

Skyway Infiltration/Inflow Reduction Project



E & P Subcommittee
Briefing

January 9, 2014



King County

Department of Natural Resources and Parks
Wastewater Treatment Division

Purpose of Today's Briefing

- King County I/I Program Context
- I/I Demonstration Project Goals
- Present results of post-construction flow monitoring
- Discuss preliminary conclusions regarding effectiveness
- Present lessons-learned during design and construction
- Respond to questions

I/I in the Service Area

- 75% of Peak Flow in King County System is I/I
- 95% of I/I is from Local Agencies
- 50% of I/I is from Private Property



King County's I/I Program

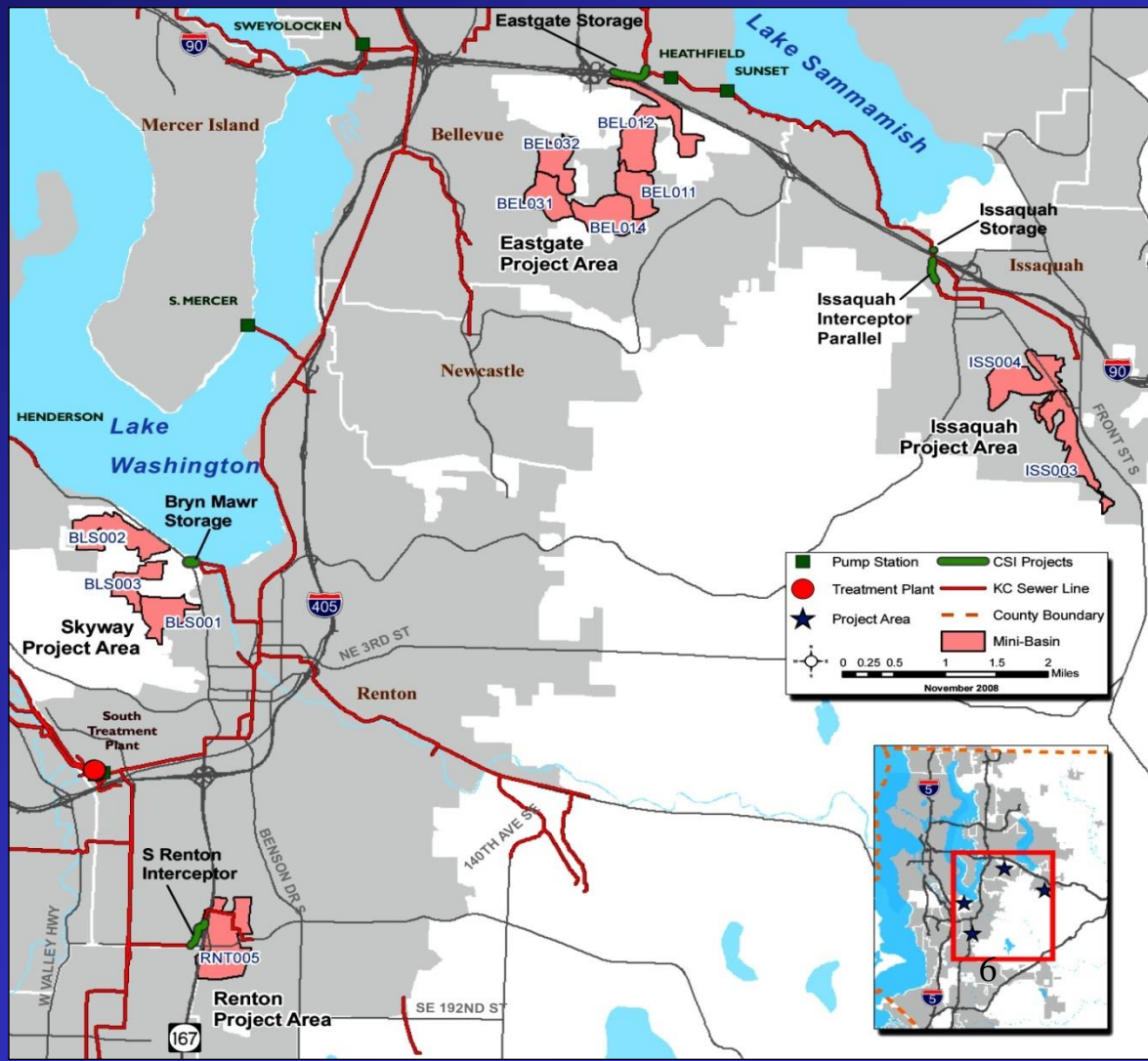
- A Regional Consensus-Based Program
- Major I/I Identified Through Flow Monitoring and Modeling
- Specific Types of I/I Identified
- Pilot Project Implemented To Demonstrate & Test the Effectiveness of Different Techniques of I/I Removal
- Results Used to Forecast Amount of I/I That Can Be Removed Cost-Effectively
- Planning Assumptions Developed Jointly with E&P Subcommittee

