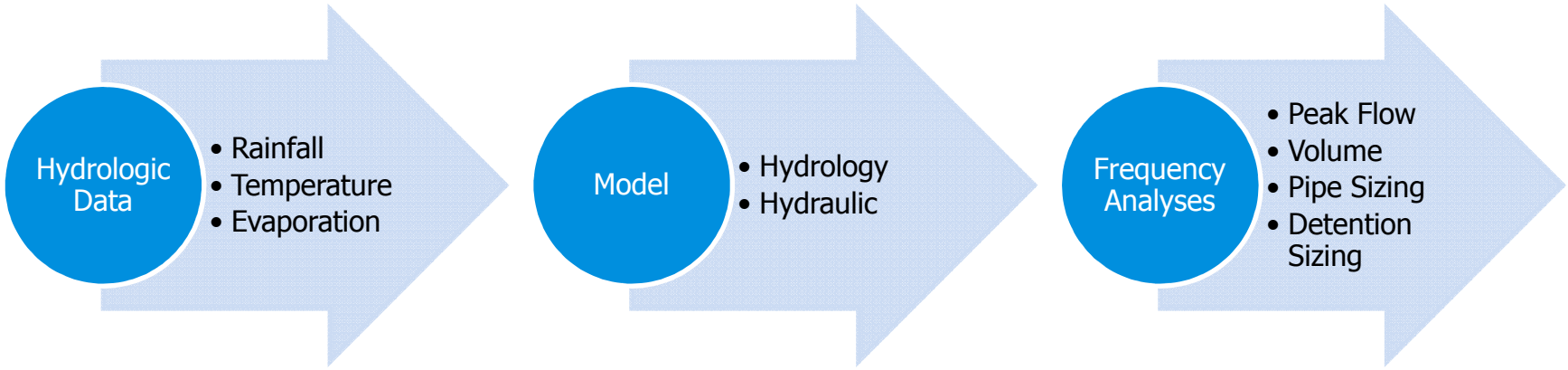
Kaukauna


Kaukauna MS5+MS6
Qmodeled (cfs)
Qmeasured (cfs)
14.00
12.00
10.00
8.00
6.00
4.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
y = 1.0073x
y = 1.0876x
0.73% Peak Flow Reduction
8.8% Volume Reduction
2011 Qavg
2011 Qp
2010 Qavg
2010 Qp

Cost-Effective Analysis

Item	Quantity
I/I Reduction Goal	30%
I/I Reduction to Date	13%
Peak Flow Reduction	8 MGD
Public Rehab Costs	$15M
Private Rehab + Ancillary	~$15M
Unit Cost	$2M - $4M per MGD

Long Term Simulations (LTS)



