Local Solutions Northeast Climate Change Preparedness Conference

Piscataquog River Watershed Stream Crossing Vulnerability Assessment Project

Southern New Hampshire Planning Commission & Trout Unlimited

May 19, 2014

Location: Radisson Hotel, Manchester NH

Presenter: Gabe Bolin, PE, Trout Unlimited

Project Partners

New Hampshire DOT

TROUT UNLIMITED

NEW HAMPSHIRE SOUTHERN PLANNING COMMISSION SNHPC

U.S. Department of Transportation Federal Highway Administration

NHDES

ANTIOCH UNIVERSITY NEW ENGLAND

Streamworks

New Hampshire FISH AND GAME Connecting you to life outdoors

Piscataquog River Local Advisory Committee

Presentation Overview

- Stream crossings – what's the problem?
- The Piscataquog River Watershed
- Project Background (Phase I)
- Phase II
  - Modeling – GIS and Excel
  - The model as an assessment and screening tool
  - Developing restoration strategies / prioritization tools
  - Assisting communities

We need to prepare for streams changing...

dramatically over time!

Photos courtesy of Dan Cenderelli, USFS

A Well Designed Crossing

Large size suitable for handling most flood flows

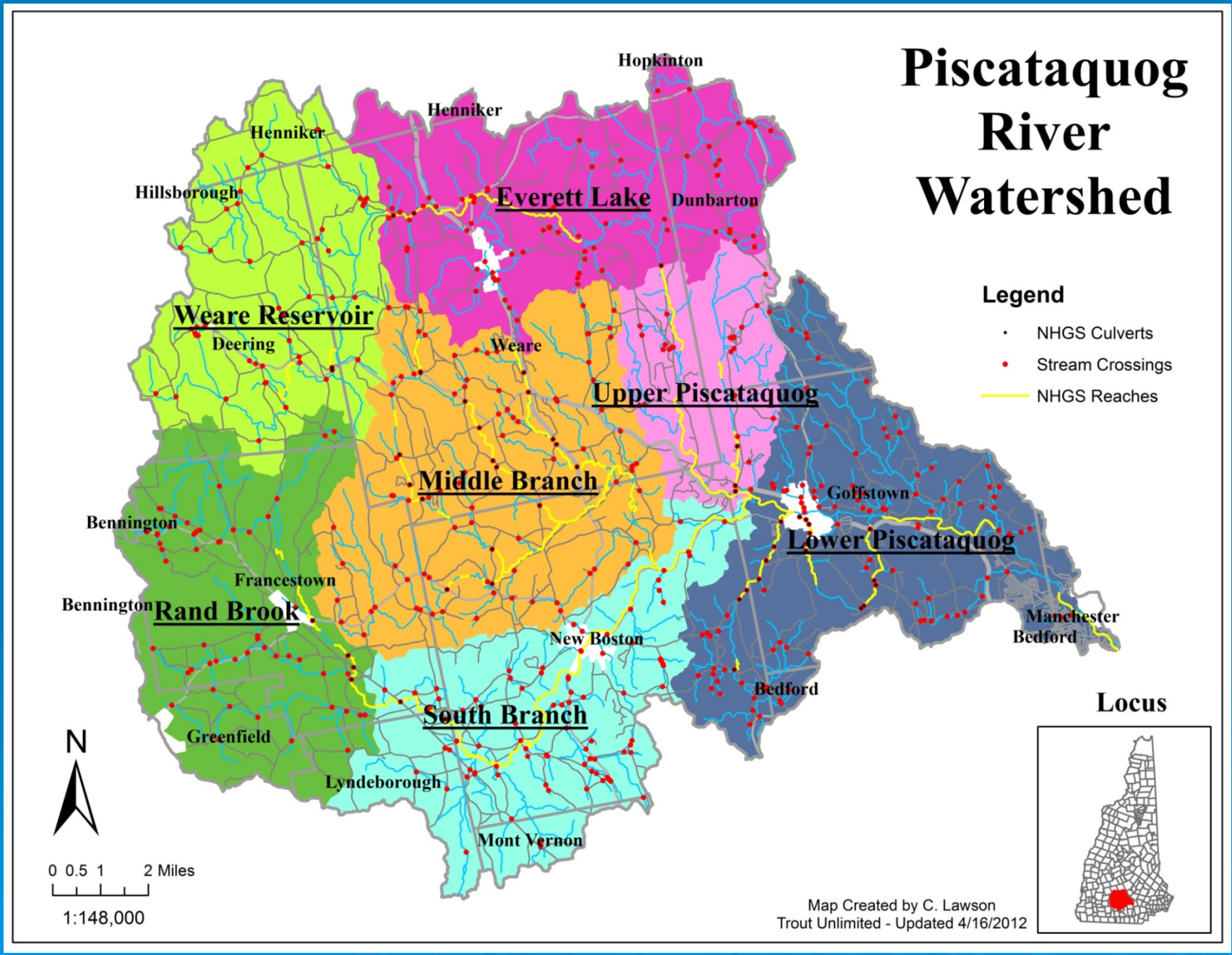
Open-bottom arch considered optimum for most conditions

Openness ratio needs to be greater than 0.5 %

Bankfull width greater than 1.2x stream's active channel

Water depth and velocity match up and down stream

Natural substrates create good conditions for stream biota


Piscataquog River Watershed
Hopkinton
Henniker
Henniker
Hillsborough
Everett Lake
Dunbarton
Weare Reservoir
Deering
Weare
Upper Piscataquog
Middle Branch
Goffstown
Bennington
Lower Piscataquog
Francestown
Bennington
Rand Brook
Manchester
Bedford
New Boston
Bedford
South Branch
Greenfield
Lyndeborough
Mont Vernon
N
0 0.5 1 2 Miles
1:148,000
Legend
NHGS Culverts
Stream Crossings
NHGS Reaches
Locus
Map Created by C. Lawson
Trout Unlimited - Updated 4/16/2012

Phase I – AOP Assessment Goals

- Spatially identify in-stream Connectivity barriers
- Complete a watershed wide Stream Crossing Assessment
- Run Field Data through NH's AOP & Geomorphic Models
- Prioritize Restoration Efforts to Improve Aquatic Habitat
- Strategize with communities to replace instream barriers

Watershed Size	
Sq Miles	Acres
217	138,880

Crossings by Catchment:

Lower Piscataquog River	128
Middle Branch Piscataquog River	99
South Branch Catchment	93
Everett Lake Catchment	74
Rand Brook Catchment	58
Weare Reservoir	48
Upper Piscataquog River	27
Total	527

Post Field Work

Visited 488
Assessed 418

Crossing by Catchment:		
Lower Piscataquog	92	22%
South Branch	78	19%
Middle Branch	73	17%
Everett Lake	62	15%
Rand Brook	48	11%
Weare Reservior	43	10%
Upper Piscataquog	22	5%
	418	100%

Volunteer help from local and regional:

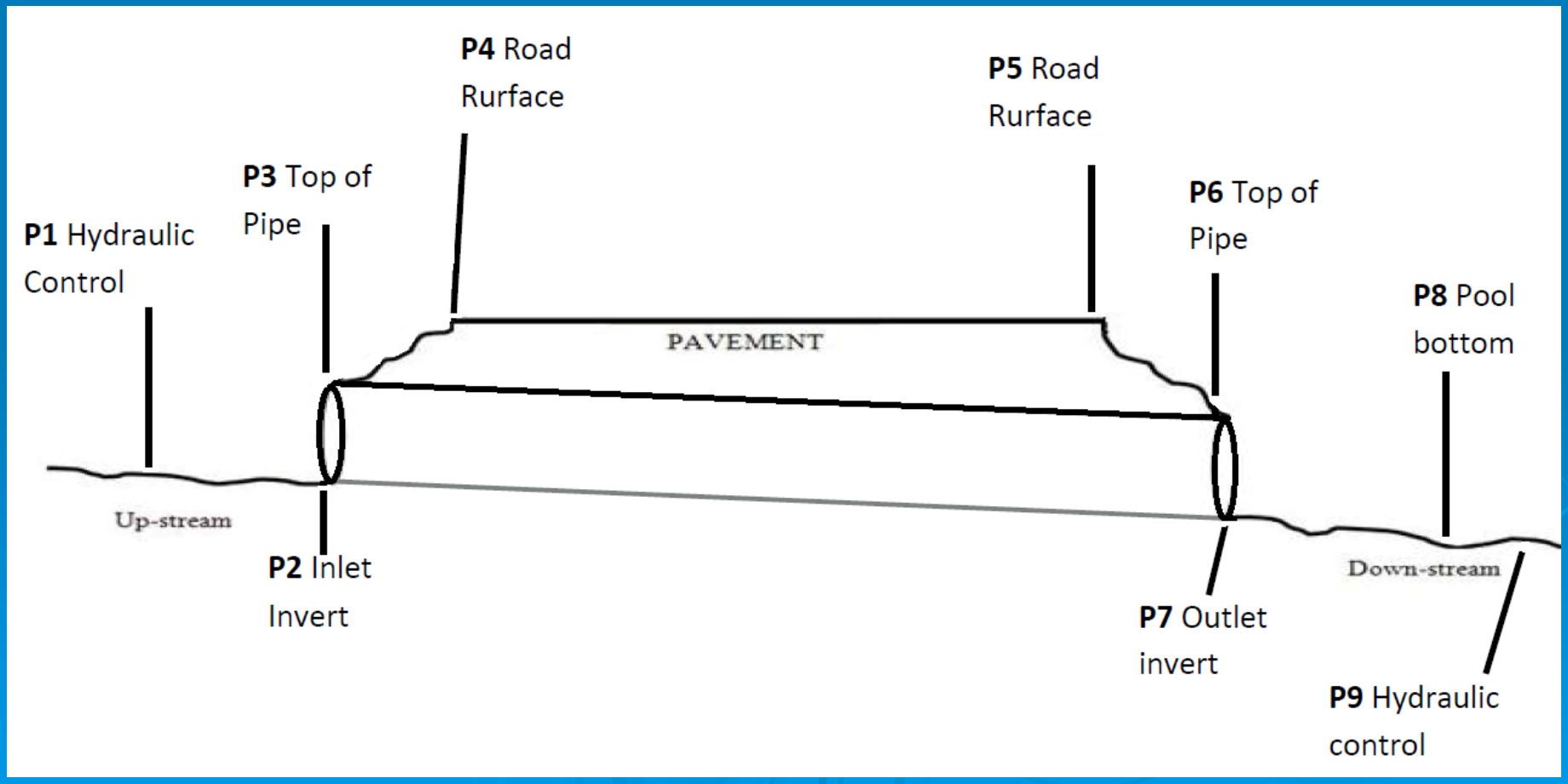
800 Hours

35 Field Days

- 15 TU Chapter Members
- 5 Community Residents
- 5 Graduate Students

Additional Elevation Data

P1: Hydraulic Control
P2: Inlet Invert
P3: Inlet Top of Pipe (inside)
P4: US Road Surface
P5: DS Road Surface
P6: Outlet Top of Pipe (inside)
P7: Outlet Invert
P8: Pool Bottom
P9: Hydraulic Control