This Project Initiated Second Phase of Program

- To Demonstrate & Test the Cost-Effectiveness of I/I Removal on Large Scale
- To Test Planning Assumptions for Use in Future I/I Reduction Planning
- To Learn More from Rehabilitating Side Sewers Involving Private Property
- To Provide Models for Successful Future Projects
- Results Will Be Used to Develop Long-Term I/I Control Strategy in Partnership With Local Agencies

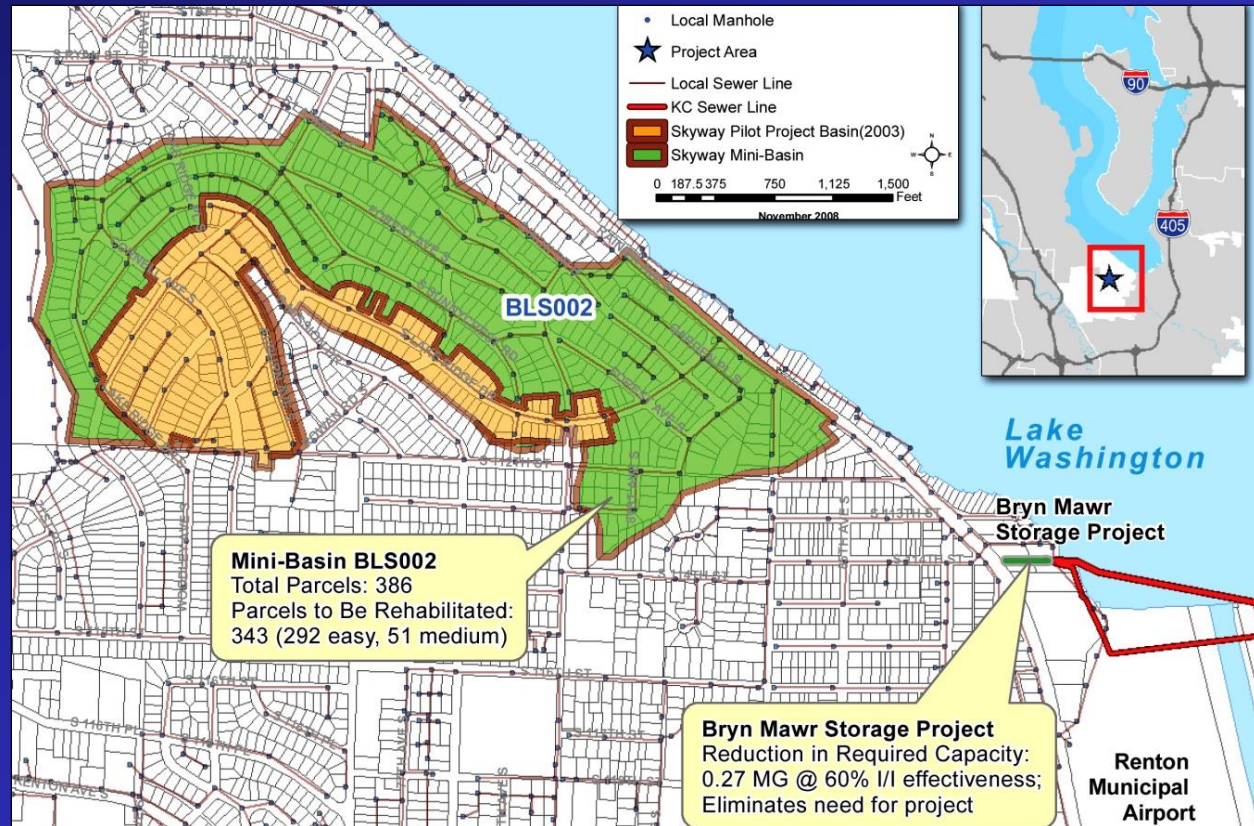
Project Areas and Mini-Basins Evaluated

- Four Project Areas with 11 Mini-Basins Evaluated
- Each Project Area has Future Downstream Conveyance Upgrade Need



Project Recap

- Rehabilitation of 343 Side Sewers in Skyway
- Estimated Removal of 1.8 to 2.2 MGD Peak I/I (60% to 75% Reduction)
- Goal to Eliminate Need for Downstream Storage



Skyway Final Design

- 369 Available Properties in Basin for Rehabilitation (Targeted 343)
- Skyway Added Sewer Main and Manhole Rehabilitation

- 20,000 LF of sewer main replacement
- Replacement of 90 manholes

- Separate Bid Schedules Developed

	Quantity
Bid Schedule A – Lateral and Side Sewer Replacement	
Preconstruction Inspection of Side Sewers and Laterals	28,990 feet
Side Sewer and Lateral Replacement by Pipe Bursting	21,981 feet
