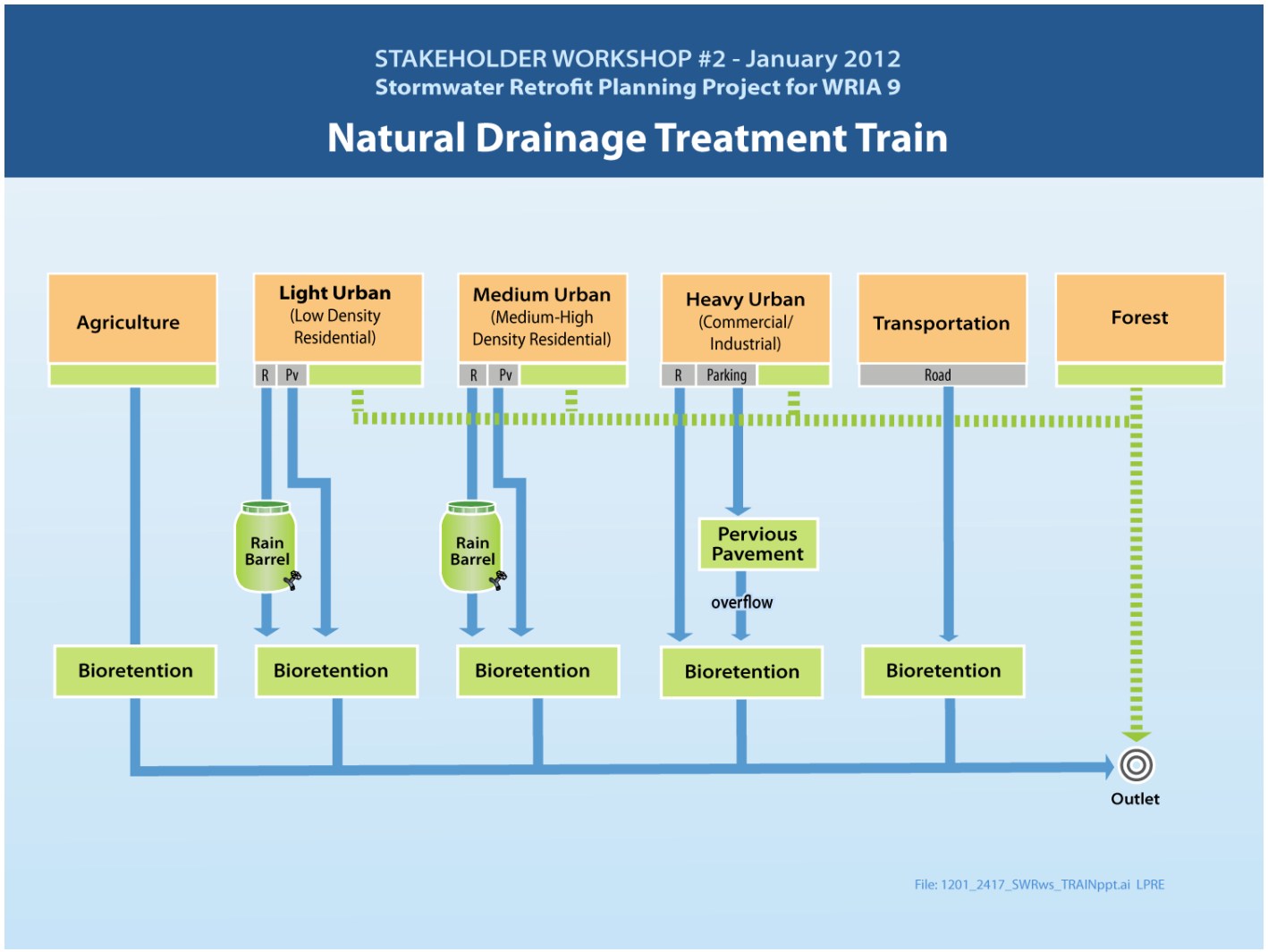
SUSTAIN Processing Steps

- BMP designs and treatment train
- BMP cost estimates
- HSPF Hydrologic Response Unit output
- Residential rooftop and commercial paved area output
- Optimization decision variables
- Cost-effectiveness model runs
- Analysis of output