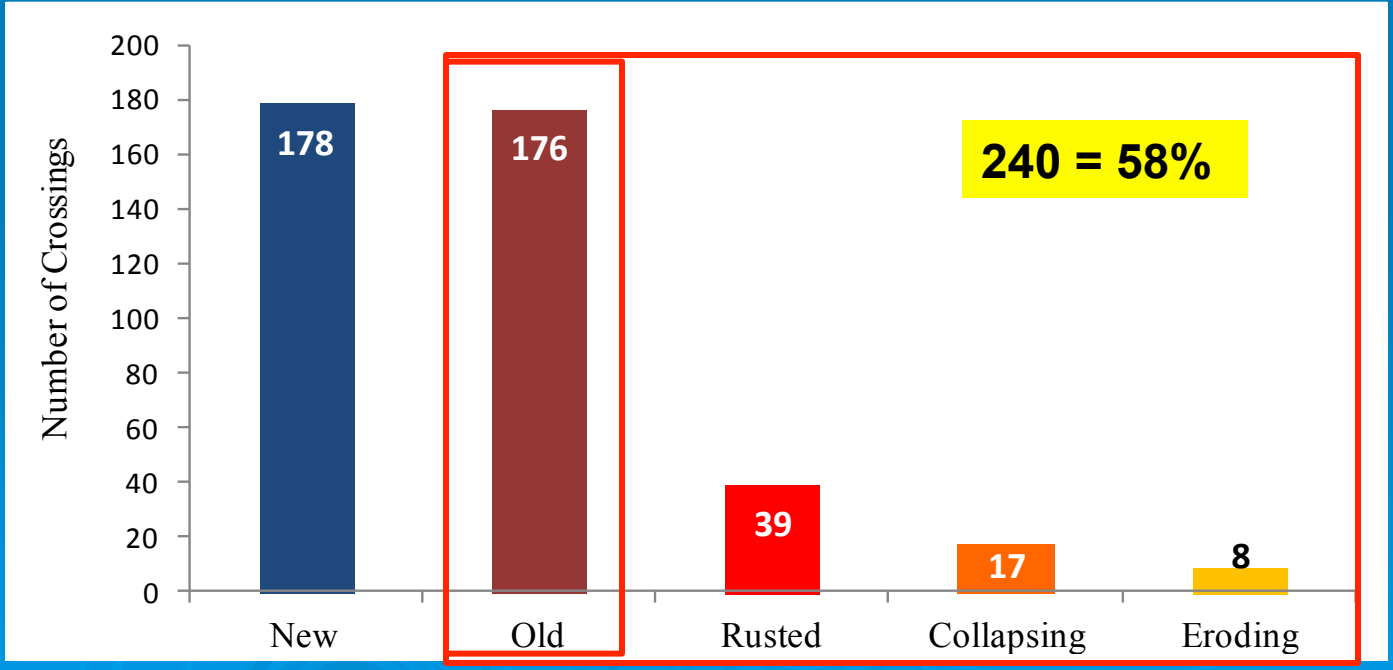


Piscataquog River AOP Results

Type	# of Crossings	% of Total
Arch	27	7%
Bridge	27	7%
Culvert	358	87%
	412	100%

Culvert Types

Culvert Condition



% Bankfull Width	# of Crossings	% of Total
< 25	178	57%
26 to 50	98	31%
51 to 75	29	9%
> 100	7	2%
	312	100%

Crossing Size as % of Bankfull Width

Outlet Condition

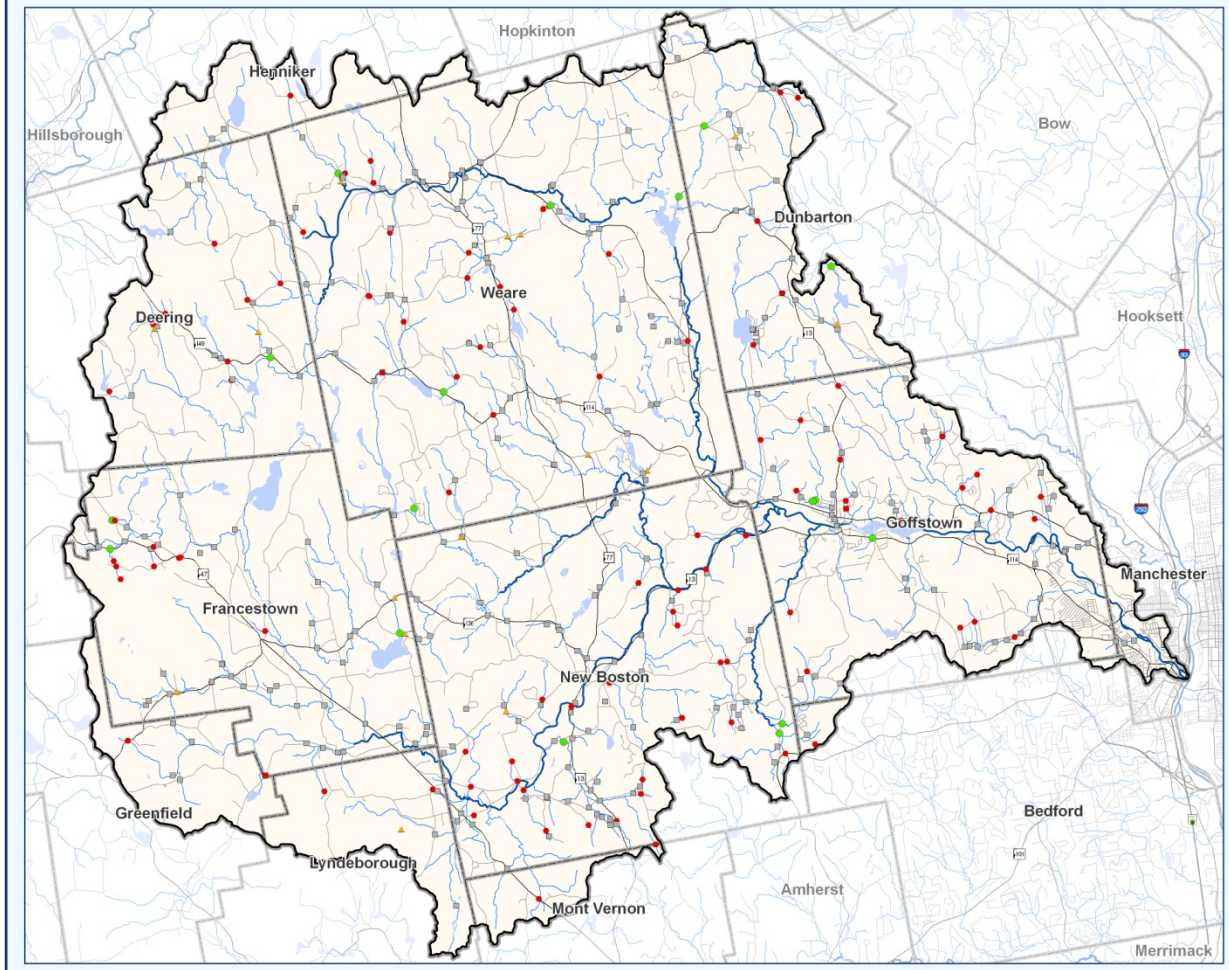
34 %

Condition	# of Crossings	% of Total
At Grade	236	48%
Free Fall	126	26%
Cascade	37	8%
Backwatered	13	3%
	412	85%