Side Sewer and Lateral Replacement by Open Cut	1,300 feet
Lateral Reconnections to Sewer Main	345
Private Property Cleanouts	371
Bid Schedule B – Sewer Mains and Manholes	
Preconstruction Inspection of Sewer Main	20,630 feet
Sewer Main Replacement by Pipe Bursting	20,389 feet
Manhole Replacements	93

- Bid Schedule A – Side Sewers and Laterals
- Bid Schedule B – Sewer Mains and Manholes⁸

Bid Costs

- Engineer's Estimate
 - Schedule A: \$3,157,000
 - Schedule B: \$1,924,100

\$5,081,100
- Low Bid
 - Schedule A: \$1,253,400
 - Schedule B: \$2,028,800

\$3,282,200
- Avg. Bid Cost
 - Schedule A: \$2,609,400
 - Schedule B: \$2,084,800

\$4,693,200



Construction Completed 2012

Schedule A: \$1,022,900

Schedule B: \$1,942,700

\$2,965,600

Change Orders: \$ 179,500

Final Cost: \$3,145,100

- Final Tally Included Work on 302 Properties
- Approx 70% of Projected Side Sewer Footage Completed
- Post Construction Flow Monitoring Completed For 2012/2013 Wet Season



Post Construction Flow Monitoring



I/I Removal Results

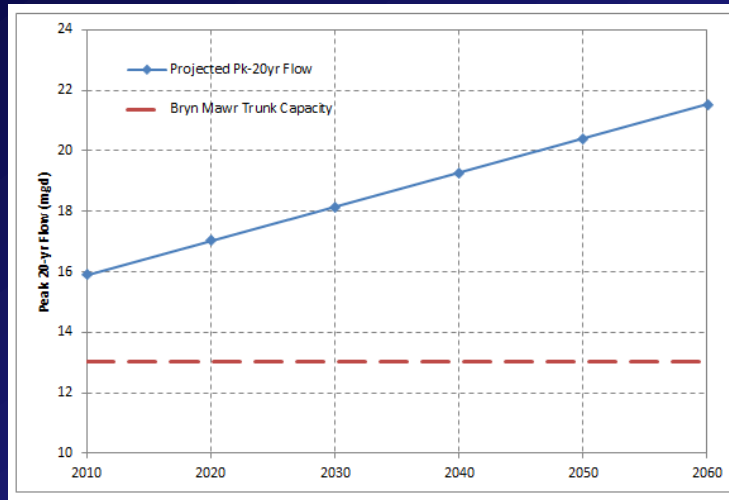
Modeled Pilot Project Effectiveness

Basin	Pre-Pilot Project Peak 20 yr I/I (mgd)	Post- Pilot Project Peak 20 yr I/I (mgd)	Peak Flow Reduction
Pilot	2.15	0.25	88.5%
BLS002	5.97	4.07	31.8%
BLS43B	12.62	11.05	12.5%