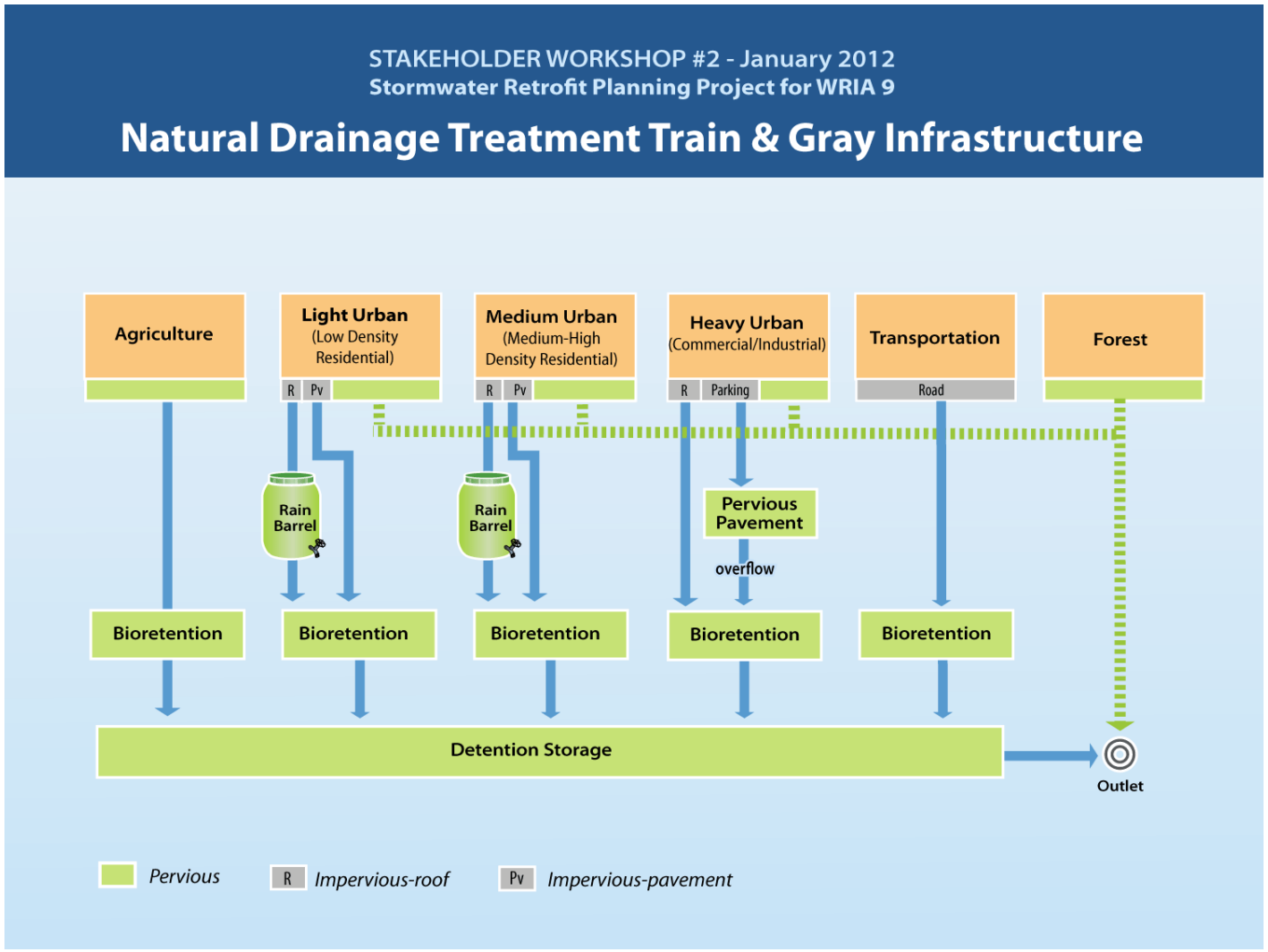
BMP Designs and Treatment Trains

Natural Drainage (Green) Treatment Train



BMP Designs and Treatment Trains

Green+Gray Treatment Train



BMP Cost Estimates

	Residential On-site Detention Facility		Bioretention		Porous Pavement
	Rain Barrel	**Custom design**	**Rain Garden**	**Linear Roadside**	
Design Unit Size	6.75 ft^3 (50 gal)	393 ft^3 (2,938 gal)	100 ft^2	100 ft^2	100 ft^2
Total Present Value	$ 1,533 /unit ~~$ 220~~	$ 2,913 /unit ~~$ 1,600~~	$ 69.73 /ft^2 ~~$ 36.91~~	$ 49.98 /ft^2 ~~$ 36.91~~	$85.95 / ft^2 ~~$ 20.31~~
Inspections/Enforcement	$ 85.40 /yr	$ 85.40 /yr	$ 213.50 /yr	$ 85.00 /yr	$ 427.00 /yr
Design and Permitting Cost	NA	NA	a	a	a
Construction Cost	$ 220/unit	$ 1,600 /unit	$ 20 /ft^2	$ 20 /ft^2	$20 /$ft^2$
Annual Operation and Maintenance Cost	NA	NA	$ 1.1 /ft^2	$ 1.1 /ft^2	$0.02 /$ft^2$
Land Cost	NA	NA	NA	NA	NA

Table 1 Cost Assumptions for Low Impact Development BMPs (30-yr planning horizon with 5% discount rate)
NA = Not applicable or assumed to be negligible.

BMP Cost Estimates

	Detention Pond		
	Commercial / Industrial	**Medium Density Residential**	**Low Density Residential**
Design Unit Volume	19,110 ft^3	12,852 ft^3	8,690 ft^3
Design Unit Area	3,539 ft^2	2,380 ft^2	1,704 ft^2
Total Present Value (Design, Construction and O&M)	\$4.78 /ft^3	\$ 4.78 /ft^3	\$4.78 /ft^3
Design and Permitting Cost	\$ 1.20 /ft^3	\$ 1.20 /ft^3	\$ 1.20 /ft^3
Construction Cost	\$ 3.43 /ft^3	\$ 3.43 /ft^3	\$ 3.43 /ft^3
Annual Operation and Maintenance Cost	\$ 0.01 /ft^3	\$ 0.01 /ft^3	\$ 0.01 /ft^3
Land Cost a	\$ 23.00 /ft^2	\$ 18.25 /ft^2	\$ 6.50 /ft^2

Table 2 Cost Assumptions for Detention Ponds (30-yr planning horizon with 5% discount rate)

NA = Not applicable or assumed to be negligible.

a Land costs for wet ponds will vary depending on predominant level of development in basin, which is highly correlated with average land cost. There are three development level categories and three associated land costs.