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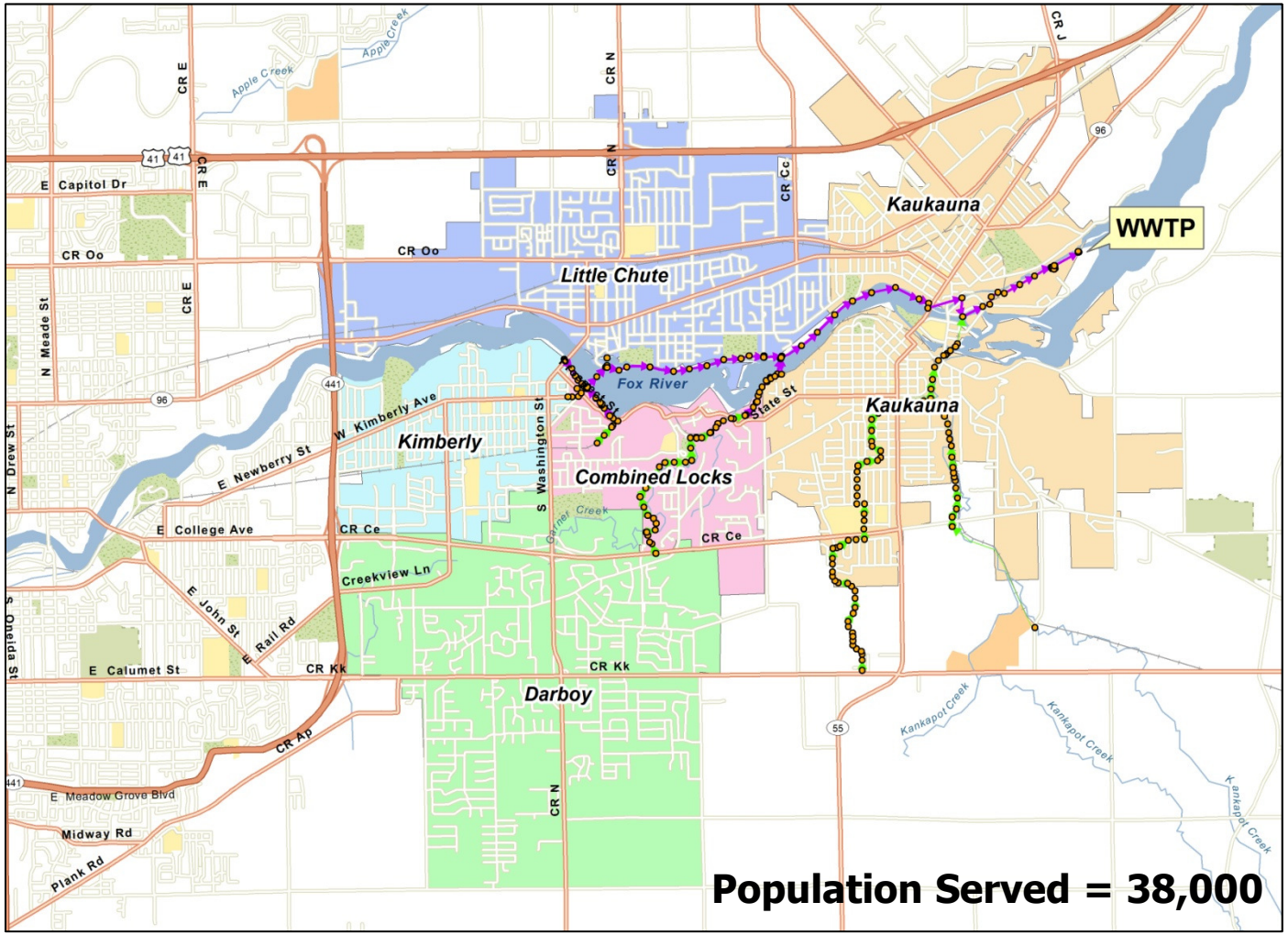
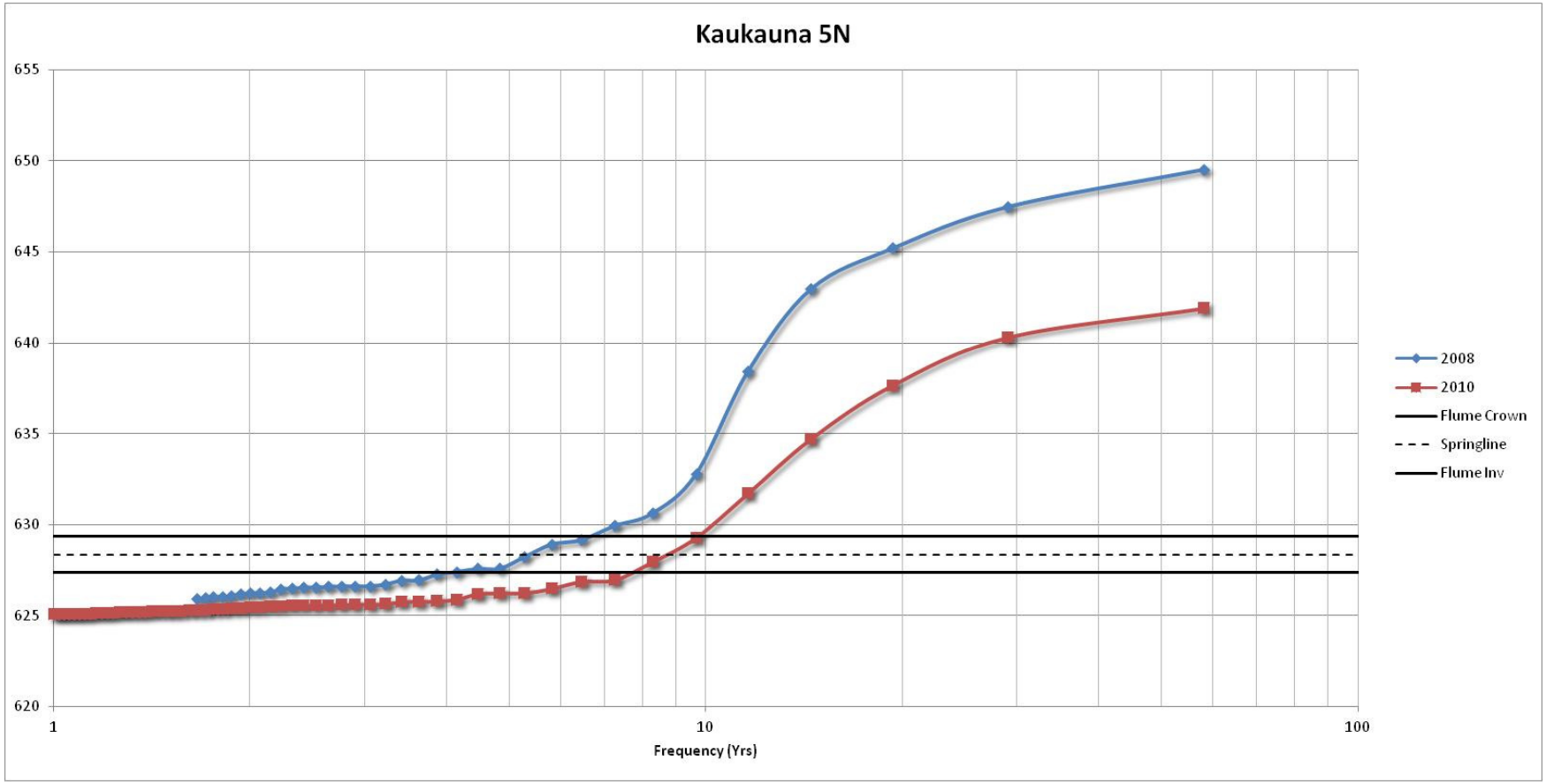