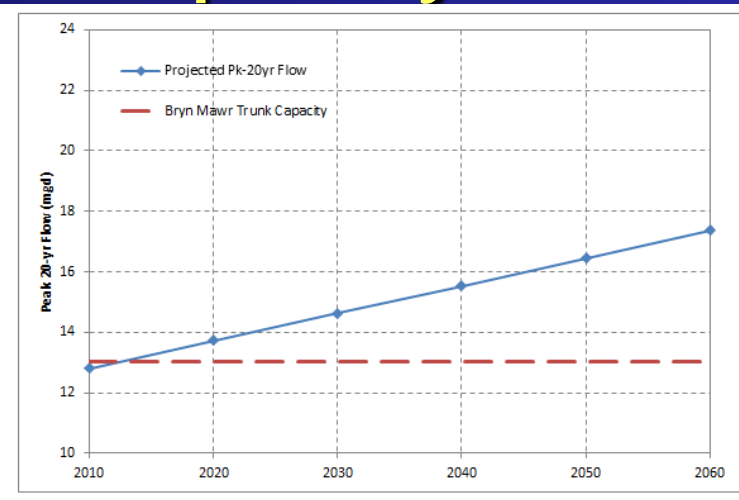
Modeled Demonstration Project Effectiveness

Basin	Pre-Demonstration Project Peak 20 yr I/I (mgd)	Post- Demonstration Peak 20 yr I/I (mgd)	Peak Flow Reduction
Pilot	0.25	0.25	N/A
BLS002	4.07	3.29	19.2%
BLS43B	11.05	11.43	-3.4%

Effect of I/I Reduction on Downstream Capacity



Pre-Pilot Project



Post Pilot/Pre-Demonstration Project



Post Demonstration Project

This Project Had Nearly Identical Characteristics as Original Pilot

- Same neighborhood and age of construction
- Sewer system in similar condition as pilot area
- Same design and pipe bursting replacement concept used
- Same construction contractor built both projects
- Same inspector on both projects

Potential Reasons For Falling Short of Reduction Goals

- Potentially more sump pumps than anticipated
- Fewer parcels included complete rehabilitation than past Pilot Project
- Area contributing to BLS002 basin larger than originally delineated