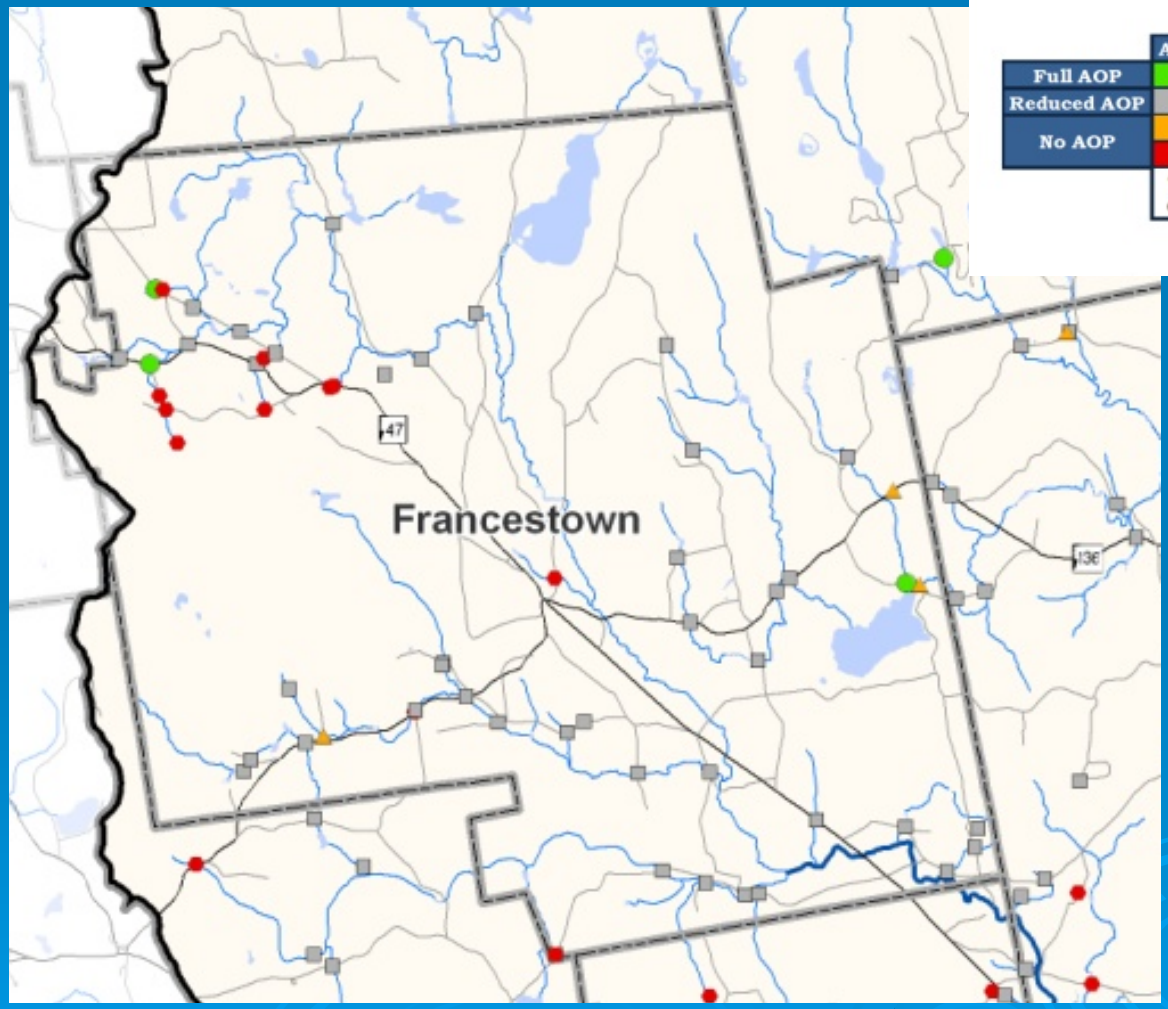
AOP Model Output – Francestown

Town	Road Name	Stream Name	Crossing ID	Structure Type	Latitude	Longitude	Crossing Condition	Structure Width (ft)	Crossing Slope	Culvert Invert Type	Culvert Drop Distance (ft)	Crossing Length (ft)	BANKFUL %	AOP Status
FRANCESTOWN	2nd NH Turnpike	Dinsmore Brook	RB_DIBK_08	Culvert	43.0194	-71.8674	New	3	5	At Grade	0	32.6	28.6	GREEN
FRANCESTOWN	2nd NH Turnpike	Dinsmore Brook	RB_DIBK_10	Culvert	43.01745	-71.86208	Old	1.25	1	Backwatered	0	40		GRAY
FRANCESTOWN	2nd NH Turnpike	Dinsmore Brook	RB_DIBK_11	Culvert	43.01498	-71.85546	Rusted	5	0.2	At Grade	0	31	39.7	GRAY
FRANCESTOWN	2nd NH Turnpike	Dinsmore Brook	RB_DIBK_15	Arch	43.01271	-71.85046	collapsing	1.2	1.5	At Grade	0	30.5	8.2	GRAY
FRANCESTOWN	2nd NH Turnpike	Piscataquog	SB_PSCR_01	Culvert	43.14875	-71.35823	Old	2	0.2	Cascade	0.25	49	53.2	GRAY
FRANCESTOWN	Abbott Ln	Dinsmore Brook	RB_DIBK_14	Culvert	43.01227	-71.85207	New	3	2.5	Free Fall	2	31	47.7	RED
FRANCESTOWN	Avery Rd	Piscataquog	SB_PSCR_03	Culvert	42.96376	-71.76141	Old	3	1.3	At Grade	0	30.8		GRAY
FRANCESTOWN	Back Mtn Rd	Dinsmore Brook	RB_DIBK_04	Culvert	43.00828	-71.86678	New	4	2.5	Free Fall	1.5	40	33.4	RED
FRANCESTOWN	Bennington Rd	Dinsmore Brook	RB_DIBK_05	Culvert	43.01162	-71.86816	New	4	1	Backwatered	0	64	29.4	GREEN
FRANCESTOWN	Bennington Rd	Collins Brook	RB_COBK_03	Culvert	43.00941	-71.84214	New	1.5	2.5	Free Fall	0.5	49	19.6	RED
FRANCESTOWN	Bennington Rd	Dinsmore brook	RB_DIBK_06	Culvert	43.01221	-71.87244	New	5	0.7	At Grade	0	49	34.8	GRAY
FRANCESTOWN	Bennington Rd	Dinsmore Brook	RB_DIBK_13	Culvert	43.01162	-71.85306	Eroding	4	1.5	At Grade	0	34	48.5	GRAY
FRANCESTOWN	bible hill rd	Whiting Brook	MB_WTBK_02	Culvert	43.00277	-71.79145	Old	3	4	Cascade	0.7	47.7	21.5	GRAY
FRANCESTOWN	bible hill rd ext	Whiting Brook	MB_WTBK_01	Culvert	43.01365	-71.79518	Eroding	2	5	At Grade	0	23.7		GRAY
FRANCESTOWN	Birdsall	Piscataquog	RB_SBPR_17	Culvert	42.97351	-71.80918	Rusted	3	3	At Grade	0	32		GRAY
FRANCESTOWN	Birdsall	Piscataquog	RB_SBPR_18	Culvert	42.97461	-71.80673	Old	1.3	0.8	At Grade	0	30	4.3	GRAY
FRANCESTOWN	Cressey Hill Rd	Rand Brook	RB_RBBK_14	Bridge	42.95793	-71.78953	New	30	0.4	At Grade	0	15	76.9	GRAY
FRANCESTOWN	Dennison Pond Rd	Whiting Brook	MB_WTBK_08	Culvert	43.00211	-71.76964	Old	3	0.5	At Grade	0	20.8	16.2	GRAY
FRANCESTOWN	Dodge Hill Rd	Piscataquog	SB_PSCR_04	Culvert	42.96848	-71.7368	Old	2.5	3.6	Cascade	0.4	28.7	40.5	GRAY
FRANCESTOWN	Dodge Rd	piscataquog	SB_PSCR_05	Culvert	42.96361	-71.75111	Old	4	0.8	At Grade	0	38.5		GRAY
FRANCESTOWN	Farrington	Rand Brook	RB_RBBK_03	Bridge	42.9706	-71.85379	Old	3.5	1	At Grade	0	16	19.9	GRAY
FRANCESTOWN	Ferson	Whiting Brook	MB_WTBK_03	Arch	42.99161	-71.7936	Old	1.4	7	At Grade	0	26.8	6.0	GRAY
FRANCESTOWN	Fisher Hill	Collins Brook	RB_COBK_04	Culvert	43.01054	-71.83504	New	1.5	2	At Grade	0	21	13.8	GRAY
FRANCESTOWN	greenfield rd	rand brook	RB_RBBK_04	Arch	42.97235	-71.84607	New	8	0.2	At Grade	0	30	33.3	GRAY
FRANCESTOWN	greenfield rd	Piscataquog	RB_SBPR_15	Bridge	42.97724	-71.82342	New	18	0	At Grade	0	37		GRAY
FRANCESTOWN	greenfield road	Piscataquog	RB_SBPR_12	Bridge	42.97572	-71.83058	New	9.2	7	At Grade	0	37.5	46.4	GRAY
FRANCESTOWN	Juniper Hill	Piscataquog	RB_SBPR_16	Culvert	42.97454	-71.81889	New	12.5	2.5	At Grade	0	27	59.2	GRAY

Stream Crossing AOP Ratings



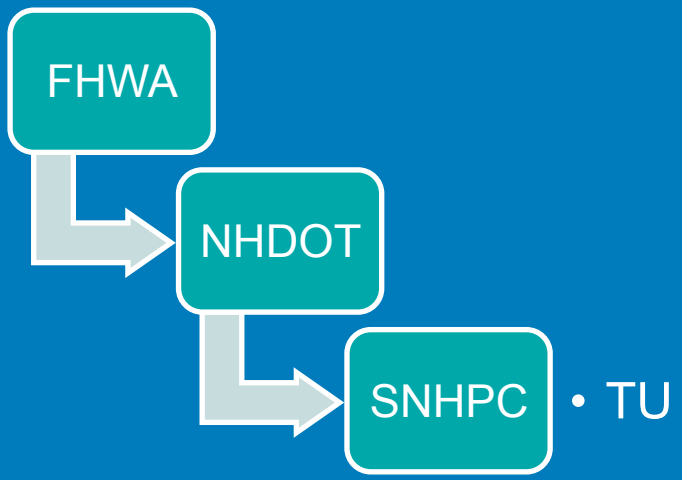
Stream Crossing AOP Ratings – Francestown



	AOP Status	Number
Full AOP	Green	17
Reduced AOP	Gray	271
No AOP	Orange	17
	Red	106
	Total # of Crossings	411

Phase II

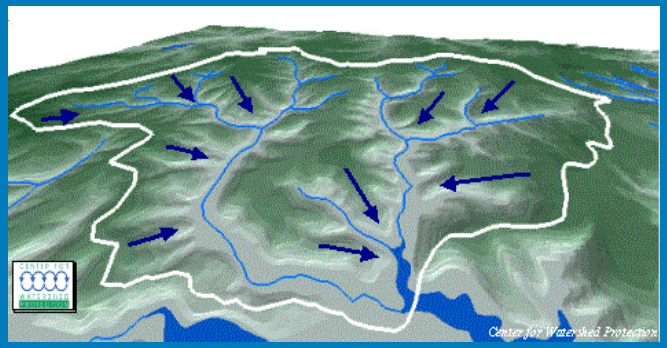
- **Funding**
  - $70,000 Research Grant



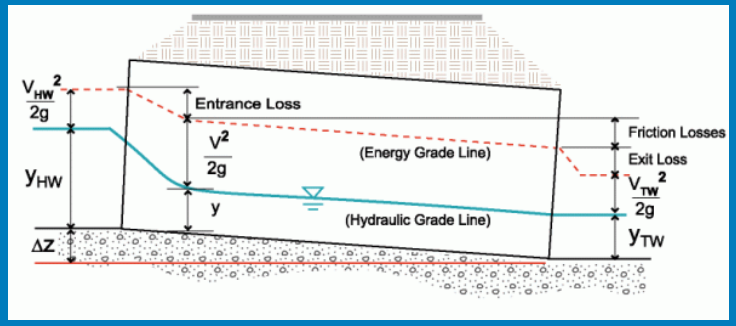
- **Project Team**
  - **SNHPC** – Jack Munn
  - **Trout Unlimited** – Colin Lawson, Gabe Bolin
  - **Antioch University** – Apollinaire William, Michael Simpson
  - **University of New Hampshire** – Joel Ballestero, Tom Ballestero
  - **Review Committee** – NHDOT, NHGS, USFWS, USGS, UMASS

Modeling

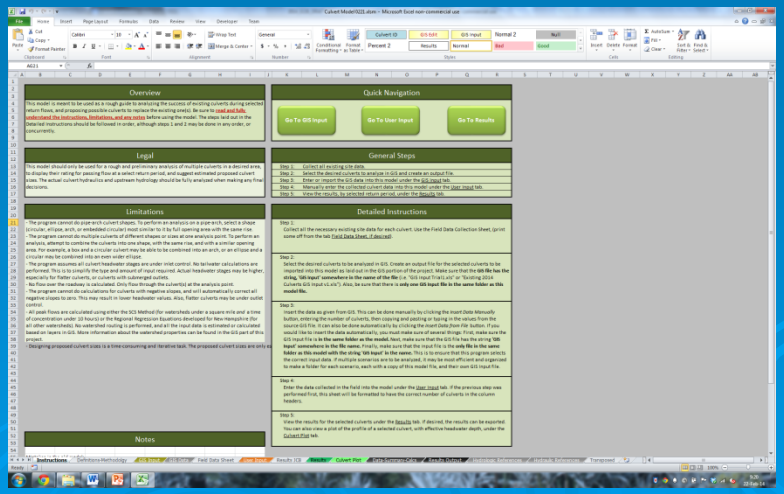
- **Hydrology:**
  (SCS, Regression Eqns.)



- **Hydraulics:**
  (HDS-5)



- **Excel Model:**

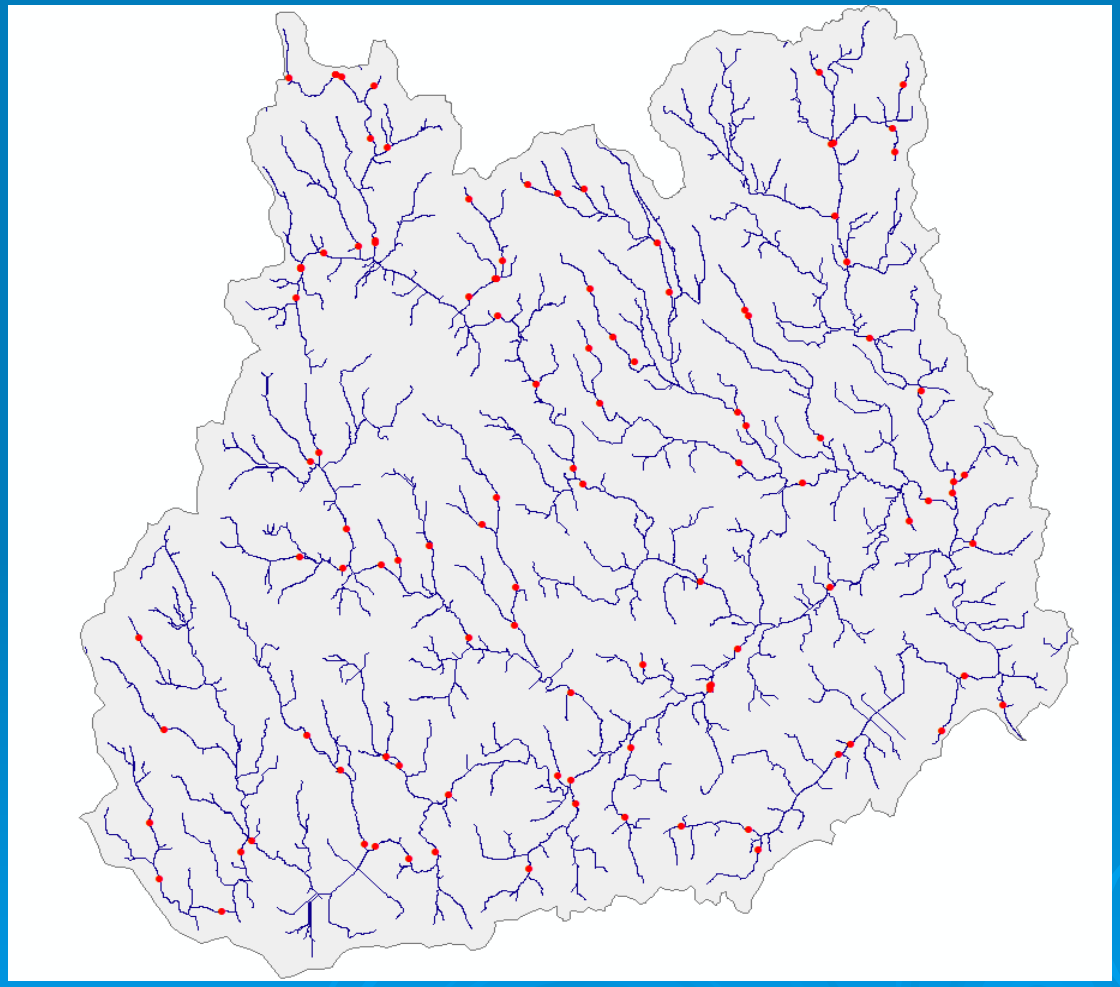


GIS Data Requirements

- **Elevation data (DEM)**
- **Watershed boundaries**
- **Stream data, road data, land cover**
- **Soil data**
- **Wetlands and ponds**
- **Precipitation (2, 10, 25, 50, 100 and mean April precip.)**