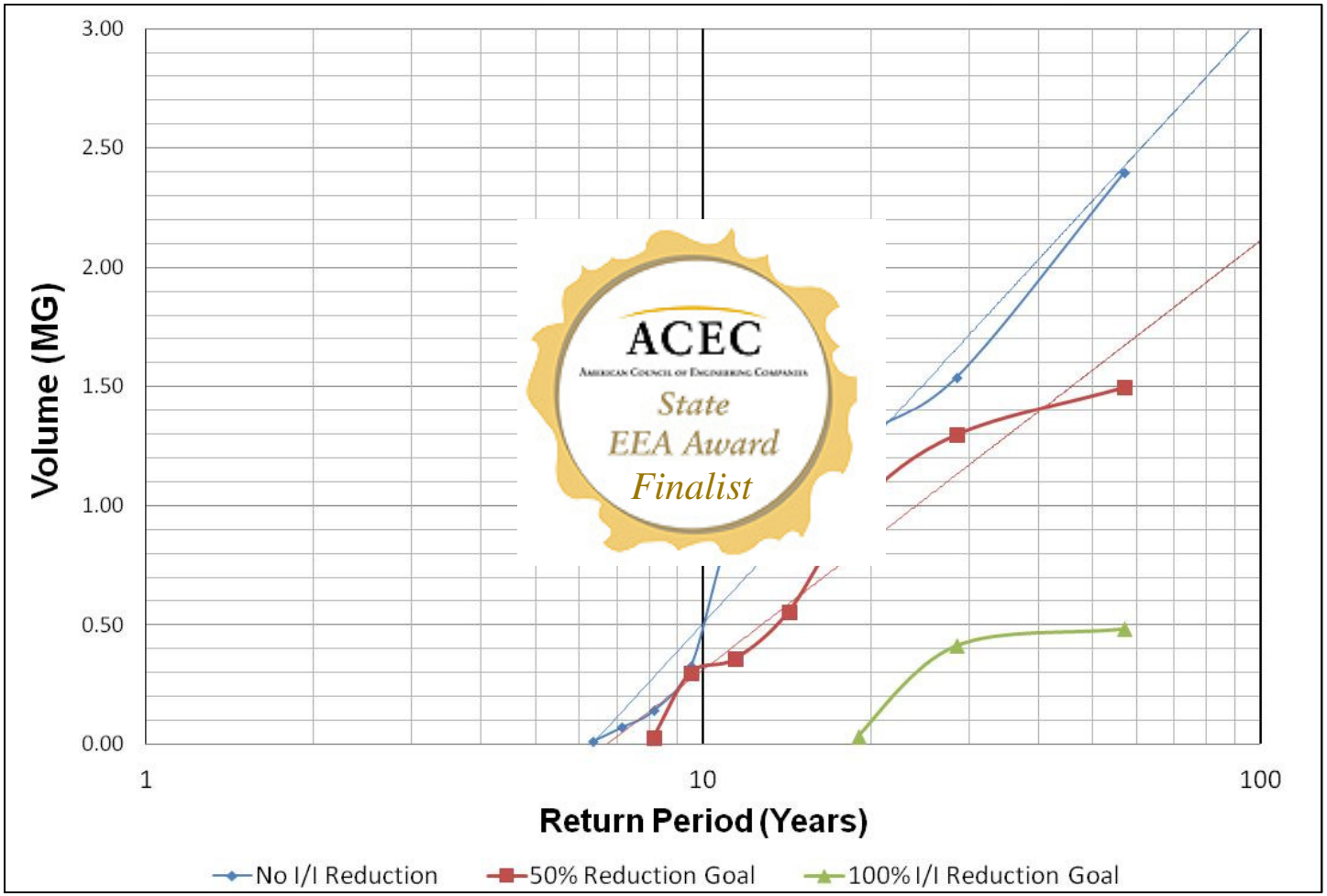