Replacement Status in Project Area



Example of Partial Rehabilitation



Example of Partial Rehabilitation



Example of Partial Rehabilitation



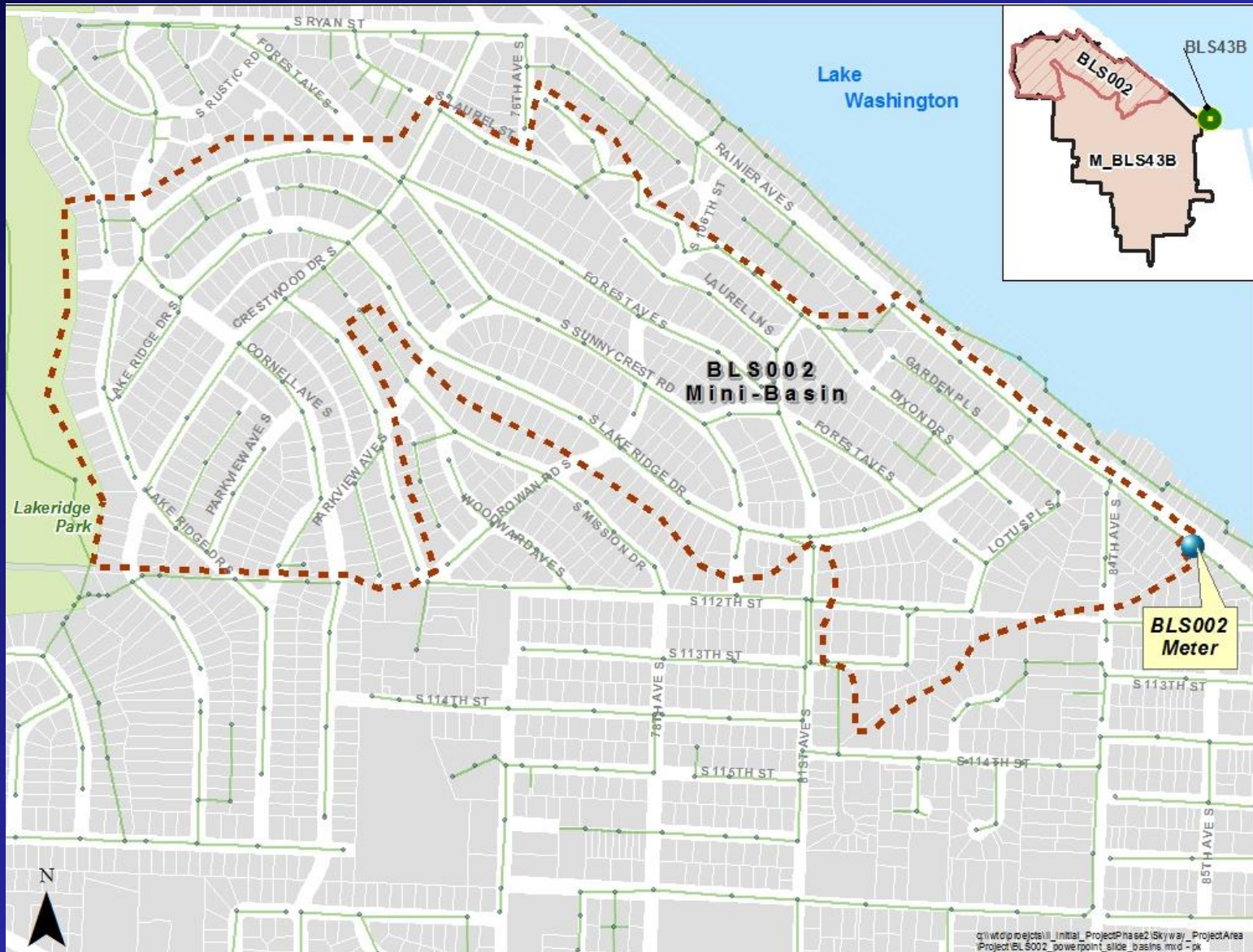