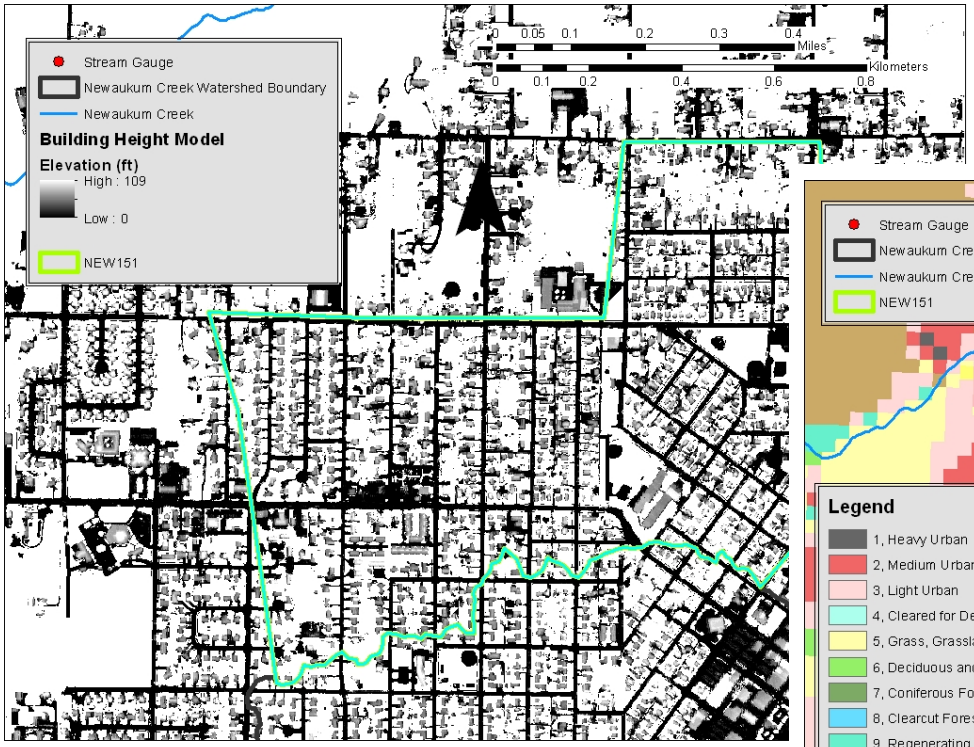
HSPF HRU Output

Hourly Oct 1948 – Sep 2009

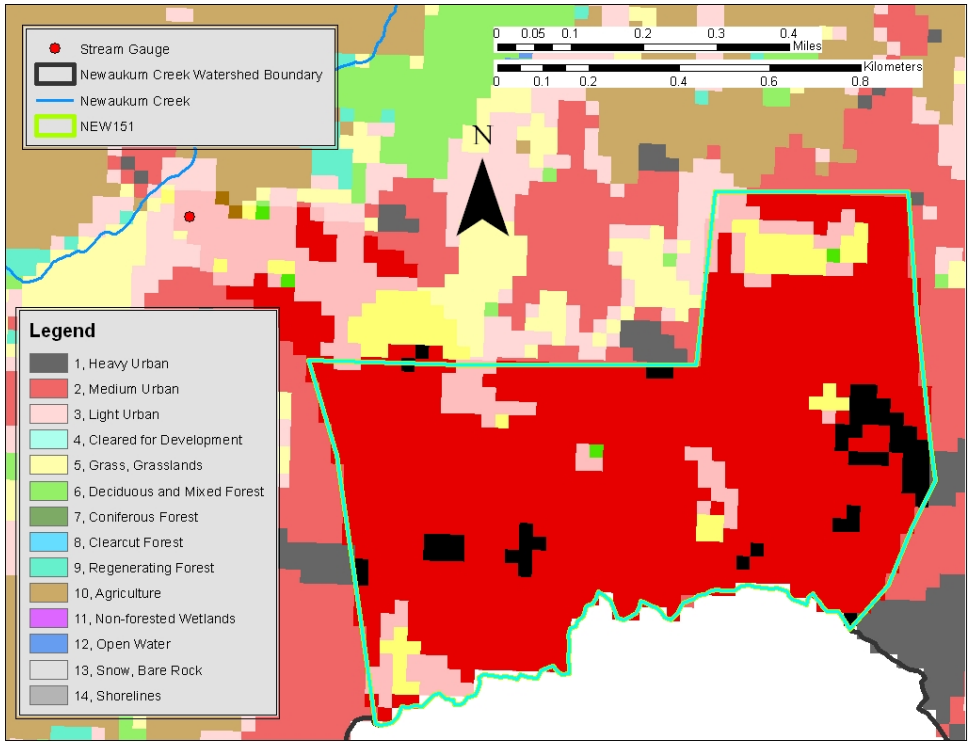
filename	Short Desc	Soil	slope	Landuse	landcover	Impervious	acres
HRU61.plt	TF1	Till	Flat	Forest	TILL_Forest_FLAT	0	0.454
HRU153.plt	EIA_RDS	Impervious	all	Roads	EIA_Roads	1	12.112
HRU150.plt	EIA_LD	Impervious	all	LD_Residential	EIA_Low_Den_Residential	1	0.656
HRU151.plt	EIA_HD	Impervious	all	HD_Residential	EIA_High_Den_Residential	1	33.38
HRU152.plt	EIA_COM	Impervious	all	Commercial	EIA_Commercial	1	5.412
HRU31.plt	TLR1	Till	Flat	Low_Density_Residential	TILL_LDGrass_FLAT	0	15.924
HRU21.plt	THR1	Till	Flat	High_Density_Residential	TILL_HDGrass_FLAT	0	149.101
HRU11.plt	TC1	Till	Flat	Commercial	TILL_COMGrass_FLAT	0	5.309
HRU51.plt	TGR1	Till	Flat	Grasslands	TILL_Grasses_FLAT	0	9.004
HRU53.plt	TGR3	Till	Moderate	Grasslands	TILL_Grasses_MED	0	0.445