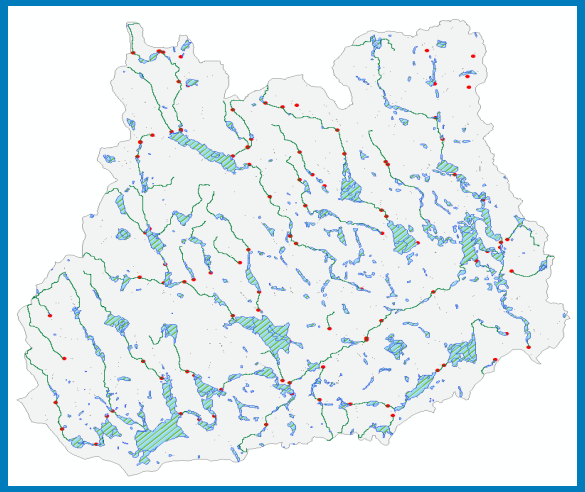
- ***Data sources: NH GRANIT, Cornell NRCC, PRISM***

GIS: Middle Branch Sub-Watershed



- Crossings in red

GIS: Watershed Hydrology



Ponds, Lakes and Wetlands

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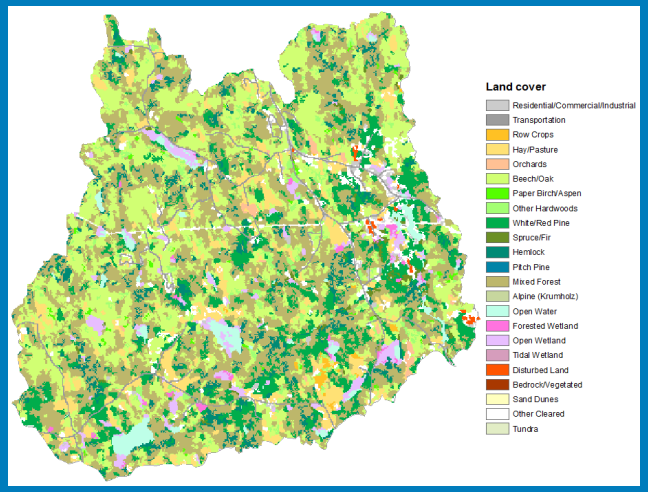

Land Cover

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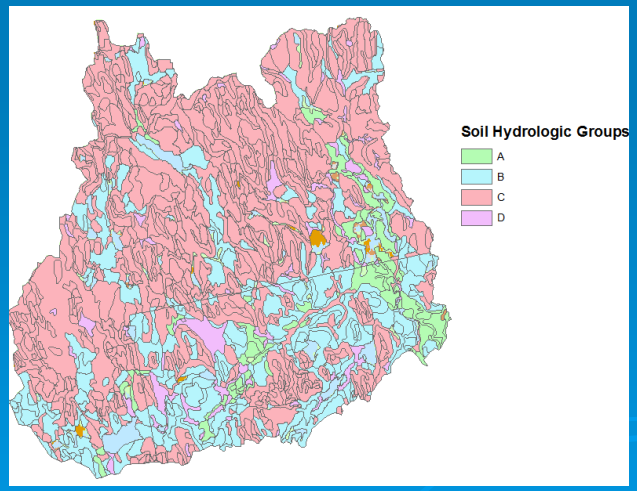

Hydrologic Soil Groups

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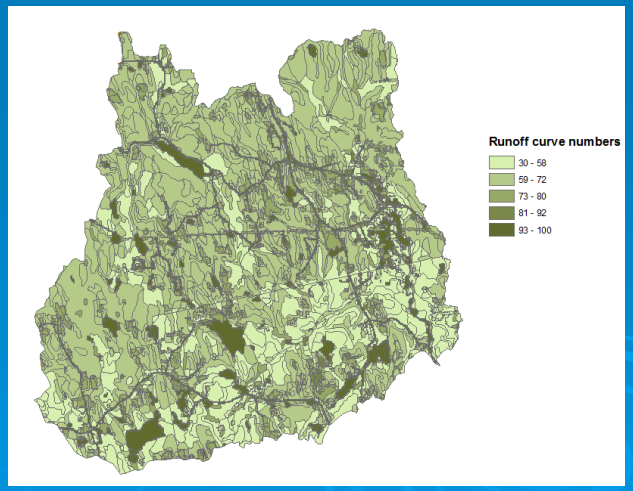
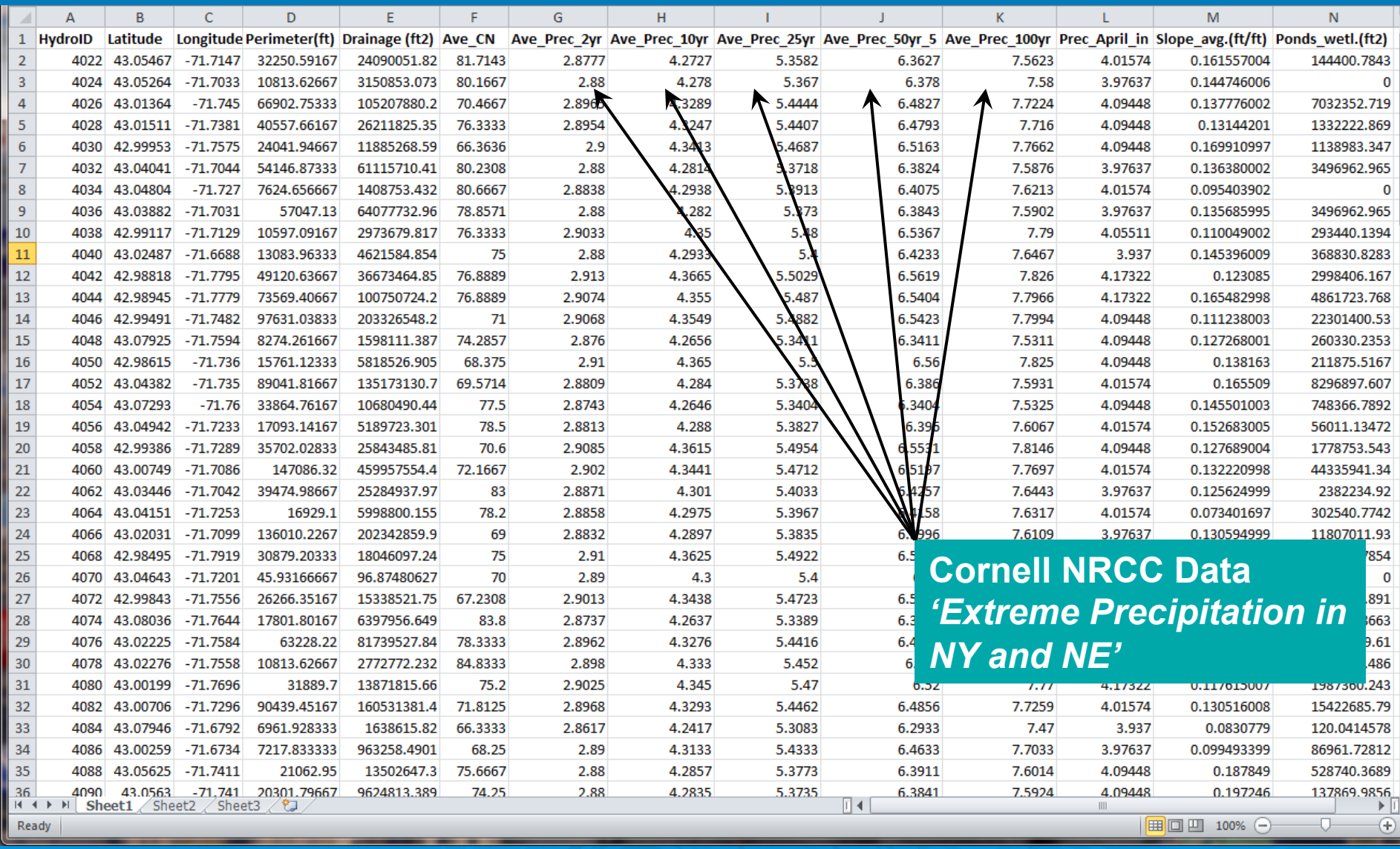