Example of Partial Rehabilitation



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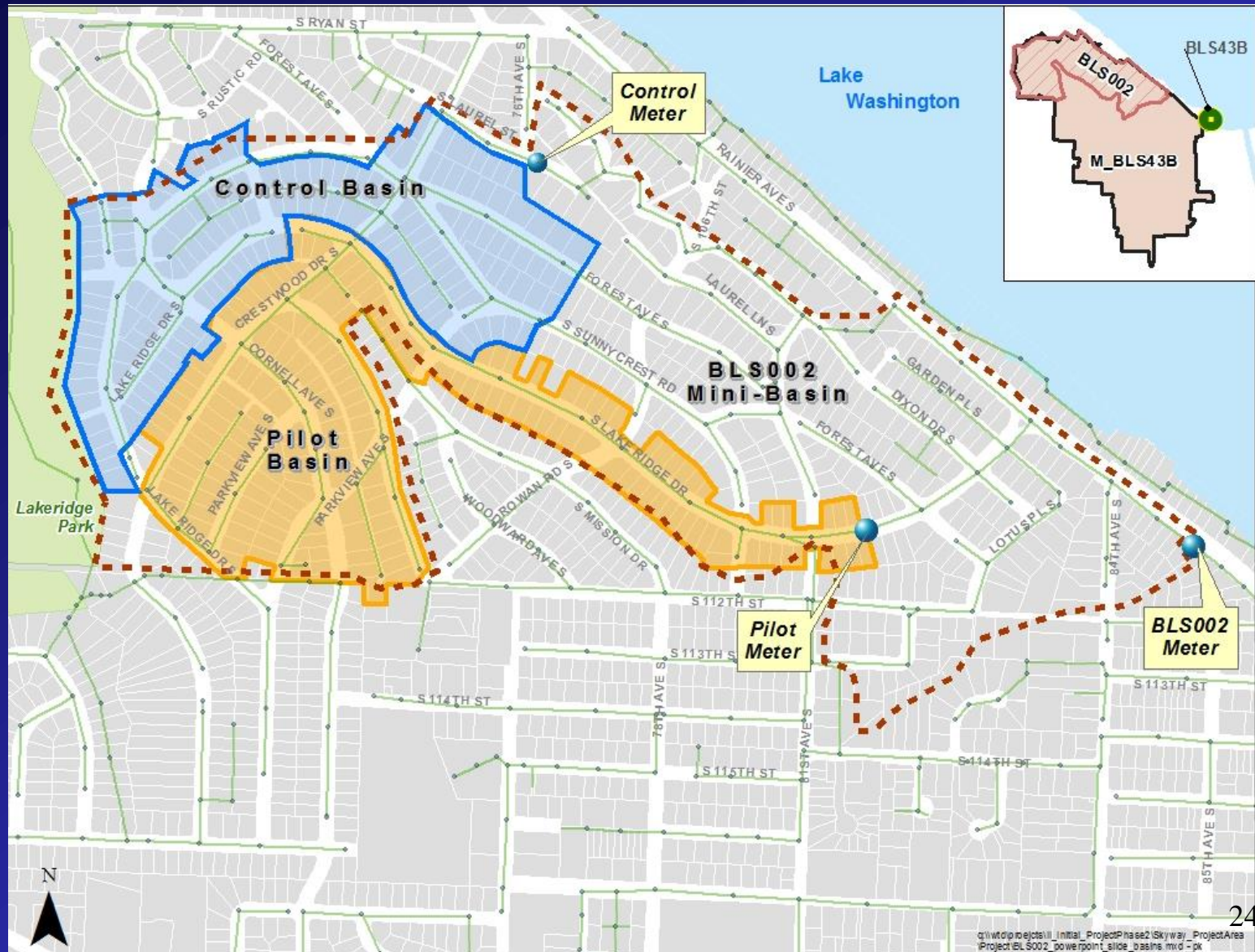
Beginning BLS002 Basin Delineation