Residential Rooftop and Commercial Parking Area Output

Building Height Model



Land Use/Land Cover

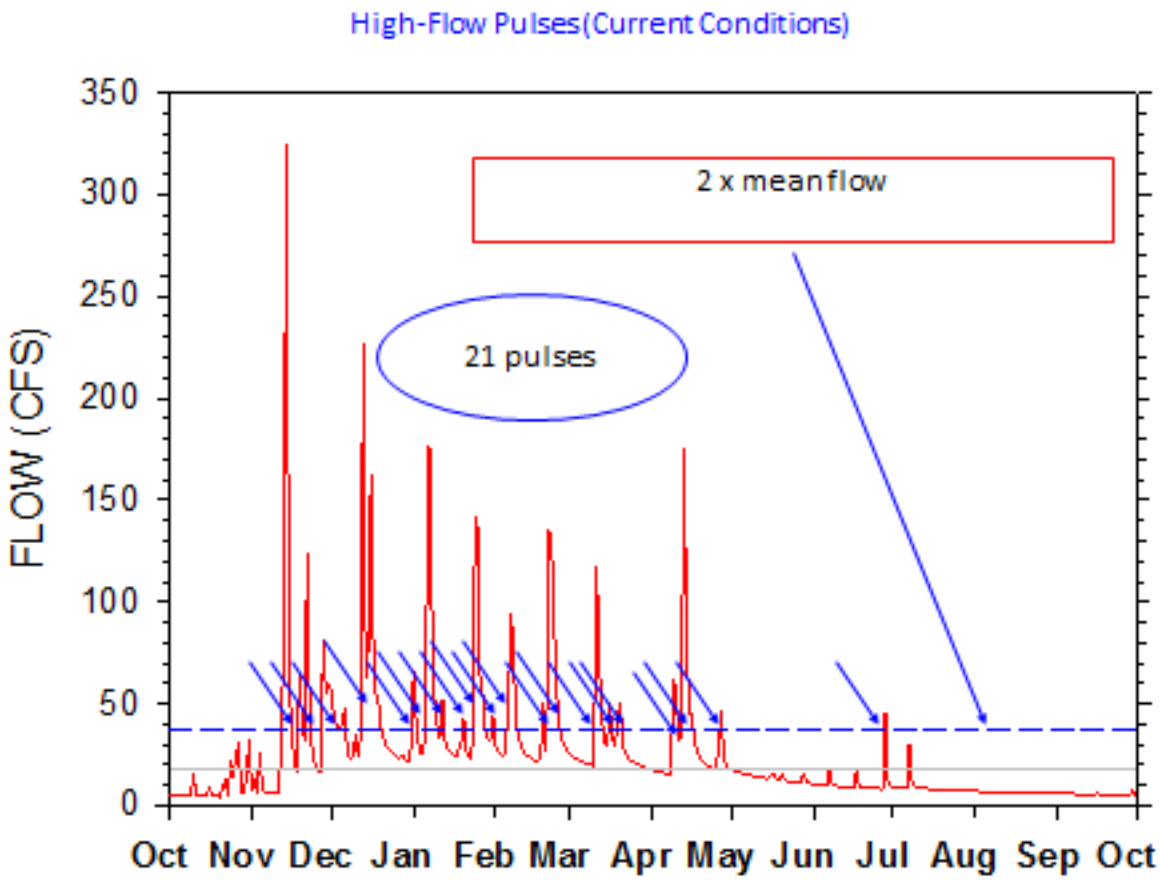


Residential Rooftop and Commercial Parking Area Output

VALUE	Acres_LE_6FT	Acres_GT_6FT	LC_Type
11	5.25	1.78	TComLow
21	61.46	30.32	THDLow
23	0.15	0.02	THDMed
31	3.77	1.68	TLDLow
33	0.09	0.00	TLDMed
51	1.27	0.48	TGrsLow
61	0.03	0.06	TFLow