Curve Number

GIS: Hydrologic Output



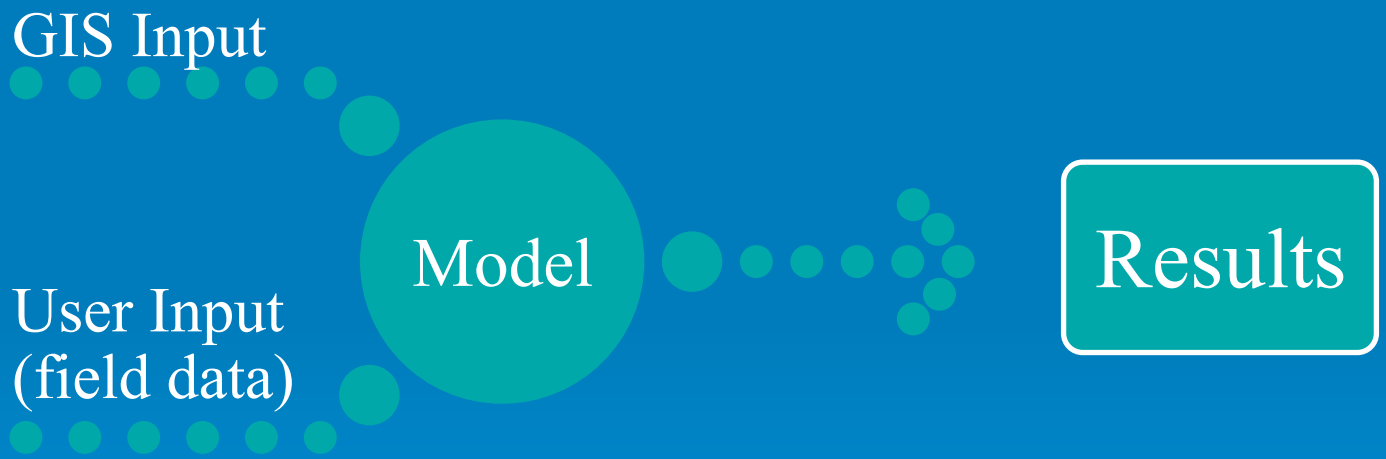
HydroID	Latitude	Longitude	Perimeter(ft)	Drainage (ft2)	Ave_CN	Ave_Prec_2yr	Ave_Prec_10yr	Ave_Prec_25yr	Ave_Prec_50yr_5	Ave_Prec_100yr	Prec_April_in	Slope_avg.(ft/ft)	Ponds_wetl.(ft2)
4022	43.05467	-71.7147	32250.59167	24090051.82	81.7143	2.8777	4.2727	5.3582	6.3627	7.5623	4.01574	0.161557004	144400.7843
4024	43.05264	-71.7033	10813.62667	3150853.073	80.1667	2.88	4.278	5.367	6.378	7.58	3.97637	0.144746006	0
4026	43.01364	-71.745	66902.75333	105207880.2	70.4667	2.8965	4.3289	5.4444	6.4827	7.7224	4.09448	0.137776002	7032352.719
4028	43.01511	-71.7381	40557.66167	26211825.35	76.3333	2.8954	4.3247	5.4407	6.4793	7.716	4.09448	0.13144201	1332222.869
4030	42.99953	-71.7575	24041.94667	11885268.59	66.3636	2.9	4.3413	5.4687	6.5163	7.7662	4.09448	0.169910997	1138983.347
4032	43.04041	-71.7044	54146.87333	61115710.41	80.2308	2.88	4.2814	5.3718	6.3824	7.5876	3.97637	0.136380002	3496962.965
4034	43.04804	-71.727	7624.656667	1408753.432	80.6667	2.8838	4.2938	5.3913	6.4075	7.6213	4.01574	0.095403902	0
4036	43.03882	-71.7031	57047.13	64077732.96	78.8571	2.88	4.282	5.373	6.3843	7.5902	3.97637	0.135685995	3496962.965
4038	42.99117	-71.7129	10597.09167	2973679.817	76.3333	2.9033	4.35	5.48	6.5367	7.79	4.05511	0.110049002	293440.1394
4040	43.02487	-71.6688	13083.96333	4621584.854	75	2.88	4.2933	5.4	6.4233	7.6467	3.937	0.145396009	368830.8283
4042	42.98818	-71.7795	49120.63667	36673464.85	76.8889	2.913	4.3665	5.5029	6.5619	7.826	4.17322	0.123085	2998406.167
4044	42.98945	-71.7779	73569.40667	100750724.2	76.8889	2.9074	4.355	5.487	6.5404	7.7966	4.17322	0.165482998	4861723.768
4046	42.99491	-71.7482	97631.03833	203326548.2	71	2.9068	4.3549	5.4882	6.5423	7.7994	4.09448	0.111238003	22301400.53
4048	43.07925	-71.7594	8274.261667	1598111.387	74.2857	2.876	4.2656	5.3711	6.3411	7.5311	4.09448	0.127268001	260330.2353
4050	42.98615	-71.736	15761.12333	5818526.905	68.375	2.91	4.365	5.5	6.56	7.825	4.09448	0.138163	211875.5167
4052	43.04382	-71.735	89041.81667	135173130.7	69.5714	2.8809	4.284	5.3738	6.386	7.5931	4.01574	0.165509	8296897.607
4054	43.07293	-71.76	33864.76167	10680490.44	77.5	2.8743	4.2646	5.3404	6.3404	7.5325	4.09448	0.145501003	748366.7892
4056	43.04942	-71.7233	17093.14167	5189723.301	78.5	2.8813	4.288	5.3827	6.395	7.6067	4.01574	0.152683005	56011.13472
4058	42.99386	-71.7289	35702.02833	25843485.81	70.6	2.9085	4.3615	5.4954	6.5531	7.8146	4.09448	0.127689004	1778753.543
4060	43.00749	-71.7086	147086.32	459957554.4	72.1667	2.902	4.3441	5.4712	6.5197	7.7697	4.01574	0.132220998	44335941.34
4062	43.03446	-71.7042	39474.98667	25284937.97	83	2.8871	4.301	5.4033	6.4257	7.6443	3.97637	0.125624999	2382234.92
4064	43.04151	-71.7253	16929.1	5998800.155	78.2	2.8858	4.2975	5.3967	6.4158	7.6317	4.01574	0.073401697	302540.7742
4066	43.02031	-71.7099	136010.2267	202342859.9	69	2.8832	4.2897	5.3835	6.3996	7.6109	3.97637	0.130594999	11807011.93
4068	42.98495	-71.7919	30879.20333	18046097.24	75	2.91	4.3625	5.4922	6.5				7854
4070	43.04643	-71.7201	45.93166667	96.87480627	70	2.89	4.3	5.4					0
4072	42.99843	-71.7556	26266.35167	15338521.75	67.2308	2.9013	4.3438	5.4723	6.5				891
4074	43.08036	-71.7644	17801.80167	6397956.649	83.8	2.8737	4.2637	5.3389	6.3				663
4076	43.02225	-71.7584	63228.22	81739527.84	78.3333	2.8962	4.3276	5.4416	6.4				9.61
4078	43.02276	-71.7558	10813.62667	2772772.232	84.8333	2.898	4.333	5.452	6.				486
4080	43.00199	-71.7696	31889.7	13871815.66	75.2	2.9025	4.345	5.47	6.52	7.77	4.17322	0.117613007	1987360.243
4082	43.00706	-71.7296	90439.45167	160531381.4	71.8125	2.8968	4.3293	5.4462	6.4856	7.7259	4.01574	0.130516008	15422685.79
4084	43.07946	-71.6792	6961.928333	1638615.82	66.3333	2.8617	4.2417	5.3083	6.2933	7.47	3.937	0.0830779	120.0414578
4086	43.00259	-71.6734	7217.833333	963258.4901	68.25	2.89	4.3133	5.4333	6.4633	7.7033	3.97637	0.099493399	86961.72812
4088	43.05625	-71.7411	21062.95	13502647.3	75.6667	2.88	4.2857	5.3773	6.3911	7.6014	4.09448	0.187849	528740.3689
4090	43.0563	-71.741	20301.79667	9624813.389	74.25	2.88	4.2835	5.3735	6.3841	7.5924	4.09448	0.197246	137869.9856

Sheet1 Sheet2 Sheet3

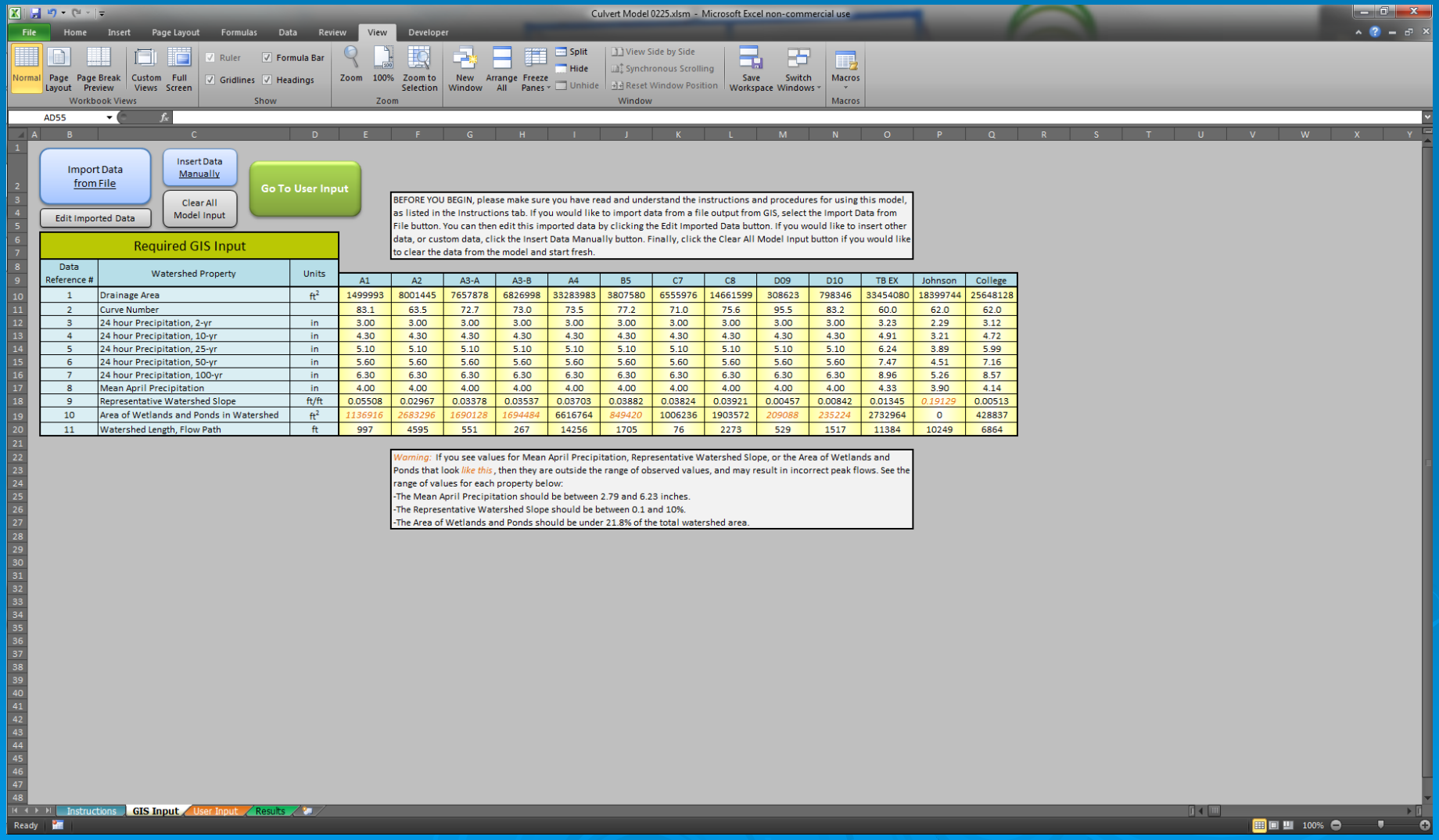
Ready 100%

Cornell NRCC Data
'Extreme Precipitation in NY and NE'