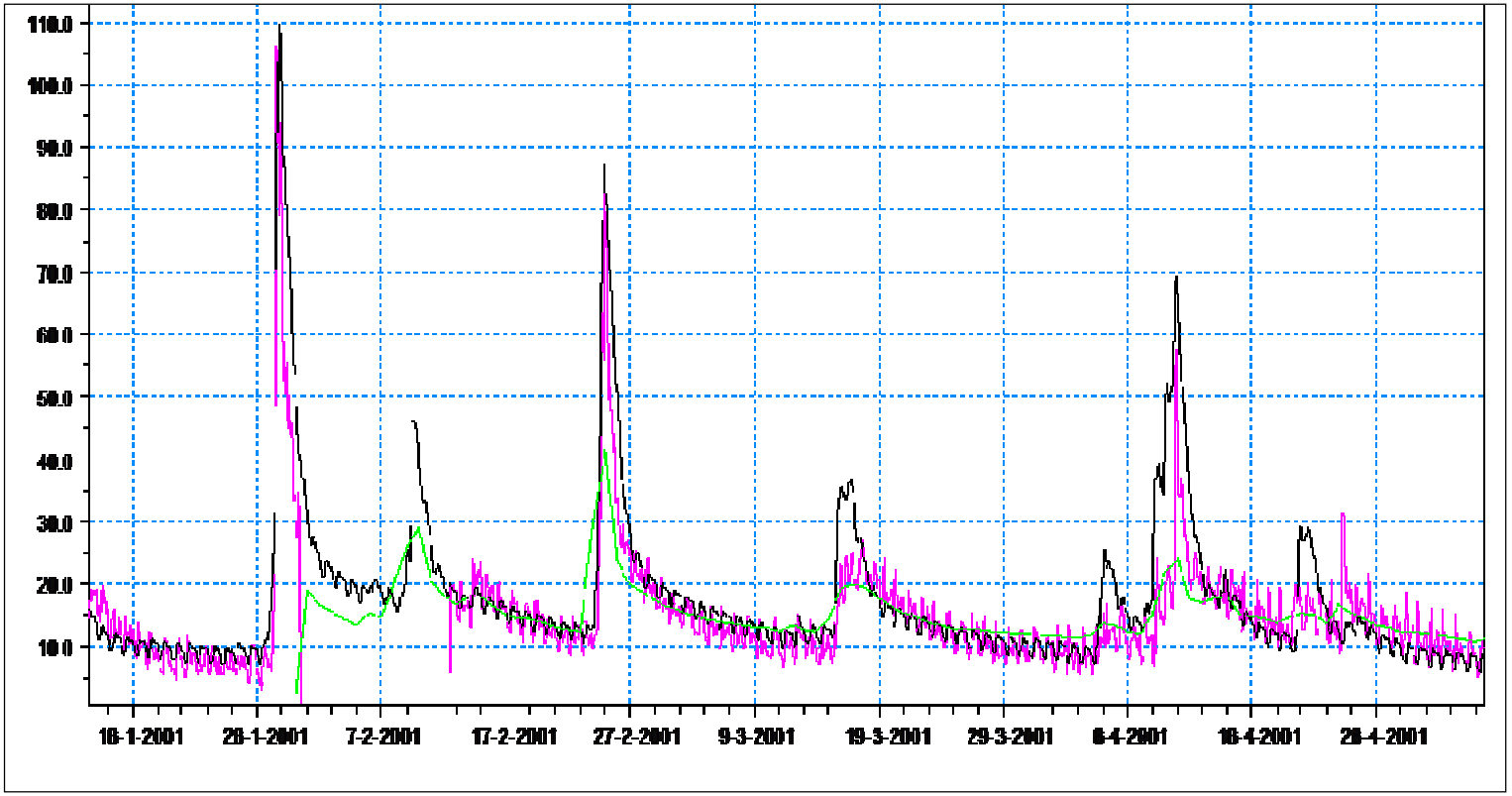
Surcharge Frequency

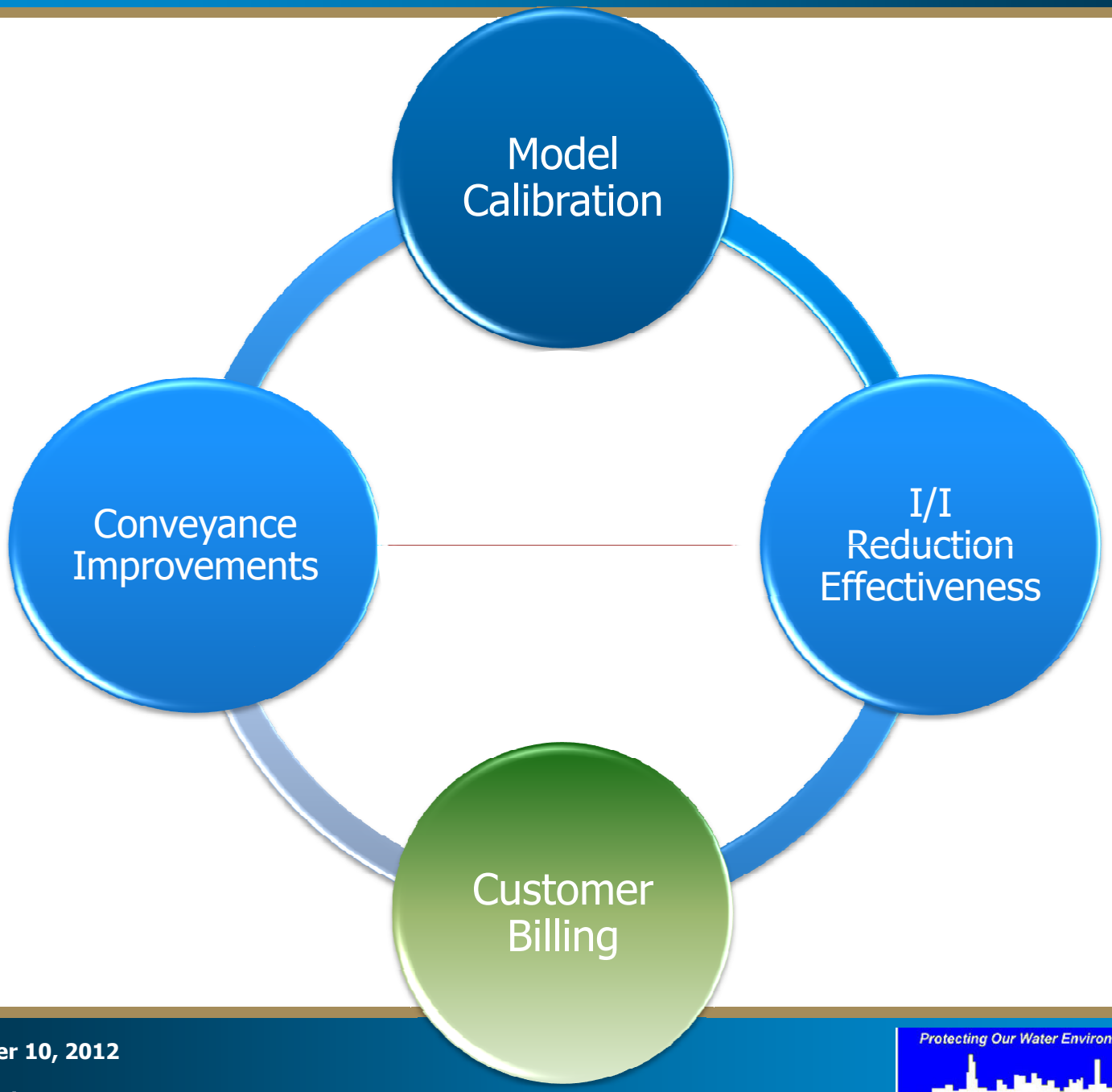


Flow Equalization Sizing



RDI Model Calibration




Model Calibration
I/I Reduction Effectiveness
Customer Billing
Conveyance Improvements

Modeling Software

Name	Developer	AMM Method	GIS Integration
MikeUrban	DHI	Full RDII	Good
XP-SWMM	XP Software	UH[1]	Poor
EPA SWMM	USEPA / CDM	UH	None
InfoWorks CS	Innovyze	Full RDII	Excellent
Info-SWMM	Innovyze	UH	Excellent
SewerGEMS	Bentley	UH	Excellent
H_2O Metrics	i3D Technologies	Variable PR[2]	N/A
Hydra	Pizer	None	None
PC-SWMM	CHI	UH	Poor

1. Unit Hydrograph
2. Percentage Runoff

Questions?

Antecedent Moisture Modeling
I/I Advisory Technical Panel
October 10, 2012

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