Optimization Decision Variables

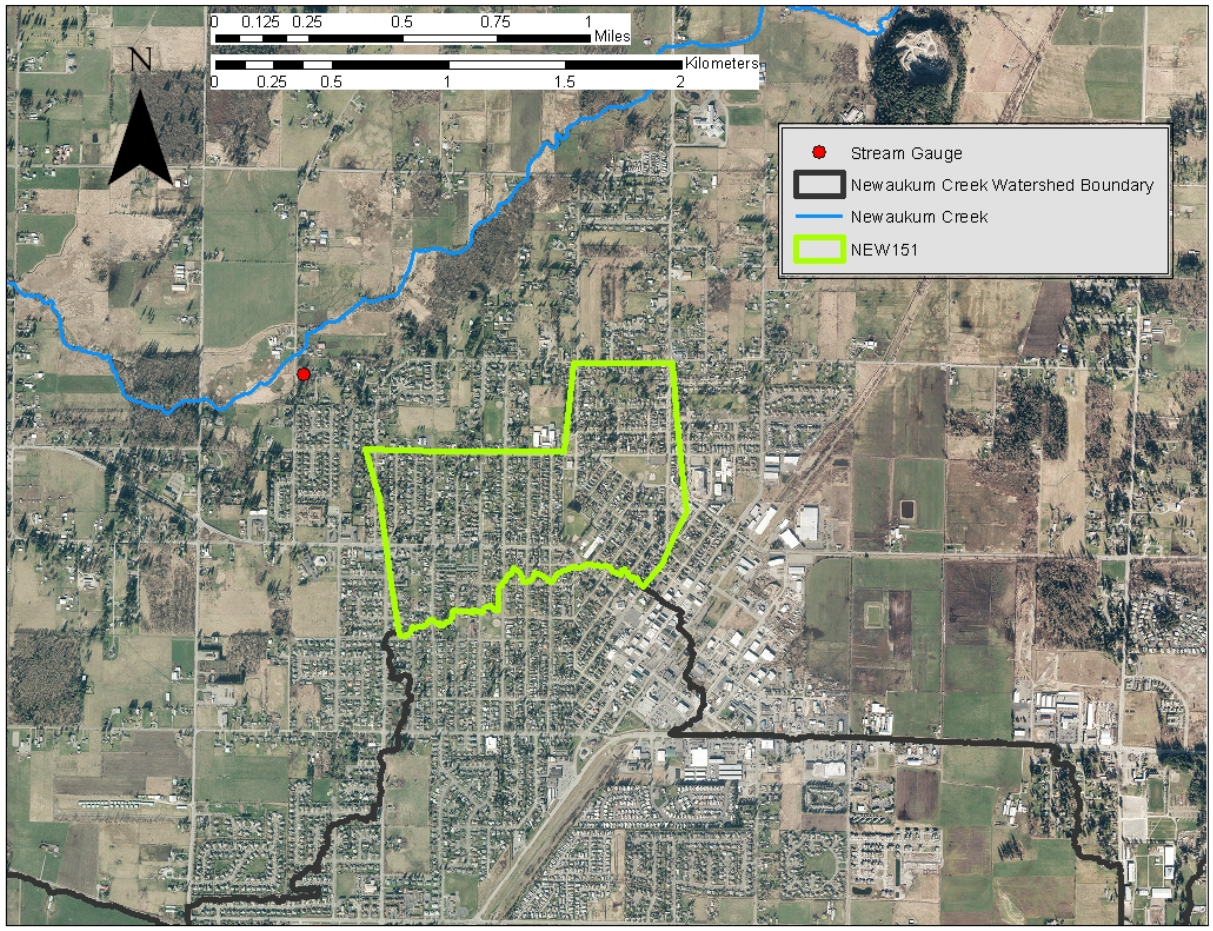
High Pulse Count



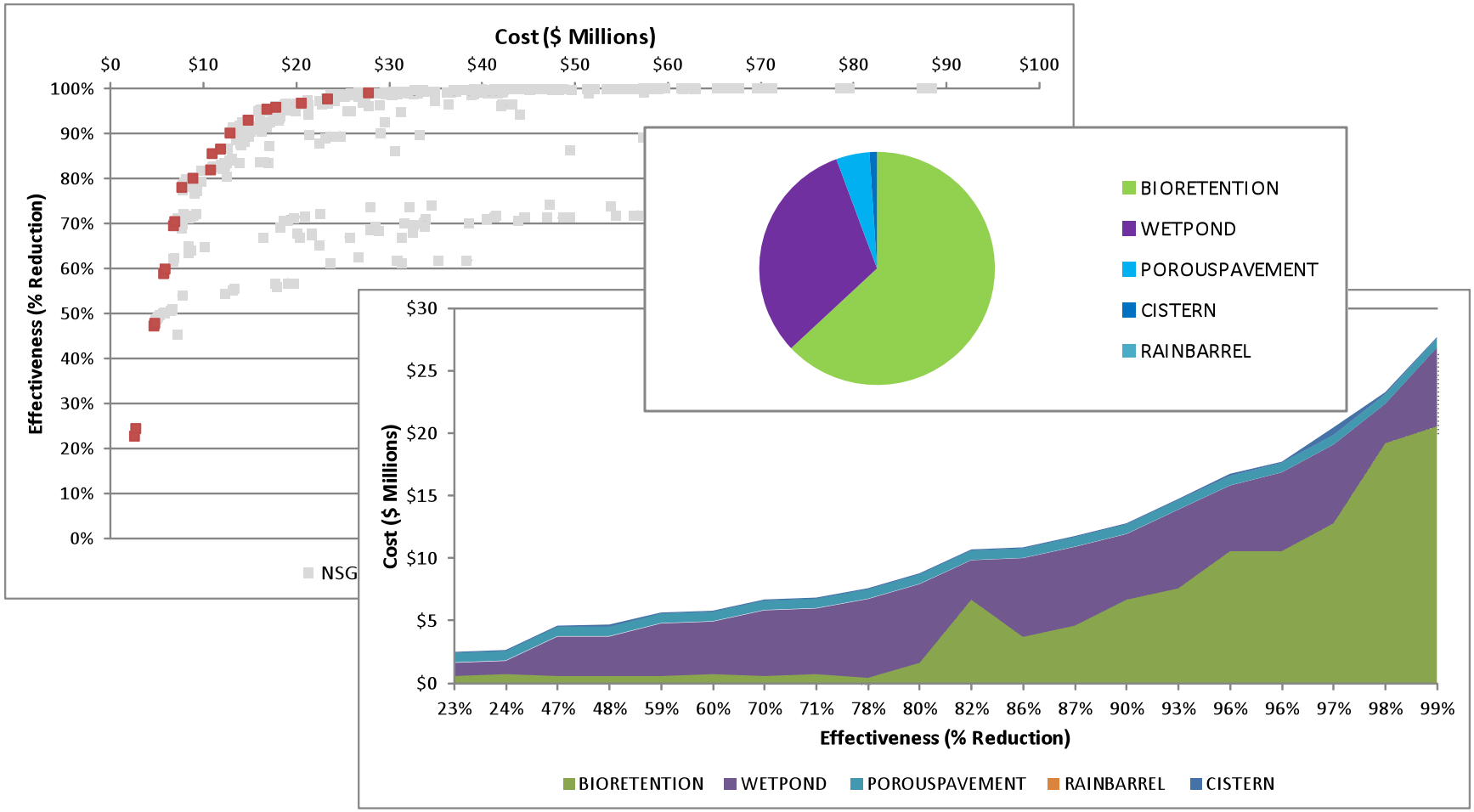
Optimization Decision Variables

c BMPSITE	VARIABLE	FROM	TO	STEP
1_2	CISTERN	0	600	30
1_3	RAIN GARDEN	0	6900	345
1_4	POROUS PAVEMENT	0	1800	90
1_5	TREAMENT POND	0	200	10
1_6	NUMUNIT	0	0	0
1_7	NUMUNIT	0	600	30