Excel Model: Inputs and Results



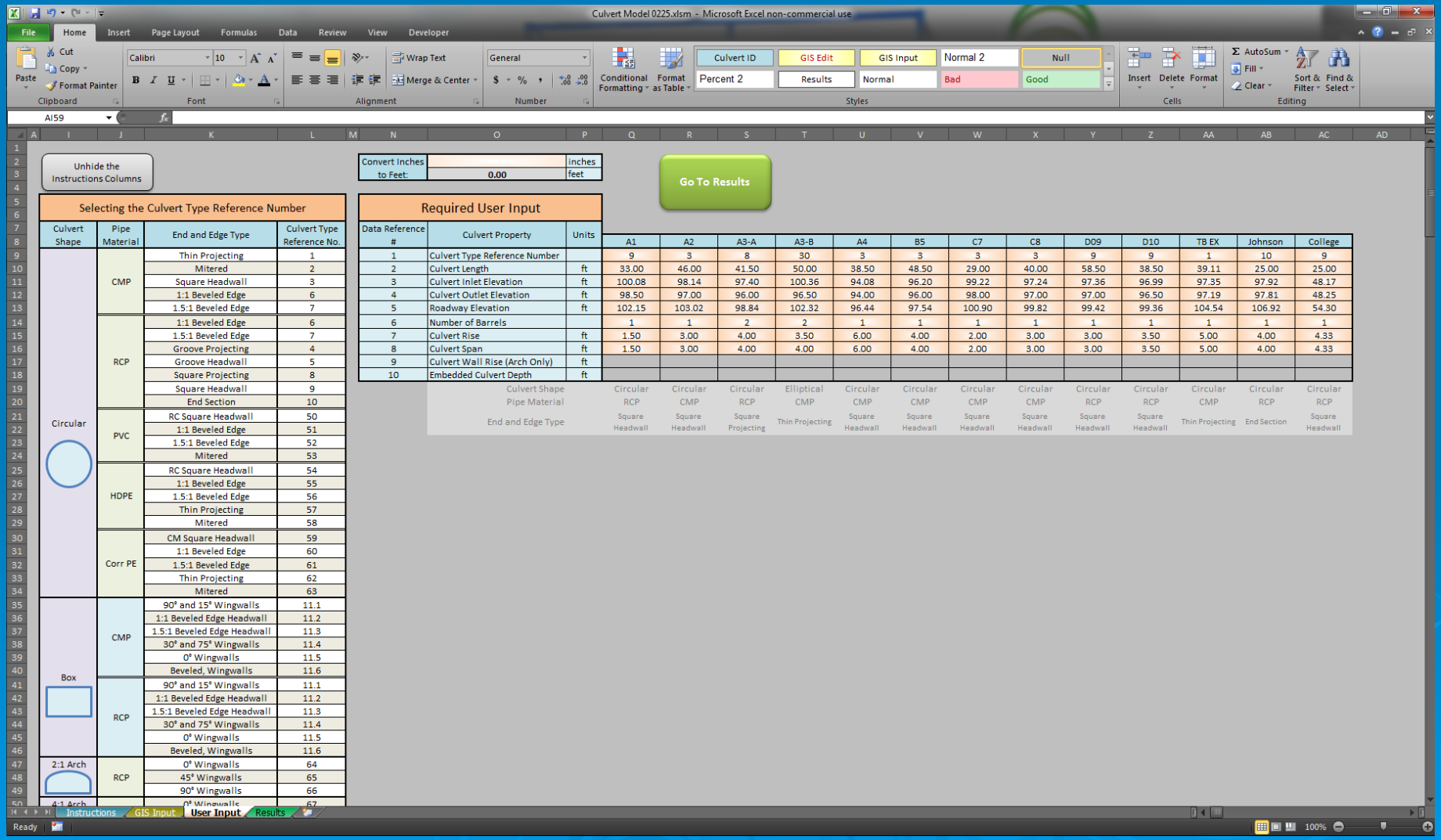
Excel Model: GIS Input



Required GIS Input

Data Reference #	Watershed Property	Units	A1	A2	A3-A	A3-B	A4	B5	C7	C8	D09	D10	TB EX	Johnson	College
1	Drainage Area	ft^2	1499993	8001445	7657878	6826998	33283983	3807580	6555976	14661599	308623	798346	33454080	18399744	25648128
2	Curve Number		83.1	63.5	72.7	73.0	73.5	77.2	71.0	75.6	95.5	83.2	60.0	62.0	62.0
3	24 hour Precipitation, 2-yr	in	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.23	2.29	3.12
4	24 hour Precipitation, 10-yr	in	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.91	3.21	4.72
5	24 hour Precipitation, 25-yr	in	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	6.24	3.89	5.99
6	24 hour Precipitation, 50-yr	in	5.60	5.60	5.60	5.60	5.60	5.60	5.60	5.60	5.60	5.60	7.47	4.51	7.16
7	24 hour Precipitation, 100-yr	in	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	8.96	5.26	8.57
8	Mean April Precipitation	in	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.33	3.90	4.14
9	Representative Watershed Slope	ft/ft	0.05508	0.02967	0.03378	0.03537	0.03703	0.03882	0.03824	0.03921	0.00457	0.00842	0.01345	*0.19129*	0.00513
10	Area of Wetlands and Ponds in Watershed	ft^2	*1136916*	*2683296*	*1690128*	*1694484*	6616764	*849420*	1006236	1903572	*209088*	*235224*	2732964	0	428837
11	Watershed Length, Flow Path	ft	997	4595	551	267	14256	1705	76	2273	529	1517	11384	10249	6864

Excel Model: User Input



Excel Model: Results

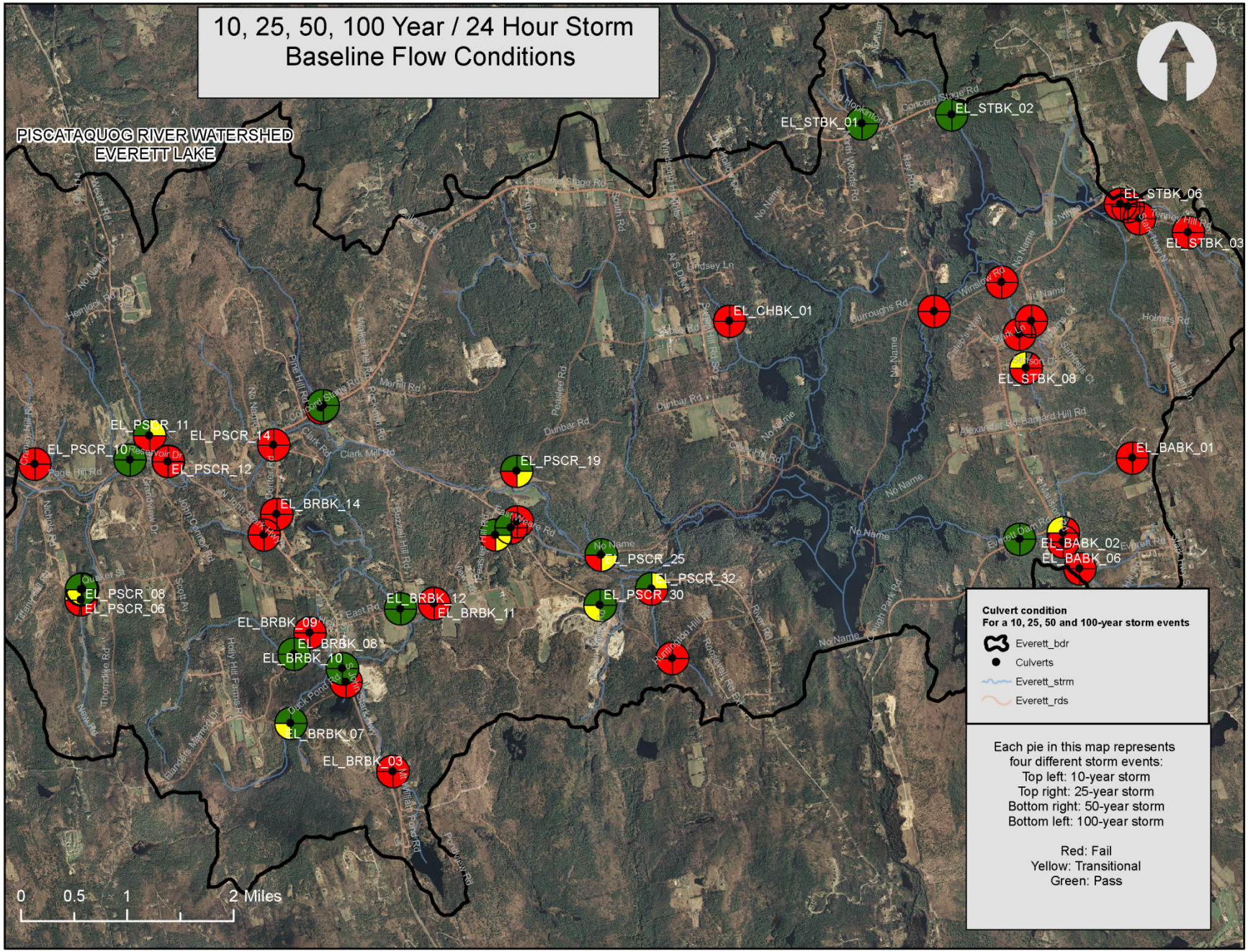
Select Return Period: 10-yr

Go To User Input

Results

	Attribute	Symbol	Unit	A1	A2	A3-A	A3-B	A4	B5	C7	C8	D09	D10	TB EX	Johnson	College
Existing Crossing Properties	Calculated Watershed Peak Flow, 10-yr	Q_p	cfs	78.64	50.11	248.72	284.54	56.65	109.11	332.81	338.60	21.74	22.83	103.26	66.59	82.95
	Culvert Shape			Circular	Circular	Circular	Elliptical	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular
	Number of Barrels	N_b		1	1	2	2	1	1	1	1	1	1	1	1	1
	Culvert Span	D_{full}	ft	1.50	3.00	4.00	4.00	6.00	4.00	2.00	3.00	3.00	3.50	5.00	3.00	4.33
	Culvert Rise	B	ft	1.50	3.00	4.00	3.50	6.00	4.00	2.00	3.00	3.00	3.50	5.00	3.00	4.33
	Total Flowable Area	A_{total}	ft^2	1.77	7.07	25.13	21.99	28.27	12.57	3.14	7.07	7.07	9.62	19.63	7.07	14.75
	Culvert Slope	S_{culv}	ft/ft	0.0479	0.0248	0.0337	0.0772	*0.0021*	*0.0041*	0.0421	*0.0060*	*0.0062*	0.0127	*0.0041*	*0.0044*	*-0.0032*
	Culvert Rating, 10-yr			Fail	Fail	Fail	Fail	Pass	Fail	Fail	Fail	Pass	Pass	Transitional	Fail	Transitional
Geo-morphic Properties	Estimated Geomorphic Bankfull Width	W_{bkf}	ft	2.99	6.77	6.63	6.26	13.60	4.71	6.14	9.11	1.38	2.19	13.63	10.18	11.97
	Estimated Geomorphic Bankfull Depth	D_{bkf}	ft	0.60	0.93	0.92	0.89	1.36	0.76	0.88	1.09	0.39	0.51	1.36	1.16	1.27
	Estimated Minimum Geomorphic Crossing Width	W_{cross}	ft	5.58	10.12	9.95	9.52	18.32	7.65	9.37	12.93	3.65	4.63	18.36	14.21	16.36
Proposed Rectangular Culvert	Proposed Number of Barrels, 10-yr, Box	N_{circ}		2	1	3	3	1	1	3	3	2	2	1	3	1
	Proposed Culvert Span, 10-yr, Box	B_{circ}	ft	5.00	4.00	6.00	8.00	4.00	8.00	8.00	8.00	4.00	4.00	8.00	3.00	6.00
	Proposed Culvert Rise, 10-yr, Box	D_{circ}	ft	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	1.00	1.00	3.00	2.00	3.00
	Proposed Total Culvert Area, 10-yr, Box	$A_{pro,\ circ}$	ft	20.00	12.00	54.00	72.00	12.00	24.00	72.00	72.00	8.00	8.00	24.00	18.00	18.00
Proposed 25% Embedded Circular Culvert	Proposed Number of Barrels, 10-yr, Circ	N_{circ}		3	3	2	1	3	3	3	3	1	1	3	3	3
	Proposed Culvert Diameter, 10-yr, Circ	B_{circ}	ft	3.00	2.50	5.00	7.00	2.50	3.00	5.00	5.00	2.50	2.50	3.00	2.50	3.00
	Proposed Culvert Rise, 10-yr, Circ	D_{circ}	ft	2.25	1.88	3.75	5.25	1.88	2.25	3.75	3.75	1.88	1.88	2.25	1.88	2.25
	Proposed Total Culvert Area, 10-yr, Circ	$A_{pro,\ circ}$	ft	17.06	11.85	31.59	30.96	11.85	17.06	47.39	47.39	3.95	3.95	17.06	11.85	17.06

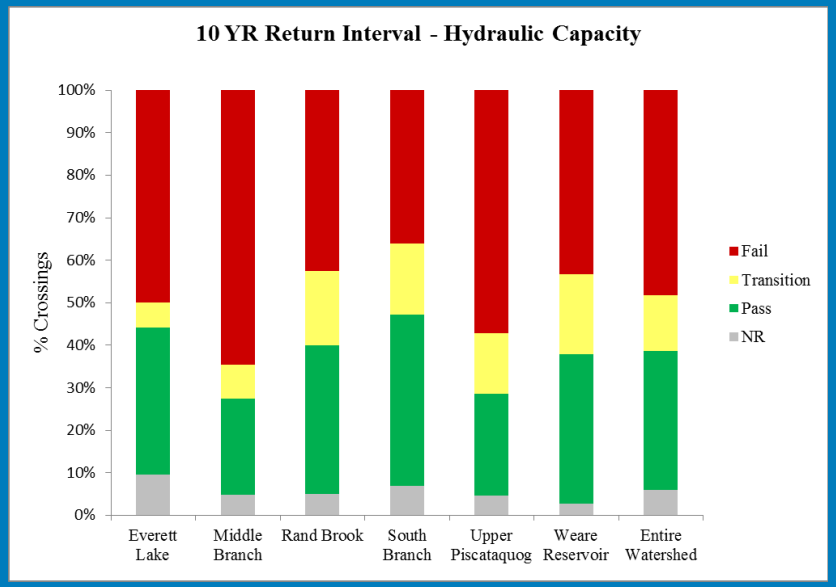
Warning: If you get a value for the culvert slope that looks *like this*, then the culvert is relatively flat, and may be under outlet control, which would result in larger effective headwater depths.