2003 Pilot Basin Delineation



2003 Control Basin Delineation



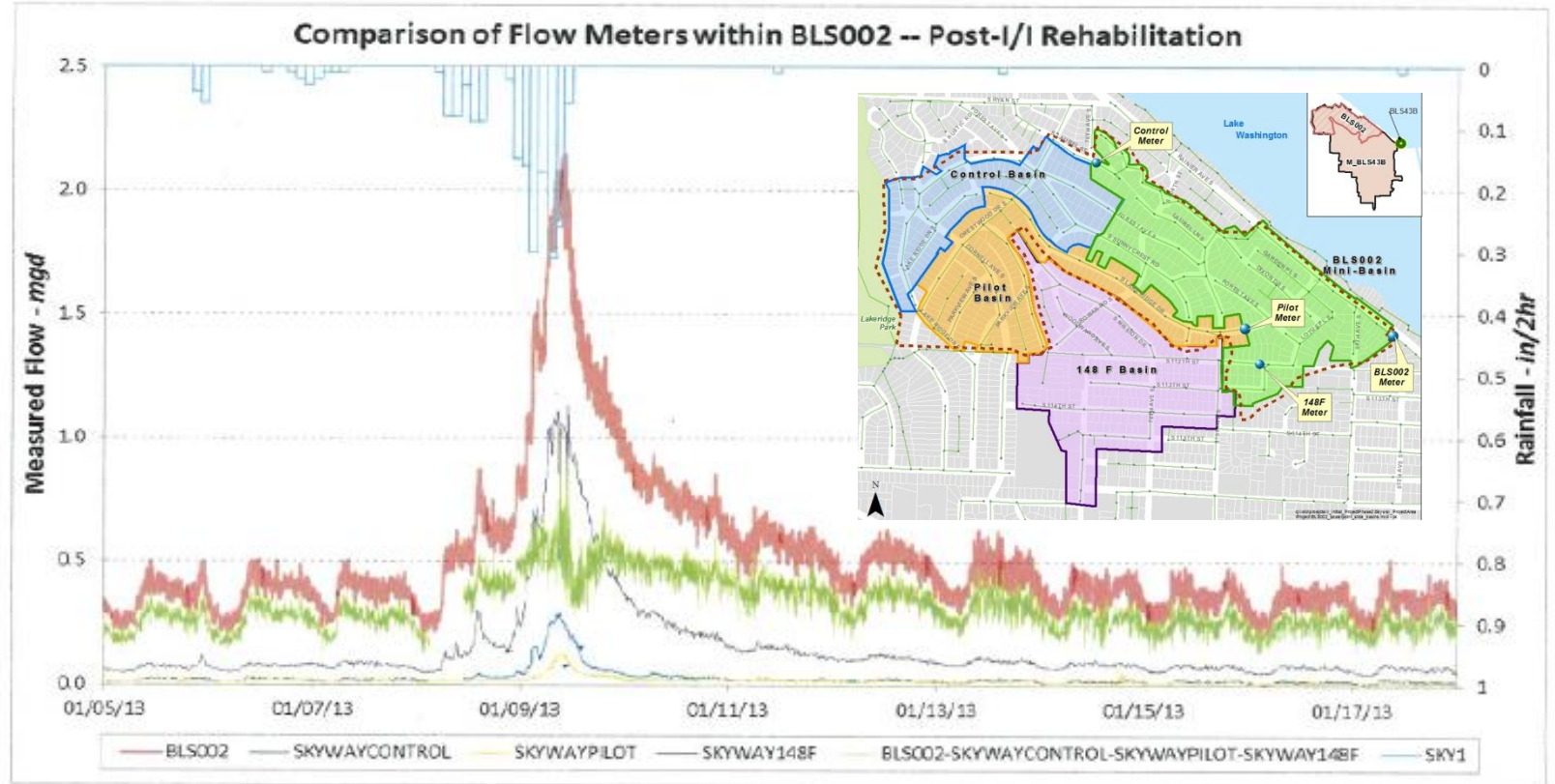
Current Project Work Limits



Additional Area Tributary to BLS002 Flow Meter



Post Project Flow Monitoring



Potential Project Risks Identified During Predesign

- I/I may not be uniformly distributed across basins as assumed; and reduction targets may not be achieved
- I/I removal targets in basins could be achieved; however, a lesser reduction rate at the location of the downstream CSI project may be realized
- Drainage issues may arise resulting from I/I removal that require resolution as part of the project; increasing project costs
- Peak I/I rates may be over-estimated
- Construction costs may be higher than anticipated due to rehabilitation difficulty

Design and Construction Lessons Learned

- Exhaustive Sanitary Sewer Evaluation Survey (SSES) Not Cost-Effective
 - Identifying specific sources of infiltration in the collection system is problematic
 - Comparing peak I/I flow with population/density in basin is a key indicator of areas to concentrate efforts
 - In areas where private property I/I is prominent; 3+ gpm per property provides good indicator of where to focus rehabilitation efforts
 - Use available dollars for cure; not for extensive up-front investigation

Design and Construction Lessons Learned

- Allow Flexibility in Contract Documents for Private Property Work
 - Separate bid item for CCTV
 - Allows field determination of what to replace
- Unit Price Contract Structure Required to Allow Flexibility During Construction

Design and Construction Lessons Learned

- Need Owner's Representative For Field Decision-Making
- Establish Bid Items or Contingency for Drainage Problems

Groundwater Issue Following Construction



Pavement Settlement Following Construction



Installation of Trench Drain Remedy Pavement Settlement



I/I Effectiveness Lessons

- Less certainty of uniform distribution of I/I throughout a basin
- Benefits of rehabilitation work are most apparent in the local system in which the work is performed
- Downstream translation of I/I reduction more difficult to achieve

Next Steps

- Additional Season of Flow Monitoring
- RWQC Briefing on Project Results
- Written Project Evaluation Report - February
- Evaluating Results in Context of I/I Program