Pilot on single ~230 ac catchment NEW151



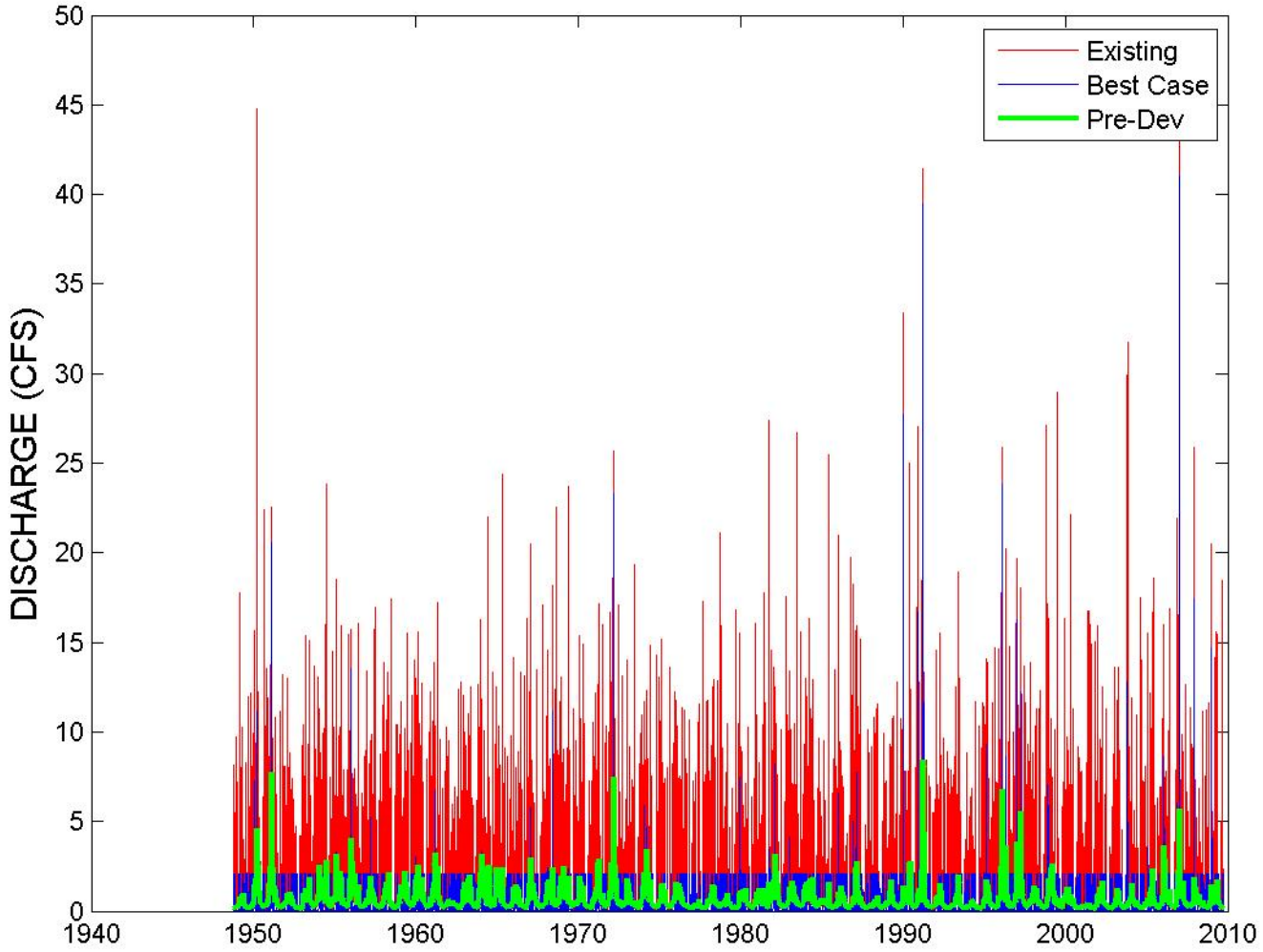
Green+Gray
80% pervious runoff treatment



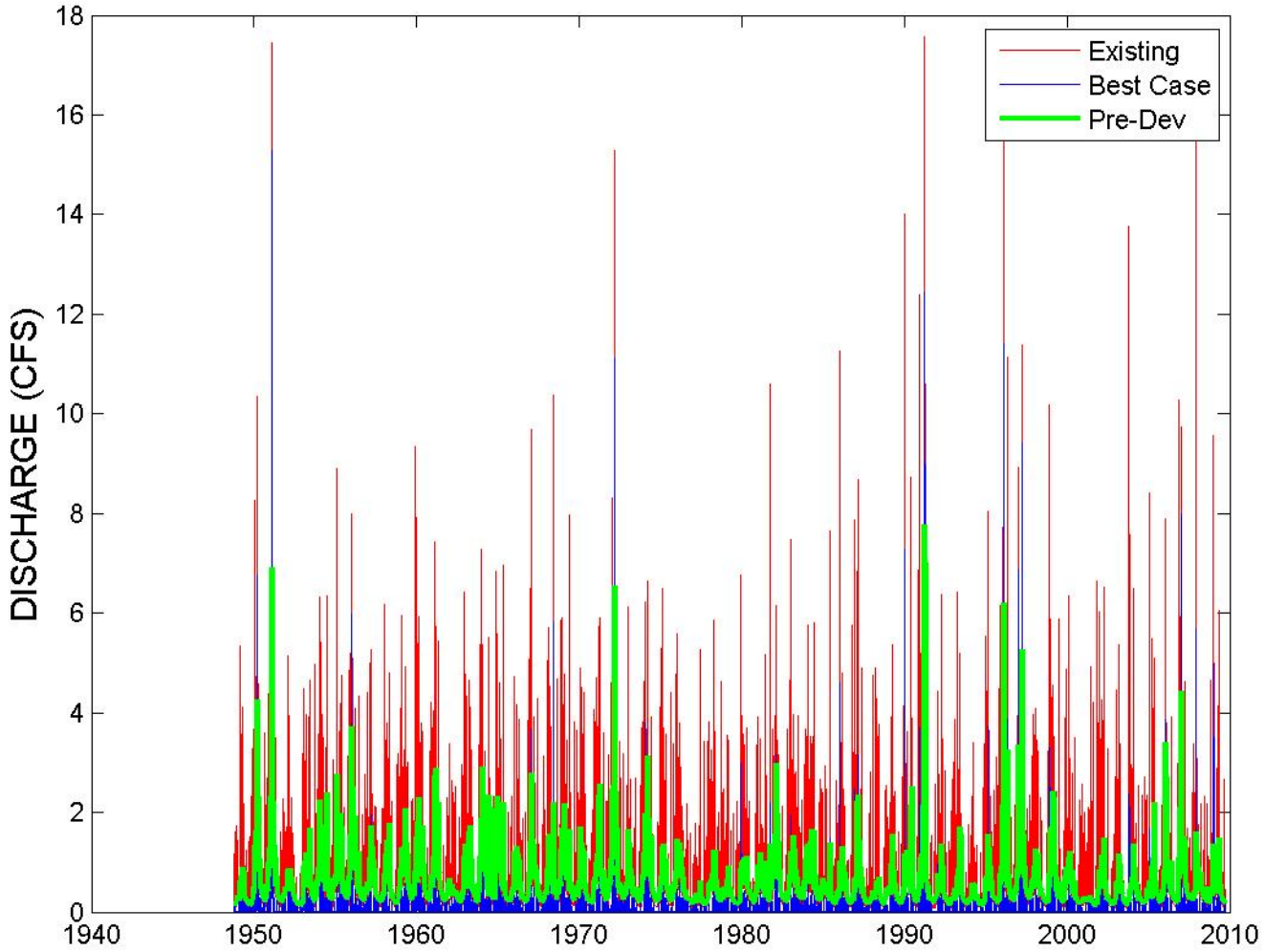
Result Details

- Solution 22 ~$17 million
- 60 cisterns
- 1,275 rain garden units
- 90 units of porous pavement
- 330 units of linear roadside bioretention
- 60 units of pond treatment
- Very large reduction in flow volume – Not all large peaks controlled