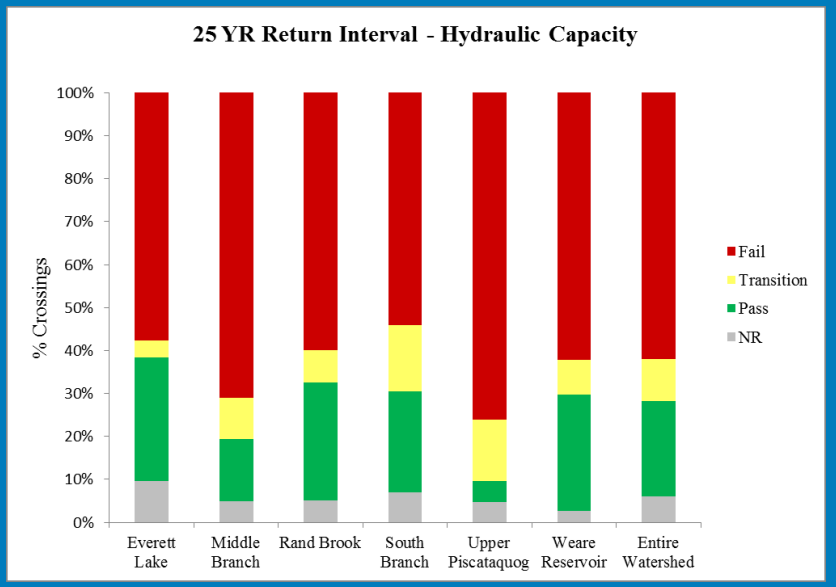

10, 25, 50, 100 Year / 24 Hour Storm
Baseline Flow Conditions
PISCATAQUOG RIVER WATERSHED
EVERETT LAKE
EL_STBK_01
EL_STBK_02
EL_STBK_03
EL_STBK_06
EL_STBK_08
EL_CHBK_01
EL_PSCR_10
EL_PSCR_11
EL_PSCR_12
EL_PSCR_14
EL_PSCR_19
EL_PSCR_25
EL_PSCR_30
EL_PSCR_32
EL_PSCR_06
EL_PSCR_08
EL_BRBK_03
EL_BRBK_07
EL_BRBK_08
EL_BRBK_09
EL_BRBK_10
EL_BRBK_11
EL_BRBK_12
EL_BRBK_14
EL_BABK_01
EL_BABK_02
EL_BABK_06
Culvert condition
For a 10, 25, 50 and 100-year storm events
Everett_bdr
Culverts
Everett_strm
Everett_rds
Each pie in this map represents
four different storm events:
Top left: 10-year storm
Top right: 25-year storm
Bottom right: 50-year storm
Bottom left: 100-year storm
Red: Fail
Yellow: Transitional
Green: Pass
0
0.5
1
2 Miles

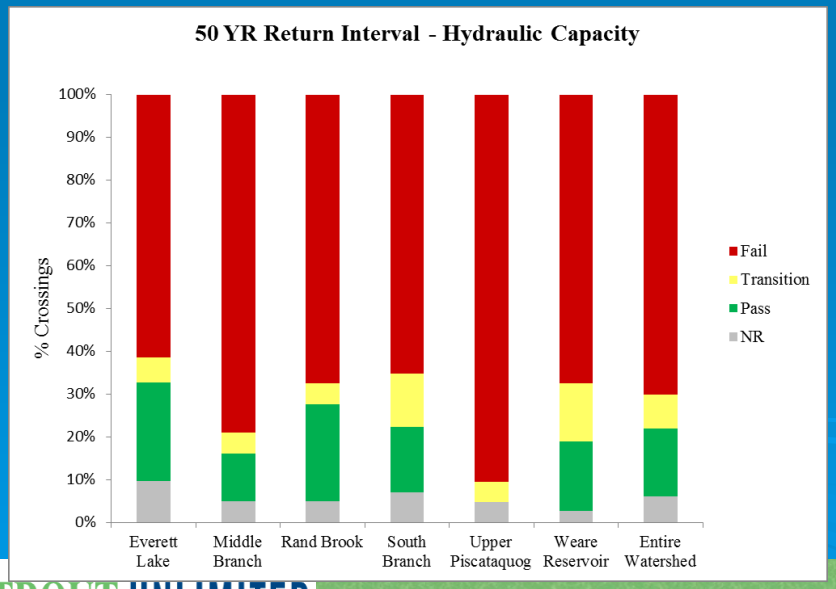
Tabular Results

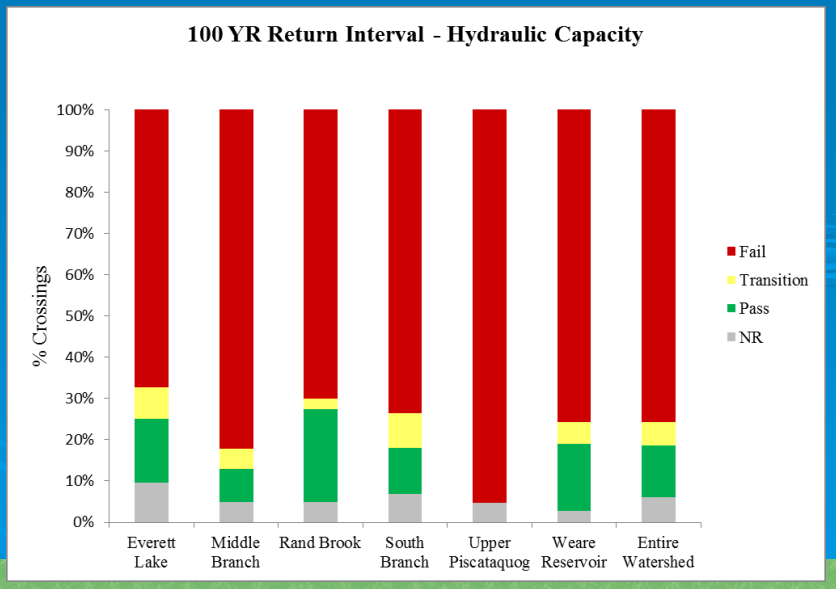
Stream Name	Crossing ID	Structure Type	Crossing Condition	Structure Width (ft)	Crossing Slope	Culvert Invert Type	Culvert Drop Distance (ft)	Crossing Length (ft)	Bankfull %	AOP Status	2 YR Return Interval	10 YR Return Interval	25 YR Return Interval	50 YR Return Interval	100 YR Return Interval
Barnard Brook	EL_BABK_01	Culvert	Rusted	1	3	Cascade	1.7	31		GRAY	FAIL	FAIL	FAIL	FAIL	FAIL
Barnard Brook	EL_BABK_03	Culvert	Old	2.4	3.5	At Grade	0	38	17.2	GRAY	FAIL	FAIL	FAIL	FAIL	FAIL
Barnard Brook	EL_BABK_06	Culvert	Old	3	8	Free Fall	5.4	58	18.8	RED	PASS	FAIL	FAIL	FAIL	FAIL
Barnard Brook	EL_BABK_07	Culvert	New	6	3	At Grade	0	44	25.9	GRAY	PASS	PASS	PASS	PASS	PASS
Breed Brook	EL_BRBK_01	Culvert	New	2	3.7	Free Fall	0.7	31	16.6	RED	FAIL	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_02	Culvert	Eroding	4	2	Free Fall	0.4	60	43.2	RED	PASS	Transitional	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_03	Culvert	Old	3	1	At Grade	0	30	21.1	GRAY	PASS	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_04	Culvert	New	2	3	Free Fall	0.4	33	17.8	RED	-	-	-	-	-
Breed Brook	EL_BRBK_06	Culvert	Collapsing	2	2.5	At Grade	0	66.5	17.4	GRAY	FAIL	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_07	Culvert	Old	3	1	Free Fall	0.9	34	13.5	RED	PASS	PASS	PASS	PASS	Transitional
Breed Brook	EL_BRBK_08	Culvert	New	4	1	Free Fall	0.8	51		RED	PASS	PASS	PASS	PASS	PASS
Breed Brook	EL_BRBK_09	Culvert	Old	1.3	2	At Grade	0	45		GRAY	FAIL	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_10	Arch	New	7	5.8	At Grade	0	63		GRAY	PASS	PASS	PASS	PASS	PASS
Breed Brook	El_BRBK_11	Culvert	Old	3	4	Free Fall	0.6	38	25.5	ORANGE	PASS	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_12	Culvert	New	8	2.6	Free Fall	0.2	30		ORANGE	PASS	PASS	PASS	PASS	PASS
Breed Brook	EL_BRBK_13	Culvert	rusted	1.5	3	At Grade	0	51	6.1	GRAY	FAIL	FAIL	FAIL	FAIL	FAIL
Breed Brook	EL_BRBK_14	Culvert	New	2.4	3	Cascade	0.4	59.5	22.4	GRAY	Transitional	FAIL	FAIL	FAIL	FAIL
Choate Brook	EL_CHBK_01	Culvert	New	1.3	4.5	At Grade	0	31	6.7	GRAY	FAIL	FAIL	FAIL	FAIL	FAIL

Statistical Results









Developing Restoration Strategies

- Set up a method for replacement prioritization:
  - Can Tailor to town interests (dams, road banks, private lands, emergency services)
  - Prioritization tool being developed now that takes into account AOP, geomorphic and hydraulics