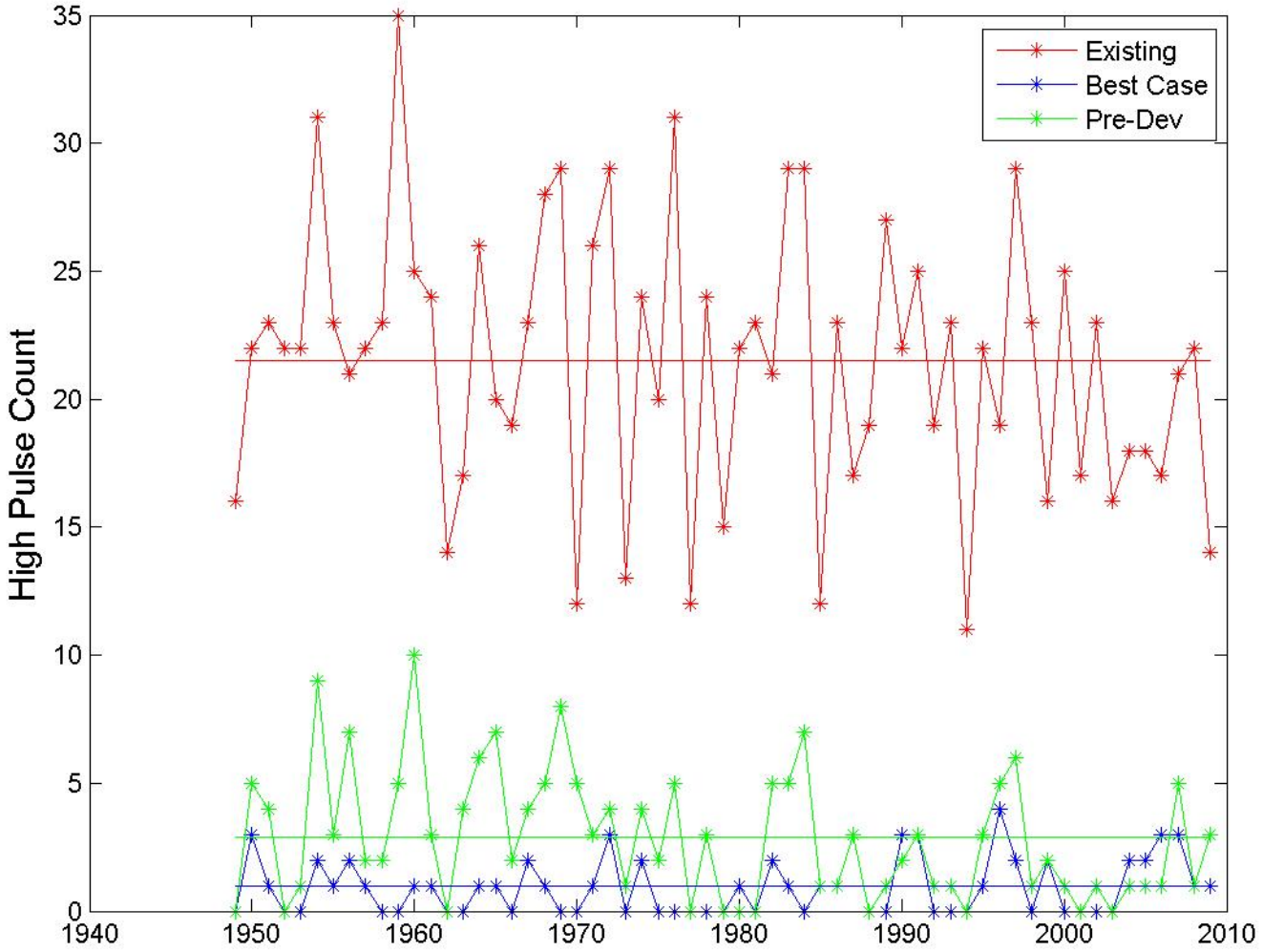
Hourly Discharge



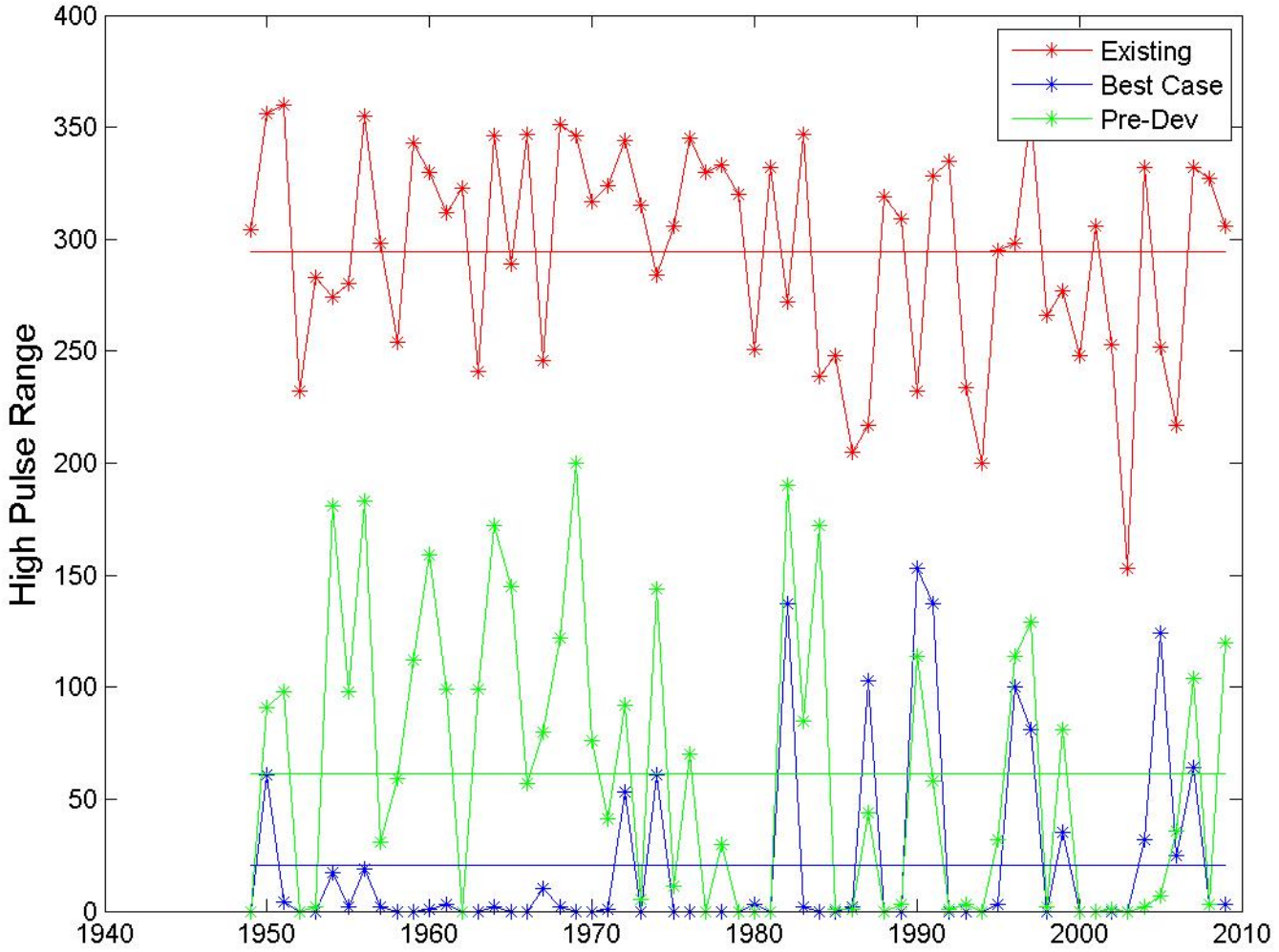
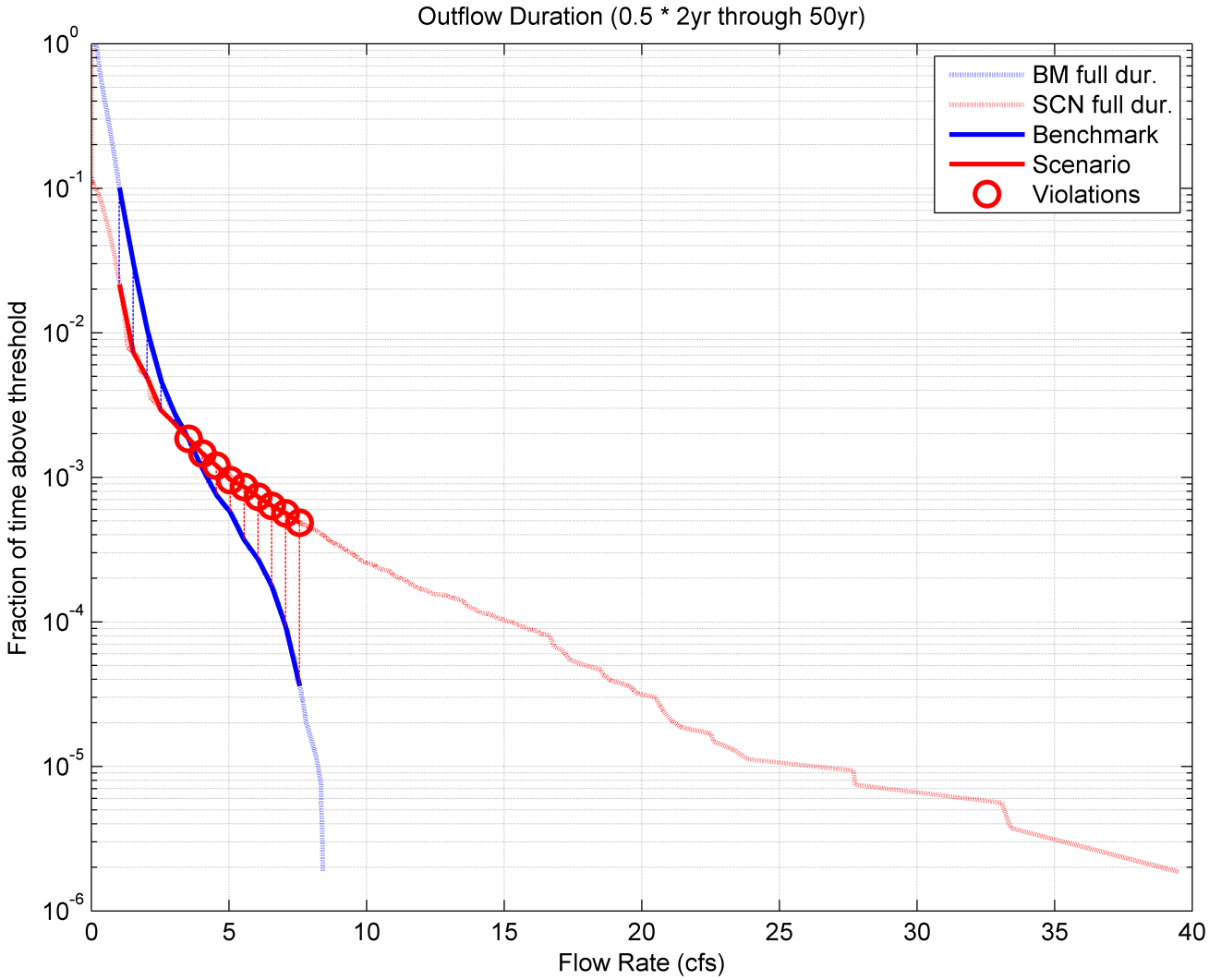
Daily Mean Discharge



High Pulse Count



High Pulse Range



Flow Duration Curves