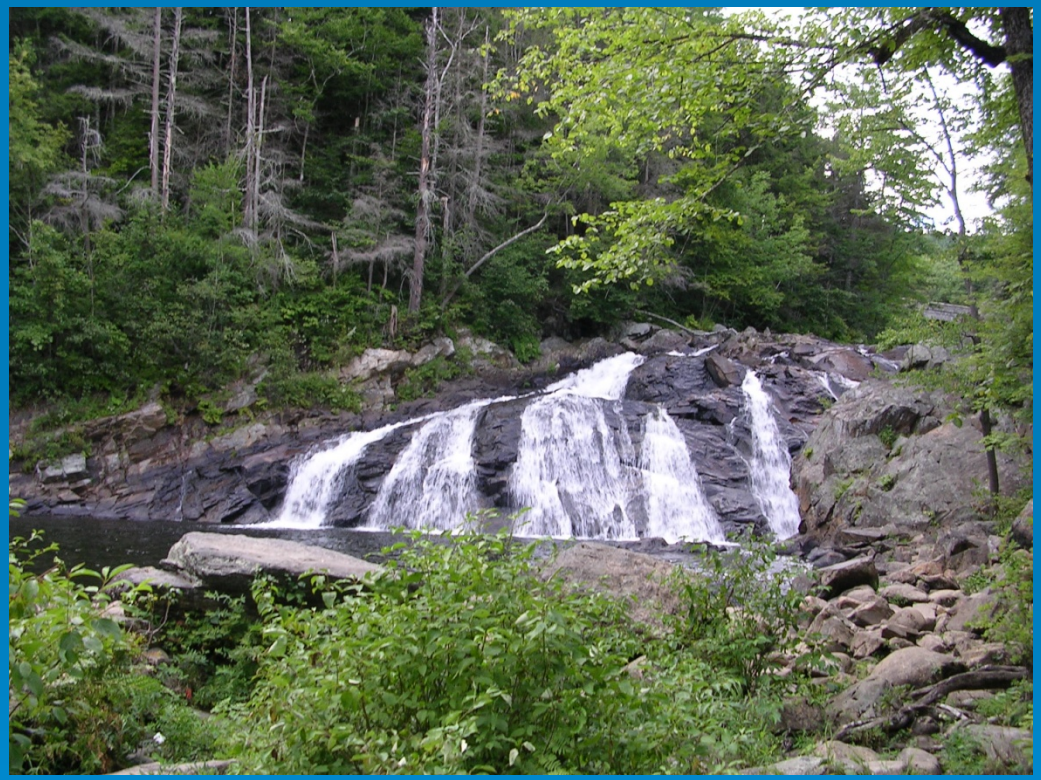
Future Assessments

- Can be transferred and used to other basins within NH
- Cost savings realized
- Requirements to run model
  - Field data; GIS and MS Excel capabilities

Take Home Messages

- Undersized stream crossings can impact the ecosystem, municipal infrastructure and public safety (flooding, storm damage, etc.)
- This is a screening tool; additional engineering will be required
- Communities can use results to develop a restoration prioritization
- This model/methodology can be used in other basins

Questions?



Gabe Bolin, PE
Eastern Stream Restoration Specialist
Trout Unlimited
(603) 809-6101

Backup Slides

Project Background

Special Transportation Project Funding provided by FHA through NH DOT to SNHPC

Data already collected from Culvert Assessment AOP (Phase I) and Fluvial Erosion Hazard studies

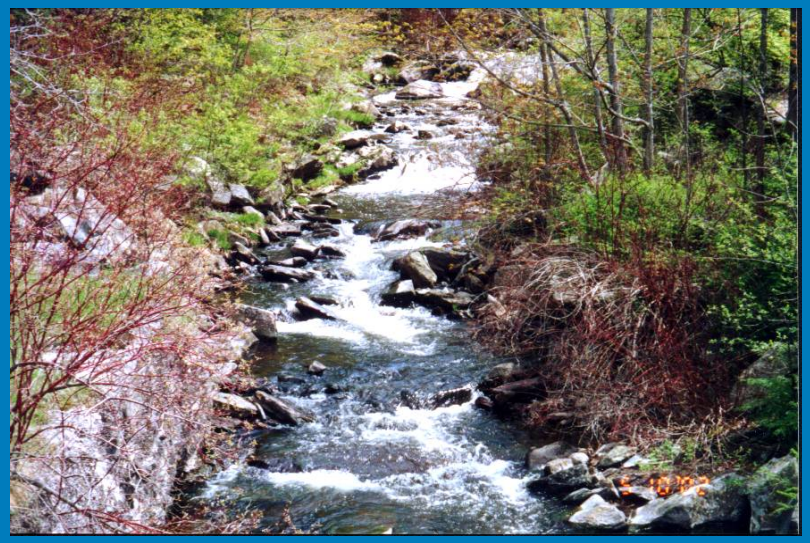
Public Benefit: Increased knowledge/information to help communities avoid future flooding and storm related damage…

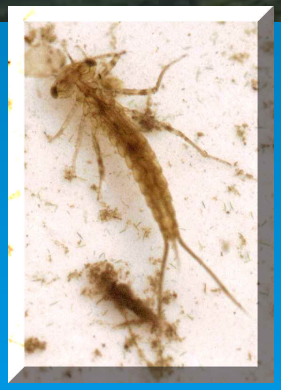
AOP Model Output – Francestown

Town	Road Name	Stream Name	Crossing ID	Structure Type	Latitude	Longitude	Crossing Condition	Structure Width (ft)	Crossing Slope	Culvert Invert Type	Culvert Drop Distance (ft)	Crossing Length (ft)	BANKFUL %	AOP Status
FRANCESTOWN	Mountain Rd	Dinsmore Brook	RB_DIBK_02	Culvert	43.00685	-71.86592	Old	3	3	Free Fall	0.3	46	37.7	RED
FRANCESTOWN	Mountain Rd	Dinsmore Brook	RB_DIBK_12	Culvert	43.00687	-71.85191	Old	2	7	Free Fall	0.4	33	20.2	RED
FRANCESTOWN	Muzzey Rd	Piscataquog	RB_SBPR_13	Culvert	42.98067	-71.82662	Old	3	0.7	At Grade	0	25	18.4	GRAY
FRANCESTOWN	Muzzey Rd	Piscataquog	RB_SBPR_08	Culvert	42.97791	-71.84844	New	1.5	4	At Grade	0	16	37.3	GRAY
FRANCESTOWN	no name	Dinsmore Brook	RB_DIBK_01	Culvert	43.0034	-71.86424	New	2	6	Free Fall	0.3	200		RED
FRANCESTOWN	no name	Dinsmore Brook	RB_DIBK_09	Culvert	43.01932	-71.86644	Old	3.5	2.5	Free Fall	0.6	41	27.3	RED
FRANCESTOWN	Old County	collins Brook	RB_COBK_05	Culvert	43.01222	-71.02998	Old	12.5		Cascade	0.2		111.6	GRAY
FRANCESTOWN	Old County	Piscataquog	RB_SBPR_19	Bridge	42.96931	-71.79913	New	23	7.5	At Grade	0	21		GRAY
FRANCESTOWN	Old County	Collins Brook	RB_COBK_01	Culvert	43.02618	-71.84238	New	3.5	0.1	At Grade	0	32	24.9	GRAY
FRANCESTOWN	Old Turnpike Rd	collins Brook	RB_COBK_02	Culvert	43.00921	-71.84273	New	2	3	Free Fall	1	20	33.6	RED
FRANCESTOWN	Pleasant Pond Rd	Collins Brook	RB_COBK_06	Bridge	43.01689	-71.82214	New	22	0.1	At Grade	0	30	68.4	GRAY
FRANCESTOWN	Poor Farm	Piscataquog	RB_SBPR_04	Culvert	42.98944	-71.81088	New	3	3	Free Fall	0.3	39	12.0	RED
FRANCESTOWN	red house rd	Whiting Brook	MB_WTBK_05	Culvert	42.98101	-71.78222	New	4	0.5	At Grade	0	40		GRAY
FRANCESTOWN	Reid RD	Piscataquog	RB_SBPR_11	Culvert	42.9756	-71.83067	New	5.8	0.5	Free Fall	0.8	48	26.5	RED
FRANCESTOWN	Rte 136	Whiting Brook	MB_WTBK_06	Arch	42.98813	-71.77956	Old	4	2	At Grade	0	39	22.7	GRAY
FRANCESTOWN	Rte 136	Whiting Brook	MB_WTBK_07	Bridge	42.98947	-71.77778	Old	11	2	At Grade	0	32.5	57.1	GRAY
FRANCESTOWN	Rte 136	Whiting Brook	MB_WTBK_04	Culvert	42.98493	-71.79176	Old	4	2	At Grade	0	33	30.8	GRAY
FRANCESTOWN	Rte 136	Whiting Brook	MB_WTBK_09	Culvert	42.99869	-71.76316	Old	1.5	2	Free Fall	0.3	48		ORANGE
FRANCESTOWN	Russell Station	Rand Brook	RB_RBBK_12	Bridge	42.95916	-71.79565	New	28	7.1	At Grade	0	19	83.2	GRAY
FRANCESTOWN	Russell Station	Rand Brook	RB_RBBK_15	Bridge	42.95665	-71.78388	New	44.8	5.5	At Grade	0	29	111.1	GRAY
FRANCESTOWN	Russell Station	Rand Brook	RB_RBBK_16	Culvert	42.95677	-71.7821	Old	1.6	1.5	ıt grade #2Free	0.4	40	21.1	GRAY
FRANCESTOWN	S New boston Rd	Piscataquog	SB_PSCR_06	Culvert	42.96164	-71.75154	Old	2.5	0.9	At Grade	0	40.8	8.9	GRAY
FRANCESTOWN	School House Rd	Dinsmore Brook	RB_DIBK_07	Culvert	43.01364	-71.86279	New	5	3.5	At Grade	0	51	52.4	GRAY
FRANCESTOWN	scobie rd	Whiting Brook	MB_WTBK_11	Culvert	42.98883	-71.75933	Rusted	7.5	3	Free Fall	0.5	29.5	58.0	ORANGE
FRANCESTOWN	scobie rd	Whiting Brook	MB_WTBK_10	Culvert	42.98905	-71.76131	Old	1.3	0.4	At Grade	0	30		GREEN
FRANCESTOWN	Spencer	Piscataquog	RB_SBPR_14	Arch	42.9804	-71.82675	Old	2.8	4.5	At Grade	0	16	19.1	GRAY
FRANCESTOWN	town line	rand brook	RB_RBBK_02	Bridge	42.96941	-71.85485	Old	3	4	At Grade	0	14		GRAY
FRANCESTOWN	Udall Rd	Piscataquog	RB_SBPR_09	Culvert	42.97305	-71.84357	Rusted	2	1.2	Free Fall	0.3	30		ORANGE
FRANCESTOWN	Woodward Hill	Piscataquog	RB_SBPR_20	Culvert	42.96936	-71.78903	Rusted	12.5	2	At Grade	0	32	46.7	GRAY

We need to focus on keeping the "Ecosystem" in balance to reduce its vulnerability!

- Improve habitat connectivity
- Allow access to large number of stream miles
- Focus on species diversity & productivity





Hydrology

- **SCS Method**
  - Components
  - Applicable Range
- **Regional Regression**
- **Equations**
  - Components
  - Applicable Range
- **Limitations**

Hydraulics

- **USDOT's FHWA's HDS-5 Method**
  - Headwater Control
    - Inlet
    - Outlet
  - Applicable Equations
    - Unsubmerged
    - Submerged
    - Regression Equations
- **Limitations**

Community Based Assessment Tool

- **Requirements to run model**
  - **GIS and MS Excel capabilities**
  - **Field staff to collect culvert assessment field data**
- **Options communities have to run model**
  - **Town has GIS and field staff, can do everything in-house**
  - **Town doesn't have GIS/field staff, contract through RPC or consultant**
- **Materials/documents from this study are available free**
- **Can contract with TU, RPC or consultant**

Developing Restoration Strategies

- **Once a community sets a replacement prioritization, set strategies for:**
  - **Funding**
  - **Higher level assessment and design (town engineer, road agent, consulting engineer)**
  - **Permitting**
  - **Construction mechanism (contractor, public works department, etc.)**
  - **Volunteers/PW involvement/community and watershed organization**

Model Graphical Ouput